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A Study of International Airline Code Sharing

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A STUDY OF INTERNATIONAL AIRLINE CODE SHARING

INTRODUCTION

Most international airline service to and from the United States today is provided by network carriers that move passengers through their gateway airports. In some cases, a carrier will take passengers to a foreign gateway and turn them over to a foreign carrier for distribution to interior points. Until recently, much of the traffic destined for non-gateway cities in the U.S. and foreign countries was handed off from one carrier to another on an interline basis. Although carriers put forth substantial efforts, they were not highly successful in coordinating interline service. Today many passengers move from domestic spoke points to the gateway and beyond on one carrier. Competitive service exists between U.S. and foreign gateways and also exists between U.S. gateways and other points within this country. However, there generally are fewer alternatives available and less competition for service behind foreign gateways.

Carriers are seeking to access behind-gateway traffic by integrating two or more existing networks through international airline alliances. Alliances allow carriers to expand the reach of their networks and offer service to many parts of the world where it may not be economical or where they may lack the authority to operate their own flights. A number of recent research studies point to economies of scope and density as the principal forces driving carriers to expand the size of their networks. Economies of scope occur because it is less expensive to add routes to an existing network than to establish service in other ways. Economies of density occur when the unit costs of serving additional passengers over an existing network decrease with increased traffic.

Code sharing has become one means for two or more international carriers to increase the reach of their networks. Other strategies such as mergers or acquisitions are constrained by national ownership laws for airlines and nationality clauses in bilateral air service agreements. However, it is important to note that the industry is responding to economic incentives to restructure into larger networks as international airline markets become more competitive. These forces will continue to drive change, and code sharing is but one means of achieving the benefits of larger networks. Another alternative for some large integrated carriers may be internal expansion to increase the reach of their own network instead of entering into a broad-based alliance with a single foreign carrier. These carriers may pursue selected code-sharing agreements to obtain access to certain markets where they do not believe it is economical to establish their own service.

THE NEED FOR THIS STUDY

The U.S. Department of Transportation (DOT) has taken the position that code sharing between U.S. and foreign airlines requires approval by DOT. It has examined and approved a number of international code-sharing agreements in recent years. As a rule, these agreements have been aggressively pursued by the carriers involved, while non-participating carriers have strongly opposed them. The opposing carriers argue that allowing foreign airlines access to the U.S. market places U.S. carriers at a disadvantage, because foreign markets are often restrictive and no single foreign country today has a market comparable in size to that of the United States. There have been no broad-based studies of the effects of code sharing on the U.S. airline industry, and the DOT has been criticized for approving such agreements without a full understanding of their effects. As a result, DOT engaged Gellman Research Associates, Inc. (GRA) to study the effects of international code sharing. The DOT set forth the following objectives for the study:

- Develop a methodology to assess the effects of code sharing on the level and distribution of traffic among carriers. The DOT wanted the capability to measure the effects of future code-sharing agreements;

- Examine the effects of code sharing on the costs and profitability of airlines;

- Assess the effects of code sharing on consumers of airline services;

- Project the future use and impact of code sharing over the next twenty years.

GRA's in-house study team was supplemented by Dr. Steven Morrison of Northeastern University who assisted in methodology and model development. Mr. Randall Malin, formerly of USAir, assisted in carrier outreach and provided expertise in computer reservation systems and other airline distribution issues. Mr. Erwin Von den Steinen lent expertise in the international airline regulatory regime.

STUDY APPROACH

The study team initiated work by conducting a review of the literature on code sharing and related topics such as transnational airline alliances, airline network economics, competition in the international airline industry, computer reservation systems, and other subjects relevant to the project. The study team also conducted outreach with U.S. and foreign airlines, U.S. government officials, and other knowledgeable and interested parties. In addition, the study team assessed the data and methods available to measure the impacts of international code sharing on airlines and consumers. The study team then developed a proposed methodology. This proposed methodology, along with the data available to apply it, was reviewed by DOT's Volpe National Transportation Systems Center on behalf of the project sponsor, the Office of Aviation and International Economics. The final methodology was submitted to the Office of Aviation and International Economics for approval. An important consideration in the methodology was the ability to examine the effects of code sharing prospectively, so that the DOT could use it to assess the effects of future proposals for code sharing.

BACKGROUND

Code sharing first became prominent in the U.S. domestic airline market after airline deregulation.[1] Carriers established hub-and-spoke networks in order to achieve economies of scope and density. The hub-and-spoke system reduced interline opportunities because airlines sought to control traffic from origin to destination. As a result, many large carriers entered into code-sharing agreements with commuter airlines operating at the large carrier hubs. Prior research had shown that passengers preferred online service to interline service.[2] Code sharing with a commuter airline allowed carriers to market this service as superior to interline service. Deregulation also allowed carriers to offer more online service on both longer domestic and international flights. However, in some cases online international service was

[1] The first code sharing between the Allegheny commuter airlines and USAir began in 1967. However, code sharing by other carriers came about largely in the post-deregulation era.

[2] Carlton, Dennis W., William M. Landes, and Richard A. Posner, "Benefits and Costs of Airline Mergers: A Case Study," Bell Journal of Economics, Spring 1990, pg. 68.

impossible for economic or regulatory reasons. As a response to these problems, code sharing has now shifted to this arena.

Some observers differentiate between "naked" code sharing and more extensive marketing arrangements that involve a code-sharing element. Naked code sharing involves putting one airline’s code on another’s flight and nothing else. Both airlines operate independently in every other respect, each marketing the flight as if it were its own. The airlines work out an agreement on what share of the revenue goes to the actual operator of the flight and what share goes to the seller of the ticket. The advantage of naked code sharing is that the same flight appears two or more times on travel agents' computer reservation system (CRS) displays. The multiple listings occur because the flight carries the code of two airlines.

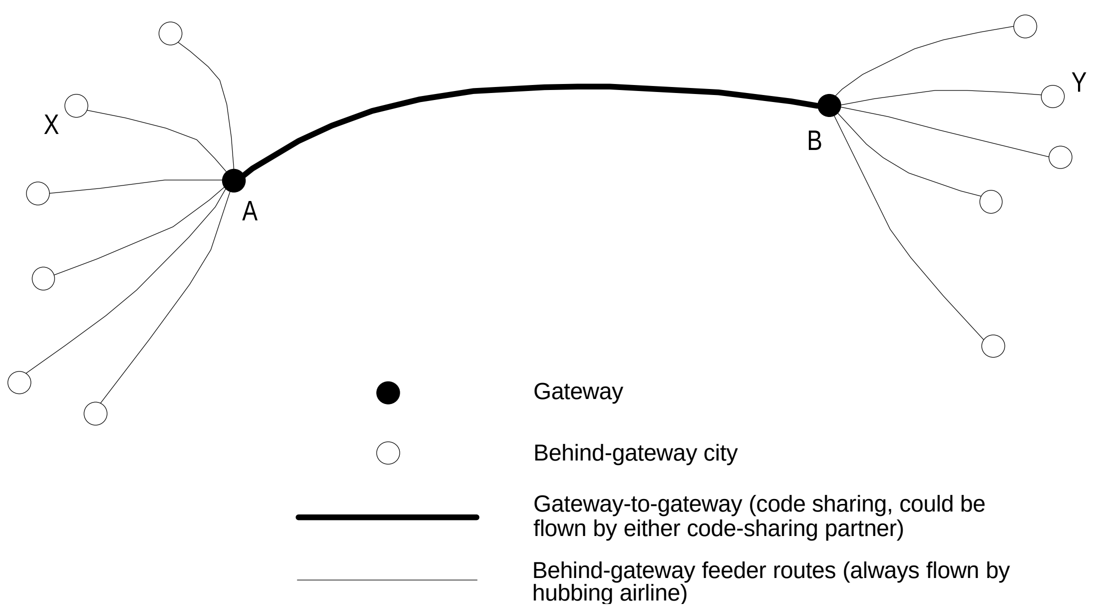
Code sharing is also an integral part of broader airline alliances, where the carriers cooperate in many aspects of their operations. They may jointly market services, coordinate major purchases and maintenance services, cooperate in baggage handling, and coordinate frequent flyer programs and in-flight service concepts. Many airlines have chosen to form broad alliances to make large, coherent systems with coordinated flight schedules.

Although many of the features common to code-sharing agreements such as single check-in, co-location of airport terminals, and so forth, could be achieved without code sharing, many of the carriers that provided input for this study indicated that they would not undertake these types of coordination without a code-sharing agreement with the other carrier. One carrier noted that code sharing is the "glue" which holds these cooperative agreements together. In fact, many air carriers tried these forms of cooperation without code sharing and found that most such arrangements produced few bottom-line benefits, and the agreement often lapsed after a short period of time. Apparently, the carriers did not believe that these cooperative agreements provided a level of commitment sufficient to undertake the necessary coordination of services with the partner airline. In addition, the ability to inform travelers of the coordinated service offers via listings in the computer reservation systems is an important benefit of code sharing. While not all code-sharing agreements are likely to be successful or long-lived, they engender a level of commitment between the partner airlines that makes it worthwhile for them to integrate their services. It is precisely this cooperation--including single check-in, through baggage handling, schedule coordination and so forth--that creates value for the consumer from code sharing. Carriers are taking these steps to make code-sharing flights more closely resemble online services.

Code sharing can also be categorized by the geographical location of the code-sharing flights. Figure 1 illustrates a code-sharing alliance between two carriers and the geographical location of their flights. Carrier A operates out of Hub A in the United States, while Carrier B centers its operations on Hub B in, say, Europe. In behind-U.S. (Type 1) code sharing, Carrier B would put its code on one of Carrier A's spoke flights, for example from X to A, in conjunction with Carrier B's service from A to B. In behind-foreign country (Type 2) code sharing Carrier A, in conjunction with its service from A to B, would put its code on one of Carrier B's spoke flights, for example from B to Y. An example of gateway-to-gateway (Type 3) code sharing would be Carrier B putting its code on Carrier A's transoceanic flight.

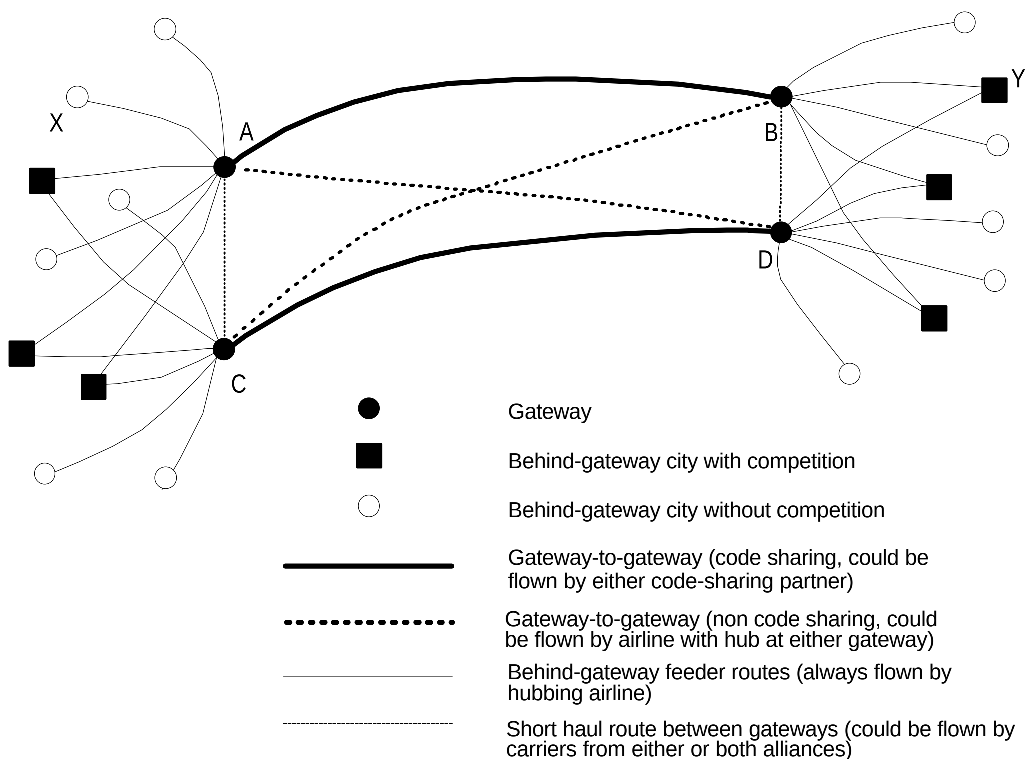
If the two carriers code share on most of the routes they offer, many possibilities open up. Both carriers can offer code-sharing online service from their hubs to a large number of foreign destinations as well as to domestic ones. Furthermore, the carriers can together serve double-connect markets, such as X to Y in Figure 1. A double-connect itinerary begins behind one hub and ends behind the other hub. Passengers must change planes at both hubs. Double-connect service allows the two code-sharing partners to serve an enormous range of city-pairs.

Figure 1
AN ALLIANCE



In Figure 2, a second alliance is shown. Carriers C and D also have connected hubs on both sides of the ocean. The result is that some cities (those represented by squares) have more competition than before. Passengers wishing to make double-connect trips can do so using either system. One can easily envision the high level of competition that would occur if additional large networks were added to the two shown in Figure 2.

Figure 2
TWO ALLIANCES



As an example of a double-connect market, consider a traveler who wants to fly from Indianapolis to Lyon, France. Neither city has direct transatlantic flights, so the traveler will need to make two connections. Code-sharing alliances give many choices. The traveler could fly Indianapolis-Pittsburgh-London-Lyon on USAir/BA. Alternatively, she could fly Indianapolis-Detroit-Amsterdam-Lyon on Northwest/KLM. Yet another option would be Indianapolis-Washington-Frankfurt-Lyon on United/Lufthansa. In this city-pair market, there are now three online competing services because of code sharing. Of course, there are many more interline options available. Just one example is flying from Indianapolis to Cincinnati to Paris on Delta and then picking up an Air Inter flight from Paris to Lyon.

ALLIANCES AND COMPETITION

Carriers enter into transnational alliances to take advantage of economies of scope and density by increasing the size and reach of their networks. They also use code sharing as a way to build a global service image. Code sharing is often the best way to market the coordinated service that an alliance offers. If this marketing is successful, the increased passenger traffic and the economies of scope and density can lead to higher airline profits.

Economies of scope occur because it is less expensive to expand an airline's route network than for a new airline to serve the additional routes.[3] An airline might find, for example, that increasing the number of city-pairs it serves by 25 percent increases the direct costs of its entire network by only 20 percent. Such economies of scope are possible because airlines can often use their capital more effectively. For instance, adding a new route might not involve buying a new aircraft but rather rescheduling the existing fleet to cover more routes. The new route may not need additional baggage handling or gate capacity either if the airline has existing stations at both points. In addition, if the flight goes into a hub, many new market pairs may be opened up.

Economies of density, on the other hand, occur when it is less expensive to increase service on the existing network than it would be for some other carrier to provide additional service on the same routes.[4] For example, an airline might increase the capacity in a city-pair market by 25 percent, but find that the direct costs of all flights on that route increase by only 20 percent. The reasons for economies of density are similar to economies of scope. For example, an airline might fly larger aircraft on a given route. In general, larger aircraft have lower seat-mile costs than smaller ones.

When airlines in the U.S. first formed hub-and-spoke systems, they achieved both types of economies. Economies of scope came from the larger route networks that the airlines could offer through their hubs. The result was more one-stop service

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[3] Ethan Weisman, Trade in Services and Imperfect Competition, Dordrecht, Netherlands: Kluwer Academic Publishers, 1990, pp. 31-33.

[4] Douglas W. Caves, Laurits R. Christensen, and Michael W. Tretheway, "Economies of Density Versus Economies of Scale: Why Trunk and Local Service Airline Costs Differ," Rand Journal of Economics, vol. 15, no. 4, Winter 1984, pg. 474.

connecting many smaller markets and lower prices on many routes.[5] At the same time, traffic density increased in many markets. A recent study by Bruekner and Spiller finds that economies of density were significant in the mid-1980's period of hub-building.[6] The trend may continue for some time. A paper by Bailey and Liu suggests that there is a tendency to create more hub-and-spoke systems than are needed.[7] After some time has passed, these systems will be pared back as some competitors retract services to regain profitability, as American has done by reducing the number of hubs in its system. The trend is now to connect hubs globally through code sharing. Economies of scope and density continue to be important in building large networks through code-sharing alliances and lead naturally to the developments being observed today.[8]

The economies of scope and density in international airline service make code sharing most valuable when it is overlaid on the existing hub-and-spoke networks of the carriers. These allow the partner airlines to increase the number of markets where they are able to offer a service over and above interline service. (Each market added to a given network adds a potential connection to every other point in the network at a lower cost than adding the same service over a smaller network.) To the extent that the code-sharing service attracts increased traffic, it also means that the carriers involved will achieve economies of density by carrying more traffic over both networks, allowing more intensive use of fixed facilities and aircraft. Both of these effects reduce the incremental cost of providing airline service. As more transnational alliances occur, it is expected that there will be fewer and larger networks providing airline service and competing against one another in many parts of the world. As long as there are no significant restrictions on competition, most of the cost savings will be passed on to consumers. This is one important lesson from the U.S. domestic airline market during the post-deregulation period.

While international airline markets are more restricted than the U.S. domestic airline market was after airline deregulation, the additional inter-network competition

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[5]Weisman, pg. 20.

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

[7]Elizabeth E. Bailey and Dong Liu, "Airline Consolidation and Consumer Welfare," The Wharton School of the University of Pennsylvania, June 1993.

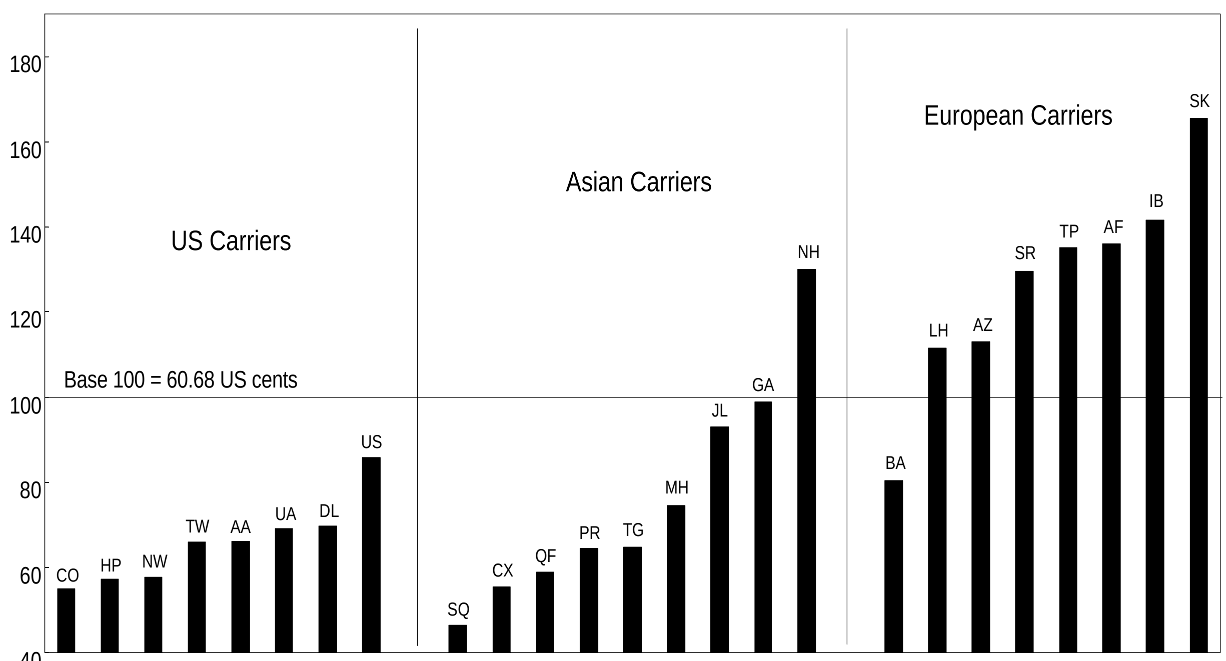
[8]Michael W. Pustay, "The Globalizing Airline Industry: The Need for a New International Policy Regime," paper presented at the Annual Meeting of the International Trade and Finance Association, Reading, England, July 1994.

produced by code sharing should serve to make these markets more open. One would expect some state-owned airlines and their governments to try to slow the process of liberalization in order to give their carriers time to restructure. However, there will be continuing pressure to liberalize from those airlines and countries that have embraced privatization and more open markets. For example, the decision of the European Union to liberalize its internal aviation market has already led to increased competition within Europe. As this process of liberalization continues, there will be more competitive pressure. Some European airlines have taken or are taking steps to become more competitive in anticipation of the changes in the market.

U.S. carriers, because they have already restructured their operations to compete with one another, are well positioned to compete in international airline markets. As shown in Figure 3, U.S. carriers have lower system-wide costs than do European carriers. However, many Asian carriers have unit costs which are competitive with U.S. carriers. (Data are from 1992, the latest year for which comparable data for U.S. and foreign carriers are available.) Figure 3 shows a horizontal line through the average unit costs for all carriers listed. In Europe, only British Airways (BA) has unit costs approaching the level of U.S. carriers. In Asia, Japan Air Lines (JL), All Nippon

Figure 3

OPERATING COSTS PER AVAILABLE TONNE-KILOMETER



Source: Civil Aviation Statistics of the World, ICAO (1992). All figures for 1992 except 1991 for GA, MH, LH, SR, and IB. (KL did not report.)

Note: Costs are not stage length adjusted.

Airways (NH) and Garuda (GA) from Indonesia have unit costs significantly higher than U.S. carriers, but other carriers, such as Singapore Airlines (SQ) and Cathay Pacific (CX) have lower costs than U.S. carriers.

While system-wide cost comparisons can blur differences between carriers, they do provide an indicator of overall cost efficiency. If airline service gravitates to the low-cost supplier (as it should in a competitive market), there would be incentives to shift flying to the U.S. carrier within a transnational alliance.[9] We would expect these incentives to be most apparent with regard to European carriers and to the Japanese carriers in Asia.

MEASURING THE IMPACT OF CODE SHARING

In order to obtain quantitative estimates of the impacts of code sharing, GRA developed an econometric market share model using U.S. Origin and Destination (O&D) Survey ticket sample data from the first quarter of 1994 and flight alternatives as shown in the Official Airline Guide. This model identifies how consumers choose among competing flight alternatives. The method entails estimating a "discrete choice" conditional logit model over a sample of city-pair markets where passengers must make a choice between two or more flight options.[10] The results of the model are then used to generate estimates of the market share impact of code sharing. Analysis of the route-choice model results also allows estimation of code-sharing impacts on U.S. and foreign airline producer surplus as well as on U.S. and foreign consumer surplus. The model considers only code-sharing agreements that affect travel to or from the U.S.

It is important to understand that the model attempts to explain only the market share of a given alternative as a function of various attributes of that alternative; it cannot explain changes in overall size of a market due to code sharing, i.e., market size is fixed. To the extent that code sharing does in fact expand overall market sizes, the results should be viewed as conservative. In addition, the model does not capture any responses by the airlines competing with the code-sharing alliance. These would tend to reduce the observed market-share impacts.

[9] However, a shift of long haul flying to the U.S. carrier might not occur for a number of reasons, including high startup costs, lack of available aircraft, small market size, or a preference for a foreign flag carrier on the part of foreign travelers.

[10] Discrete choice models have been used in numerous econometric studies since the mid-1970's. Such models, also called "qualitative response" models, are relevant for situations where a decision-maker must make a choice between two or more "discrete" options. They are widely used in transportation studies.

The model starts with the choices actually made by passengers as shown in the ticket sample. Because the U.S. O&D Survey does not include passengers whose journey was entirely on a foreign airline, such passengers were not included in the sample markets used in the discrete choice model estimation. For prediction purposes, however, these foreign alternatives were added back in after the model coefficients were estimated to obtain market share predictions based on the attributes of these foreign service offerings. Those markets which involve only a single alternative were by necessity excluded from the model because there is no choice decision to make in such markets.

The model is estimated by relating the observed market shares of the choices available in each market to a set of explanatory variables: the explanatory variables include seat shares, average time between departures, fare, average elapsed time of flights, a service quality proxy represented by the percent of first class or business seats offered, and a set of carrier specific hub dummies. Seat offers are divided into five different categories in order to distinguish code-sharing offerings from other types of service.

Because the BA/USAir and Northwest/KLM code-sharing arrangements are the most developed of the existing major agreements, a sample was drawn from a list of DOT-approved code-sharing markets which would most likely be dominated by one of these two carrier combinations.[11] The DOT list specifies three basic types of code-sharing service: Type 1--service between foreign gateways and cities behind U.S. gateways; Type 2--service between U.S. gateways and cities behind foreign gateways; and Type 3--service between U.S. and foreign gateways. These approvals implicitly give sanction to a great number of additional double-connect markets which are also served via code sharing. These latter markets were not included in the sample for two reasons. First, many of these markets are quite thin and therefore would not be adequately represented in the ticket sample; second, alternative service offers in many of these markets are not published and are difficult to construct. However, the aggregate sizes of these markets for BA/USAir and Northwest/KLM have been estimated and allow a reasonable estimate of the total impact of these code-sharing arrangements.

The sample used in the model estimation has the following composition:

Number of markets:	91

[11]It was not practical to include all code-sharing markets because much effort was involved in constructing the choice sets available in each market from the OAG data.

Number of code-sharing markets:	50
Number of NW/KL code-sharing markets:	25
Number of BA/US code-sharing markets:	21

MODEL RESULTS

Market Share Estimates

As noted earlier, foreign alternatives were added back in after the model coefficients were estimated to obtain market share predictions for all choices under the "baseline" (code-sharing) scenario. Then, to assess the impacts of code sharing, a counterfactual scenario was specified where online code-sharing offers were treated as regular online offers and interline code-sharing offers were treated as regular interline offers. The average elapsed time of flights was also changed to equal the average of non-code-sharing offers. The projected difference between the two scenarios for those choices involving code-sharing offers can be interpreted as the "impact" that code sharing has on market shares.

Estimated market shares for the two major alliances with and without code sharing are shown in Figure 4. The data in the first column reflect BA/USAir's predicted market share across all BA/USAir code-sharing markets which are in the estimating sample. Likewise, the data in the second column reflect Northwest/KLM's predicted market share across all Northwest/KLM code-sharing markets which are in the estimating sample.

Figure 4

SAMPLE CARRIER CHOICE MODEL MARKET SHARE RESULTS
(Based on 1994Q1 Data)

Estimated Market Share	BA/USAir (in percent)	KLM/Northwest (in percent)
Without Code Sharing	2.9	34.4
With Code Sharing	11.2	45.0
Interline Code Sharing Equivalent to Online	19.2	46.4

The "Without Code Sharing" row shows the results from a counterfactual scenario where online code-sharing offers are treated as regular online offers and interline code-sharing offers are treated as regular interline offers. The average elapsed time of flights for interline code-sharing flights is also changed to equal the average of non-code-sharing offers. This row reflects the shares that would be expected if the code-sharing partners continued to offer the same number of flights as observed during the first quarter but without the benefit of code sharing. The "With Code Sharing" row shows the predicted shares under the baseline scenario where code-sharing alternatives are left as is. The "Interline Code Sharing Equivalent to Online" row shows the predicted shares under a second counterfactual scenario where interline code-sharing service is viewed just as favorably as true online service. Under the assumptions regarding fixed market sizes and no other changes in service offers, this represents a likely upper bound on the ultimate impact of code sharing in the sample markets.

The scenario results indicate that code sharing has a significant impact on market share. Across BA / USAir code-sharing markets in the sample, the projected market share for code-sharing flights falls by about eight percentage points when code sharing is "turned off." In the other scenario where interline code sharing was assumed to have the same effect as true online service, the model predicts that BA / USAir shares would increase by about eight points. If the "effectiveness" of a code-sharing alliance is viewed as the ability of the partners to offer a service that is as close to true online service as possible, we can say that current BA / USAir code-sharing "effectiveness" (as of 1994Q1) is about 50 percent.

Across Northwest / KLM code-sharing markets in the sample, projected market share for code-sharing flights falls about 10.5 percentage points when code sharing is turned off. In contrast, if interline code sharing had the same attributes as true online service, the model predicts that Northwest / KLM shares would increase about 1.5 percentage points; thus, their current code-sharing "effectiveness" is almost 90 percent.

Producer and Consumer Surplus Estimates

The model allows direct computation of consumer surplus by calculating the change in consumer welfare between the baseline and counterfactual cases. A disaggregation into U.S. and foreign impacts is based on Immigration and Naturalization Service data indicating U.S. passenger shares by country of origin and destination. The consumer surplus valuation is based on an external estimate of the value of time.[12]

The effect of code sharing on producer surplus is measured as the change in net profits--revenues minus costs for each alternative. Carrier-specific cost data are used to

[12] An important assumption in the calculation is that the market share declines for code-sharing alternatives in the counterfactual case that result when switching seat shares from code-sharing categories to non-code-sharing categories actually reflect changes in consumer utility.

estimate impacts. As noted earlier, the model assumes that the market size is fixed and there is no change in capacity, so the only incremental costs incurred are passenger-related: ticketing, sales and promotion costs (measured as a percentage of the fare) and passenger services costs (measured as a percentage of revenue passenger miles).

Both consumer and producer welfare effects apply on a per capita basis for each passenger in a given market, so the overall welfare impacts can be found by scaling the results by overall market size. To gauge the overall dollar impact of each of the two major code-sharing agreements, estimates were computed of the total annual gateway-gateway, behind U.S.-Europe and behind Europe-U.S. O&D traffic across all BA/USAir and Northwest/KLM code-sharing markets. These traffic estimates were based on the ticket sample and an adjustment factor to account for passengers on pure foreign alternatives which do not appear in the ticket sample. The estimates which follow do not include "behind-behind" markets where code-sharing partners could offer double-connect service. However, based on an evaluation of ticket sample data for these markets, it is estimated that a doubling of the following projections may provide a reasonable gauge of the overall annual impact of these two code-sharing alliances.

Figure 5 shows the model estimates of the annualized impacts for the BA/USAir code-sharing alliance based on traffic data from the first quarter of 1994. The results show that the consumer benefits are significant from the BA/USAir alliance, but the alliance has benefitted foreign carriers at the expense of U.S. carriers. Even after accounting for benefits to U.S. consumers, the overall net impact on the U.S. is negative. This is not surprising given the one-way nature of the code sharing (BA puts its code on USAir flights, but not vice versa), and the fact that BA does virtually all of the long-haul flying between the U.S. and London.

Figure 6 shows the model estimates of the annualized impacts of the Northwest/KLM code-sharing alliances based on traffic data from the first quarter of 1994. In contrast to the BA/USAir alliance, the Northwest/KLM alliance provides sizable benefits to U.S. passengers and small (but positive) benefits to U.S. carriers as a group. Based on reports filed by Northwest since the first quarter, it is likely that the overall traffic accruing to U.S. vis-à-vis foreign carriers due to the Northwest/KLM alliance is much more favorable to U.S. interests than is indicated in the model, which is based only on first quarter data. Specifically, these reports indicate that code-sharing traffic over Northwest's Minneapolis and Boston hubs is growing significantly faster than traffic flowing over its Detroit hub. Since Northwest does all of the flying on the Minneapolis-Amsterdam and Boston-Amsterdam segments, while KLM flies only the Detroit-Amsterdam segment, Northwest is undoubtedly receiving the lion's share of the traffic (and revenue) increase for flying between the alliance's hub airports. Thus, overall traffic and revenue flows to U.S. carriers will be higher than is indicated in the results reported in this analysis.

Figure 5

ESTIMATED ANNUALIZED IMPACTS OF THE BA/USAIR CODE-SHARING ALLIANCE (Based on 1994Q1 Data)

Carrier	Producer Revenue ($Mil)	Producer Cost ($Mil)	Net Producer Surplus ($Mil)	Consumer Surplus ($Mil)	Net Social Surplus ($Mil)
USAir	$7.9	-$2.3	$5.6		
Other US Carriers	-41.7	14.9	-26.7		
US Total	**-$33.8**	**$12.6**	**-$21.1**	**4.9**	**-16.2**
British Airways	45.8	-18.6	27.2		
Other Foreign Airlines	-1.3	0.5	-0.8		
Foreign Total	**44.5**	**-18.1**	**26.4**	**5.4**	**31.8**
Grand Total	**$10.7**	**-$5.5**	**$5.3**	**$10.3**	**$15.6**

Figure 6

ESTIMATED ANNUALIZED IMPACTS OF THE NORTHWEST/KLM CODE-SHARING ALLIANCE (Based on 1994Q1 Data)

Carrier	Producer Revenue ($Mil)	Producer Cost ($Mil)	Net Producer Surplus ($Mil)	Consumer Surplus ($Mil)	Net Social Surplus ($Mil)
Northwest	$24.6	-$8.5	$16.1		

Other US Carriers	-25.6	9.9	-15.7		
US Total	**- $1.0**	**$1.4**	**$0.4**	**13.0**	**13.4**
KLM	18.6	-8.0	10.6		
Other Foreign Airlines	-16.5	7.9	-8.6		
Foreign Total	**2.1**	**- 0.1**	**2.0**	**14.1**	**16.1**
Grand Total	**$1.1**	**$1.3**	**$2.4**	**$27.1**	**$29.5**

Limitations

The model developed for the study assumes a fixed market size; as such, it assumes no increase in the overall size of the market from service quality improvements associated with code sharing. In addition, the model does not measure any response by carriers competing with the code-sharing alliances. In combination, we would expect these two factors to result in a larger market and a lesser impact on market share than that observed.

The type of model developed for the study also was not appropriate to measure code-sharing impacts in the many small markets which are from a point behind a U.S. gateway to a point behind a foreign gateway. Data for passengers who fly their itinerary entirely on a foreign carrier are excluded from the O&D ticket sample and from other special reports required by DOT. In addition, there are no data which report the actual prorates of revenue between carriers for interline and online code-sharing flights. While the study team was able to develop estimates for these parameters, the model results would be more accurate with actual data. In addition, as noted above, more recent traffic data for KLM and Northwest show that the effects of code sharing are still evolving. If DOT wants to continue to monitor the effects of international code sharing on airlines and consumers, it should consider expanding the reporting requirements for code-sharing operations, particularly those of foreign carriers.

SOME CONCERNS ABOUT CODE SHARING

A number of concerns about international code sharing were raised during the outreach conducted for this study. Most of these can be addressed within the current framework where DOT provides oversight of code-sharing agreements.

Some have argued that code sharing can be a form of deception for air travel consumers. This occurs when the consumer believes that the flight is on one airline when the service is really on a different carrier. To address this, DOT recently proposed that travel agents and airlines be required to improve disclosure for code-sharing flights. While continued DOT oversight may be required in this area, there appear to be ample means available to protect consumer interests.

Questions have been raised about the ability of U.S. carriers to obtain equivalent opportunities for code sharing in foreign markets as are afforded to foreign carriers who receive permission to code share in the U.S. These questions arise partly from the large size of the U.S. domestic airline market in relation to that of foreign countries (no single country today can provide access to a market of a size approaching that of the U.S.), and partly out of concern that the ability of U.S. carriers to benefit from code sharing may depend, in part, on the ability to serve third country markets behind foreign gateways via code sharing. The analysis of the Northwest/KLM alliance undertaken in this study demonstrates that U.S. carriers can be substantial beneficiaries of code-sharing alliances even with a carrier from a small country and without fully equivalent code-sharing opportunities beyond the foreign gateway.

Some countries may offer to open up more capacity to U.S. carriers in exchange for increased access to the U.S. market. In such cases, DOT should continue to weigh the opportunity provided to the U.S. in relation to what is granted to foreign carriers. Additional access to overseas markets can be important to the U.S. because its carriers are cost-efficient and should do well in a more open environment.

There also are concerns when a state-owned foreign carrier seeks to expand its network via code sharing with a U.S. carrier. The concern here is that such carriers may be insulated from market forces, and the most efficient carrier may not prevail. If a foreign country has a policy of subsidizing its carriers' losses, the granting of access to the U.S. via code sharing could increase market distortions.

Antitrust is another consideration when carriers seek to combine networks via code sharing. At present, both the DOT and the Department of Justice review code-sharing agreements to assure that they do not lead to anti-competitive outcomes. This appears to be a consideration when the code-sharing carriers control a large part of the traffic in markets affected by their code-sharing agreement. In some such cases, the U.S. has required one of the partners to divest certain operations to maintain competition. Such divestiture was part of the USAir agreement to code share with British Airways, to avoid antitrust objections.

A final concern expressed is that foreign carriers may dominate the long-haul flying in some code-sharing agreements. This is a concern of the U.S. Department of Defense because of potential effects on U.S. carriers' fleet of long-haul aircraft available for the Civil Reserve Air Fleet. U.S. labor interests also are concerned about the employment effects if long-haul flights were to shift to foreign carriers as a result of code sharing. In the longer term, the carriers in a transnational alliance will have the incentive to shift flying to the lower cost carriers in the network. U.S. carriers should be well positioned because their costs are low relative to foreign carriers. It may also be instructive to look at the prior positions of the carriers which have established broad-based code-sharing agreements. In some existing cases (e.g., BA-USAir), the foreign carrier already had a much larger share of long-haul flying prior to code sharing. In the case of the Northwest/KLM code-sharing agreement, recent data show large increases in traffic on those long-haul segments operated by Northwest.

OUTLOOK FOR THE FUTURE

Most knowledgeable observers expect growth in air travel markets to continue, although they may differ on the level of such growth. As route density increases, more point-to-point service becomes attractive. As markets grow, low cost operators may enter to compete on a point-to-point basis. This trend has already emerged in the U.S. domestic market and in some international markets. In itself, this would tend to decrease the attractiveness of code sharing in certain markets.

At the same time, there will be supply-side forces at work which will tend to reinforce the benefits of alliances and code sharing. These include the economies of scope and density that result from large networks and the marketing advantages that code sharing provides. Increasing congestion at airports is also likely to encourage code sharing as carriers seek to serve airports where landing and take-off slots are scarce.

The liberalization of foreign airline markets will have a profound effect on airline route networks. It can be expected that a smaller number of large foreign carriers will emerge, which is what happened in the U.S. after airline deregulation. Because of political considerations attached to national carriers in Europe, we may see a large carrier alliance which is made up of a number of smaller carriers, each retaining some separate identity. While European carriers are allowed to operate anywhere within the European Union, it still may be more effective to do so via code sharing. Other carriers are beginning to explore relationships based on "franchising," where a number of nationally-based carriers operate under the brand of a large carrier and there may be investment by the lead airline. British Airways is using this approach to operate parts of its intra-Europe network based in other countries.

Code sharing makes a concentrated hub-and-spoke network more valuable by making it easier to connect it to another network. Thus, code sharing can be a force leading to fewer, larger airline networks. These networks will increasingly compete with one another in many markets assuring that a large part of the reduced costs of these larger networks are passed forward to consumers. In addition, as the carriers within these networks take steps to integrate their operations, consumers will benefit from a higher quality of service.

It may be that foreign carriers will have incentives to concentrate more service at the hubs of the U.S. carriers with which they have a code-sharing agreement. For example, Northwest/KLM is increasing service to Amsterdam from Northwest's U.S. hubs. Steps such as these are consistent with a strategy of trying to concentrate more service where the networks of the code-sharing partners connect. It remains to be seen whether foreign carriers will reduce service at U.S. gateway cities that are not hubs for their code-sharing partners.

The future regulatory regime, including bilateral air service agreements and foreign ownership laws, also can affect the need for carriers to code share. If the environment is significantly liberalized, carriers may attempt to become larger via cross-border mergers and acquisitions. To the extent that these avenues are foreclosed, code sharing will continue to be an important tool for airlines seeking to expand their own networks to compete more effectively with the other large networks.

The move towards increasing the size of airline networks will likely continue whether or not U.S. carriers are involved. Some observers believe that Asia will be the next place where code sharing becomes more prevalent. For example, BA has entered into an alliance with Qantas, and Lufthansa has entered into an alliance with Thai Airways International. Asia is currently the fastest growing market for air travel, and U.S. carriers will seek to participate in this growth. These U.S. carriers, acting in their own business interests, will continue to seek code-sharing agreements and broader alliances with foreign carriers.

Code-sharing partners will increasingly try to sell their coordinated service through common branding. Already Delta aggressively promotes its partnerships with other airlines. Northwest and KLM want to go further, acting as one airline and perhaps eventually organizing themselves as one airline. If code-sharing airlines are allowed to coordinate their prices and fly under one brand name, there may be important impacts on competition and consumer and producer welfare.

Finally, the model developed for this study will allow the DOT to more closely examine the likely effects of code-sharing access. With improved knowledge about how U.S. and foreign carriers and consumers are affected by code sharing, it can better evaluate how these agreements affect U.S. interests. In particular, it will have a better understanding of how much foreign carriers can benefit from the increased access to the U.S. provided by code sharing.

NOTE

This report was prepared under a contract with the U.S. Department of Transportation. The contractor is responsible for the facts and accuracy of the data and analyses presented in the report. The contents of the report do not necessarily reflect the views of the U.S. Department of Transportation or the sponsoring office.

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Alliances between international airlines are becoming increasingly prevalent as carriers seek to extend the range of their networks and access new markets. These international alliances range from marketing agreements that feed traffic to another carrier in a specific market to investment by one carrier in another. The ability of carriers to enter into alliances is limited by laws governing foreign ownership of airlines, as well as the nationality clauses of bilateral air service agreements which require that carriers exercising rights under a country's bilateral be owned and controlled by citizens of that country. As a result, international carriers have embarked upon code-sharing agreements as one way of entering into an alliance with a foreign carrier. Code sharing, an arrangement in which one carrier puts its two character code on the flight of another carrier, allows an airline to hold out service as its own in markets where it does not operate or operates infrequently. Code sharing can range from a very limited agreement involving only one market to broad-based agreements such as those between British Airways and USAir, KLM and Northwest, or United and Lufthansa, which cover large parts of the participating carriers' route systems. Code sharing allows these carriers to compete as large integrated networks serving many parts of the world.

Code sharing began in the 1960's when Allegheny Airlines (now USAir) stopped serving smaller markets that it could not serve economically. It turned the routes over to commuter airlines, but retained its two letter code on these flights. Code sharing came into wide use as U.S. domestic airlines sought to integrate the services of their commuter airline partners in the post-deregulation era. The large domestic carriers had established hub-and-spoke route systems and decreased the amount of interline traffic carried. Code sharing became one means to provide passengers with online service system-wide. (Prior research had shown that passengers prefer online service to inter-line service.)

Today, carriers are establishing international code-sharing relationships which, in some cases, make "online" service available from many parts of both carriers' networks. For example, large U.S. carriers have entered into code-sharing agreements with large European carriers such as USAir with BA, Northwest with KLM, and United with Lufthansa. Many other U.S. airlines have entered into or are seeking approval for code-sharing agreements with carriers from other countries. Code sharing has become an important issue in bilateral air service agreement negotiations between the U.S. and foreign governments.

Because of the prevalence of these agreements and their potential effects on the U.S. airline industry, the Office of Aviation and International Economics at the U.S. Department of Transportation (DOT) engaged Gellman Research Associates, Incorporated (GRA) to analyze code sharing between U.S. and foreign airlines. DOT established the following objectives for the study:

- Develop a methodology to assess the effects of code sharing on the level and distribution of traffic among carriers. The DOT wanted to examine the effects of future agreements;

- Examine the effects of code sharing on the costs and profitability of airlines;

- Assess the effects of code sharing on consumers of airline services;

- Project the future use and impact of code sharing over the next twenty years.

1.2 STUDY ISSUES

Major DOT policy goals in international aviation include the promotion of U.S. air carrier interests in international agreements and operations, and the promotion and protection of U.S. passengers' interests in efficient and competitive international air service. While international code-sharing agreements may advance these goals, they have the potential to adversely affect them as well. Therefore, to fulfill its public policy responsibilities, DOT must have the capability to assess the impact of code-sharing agreements on U.S. passengers' and air carriers' interests.

A fundamental concern is how these types of agreements and associated alliances affect the vitality of competition in the affected markets. To the extent possible, competitive market forces are relied upon in domestic markets to secure economically efficient outcomes for both producers and consumers of aviation services. Because of entry constraints in some international markets and the resulting small number of competitors in those markets, carrier agreements that change the degree of competition and cooperation between air carriers require scrutiny.

The interest in competition flows from a more fundamental concern about the welfare of U.S. air carriers and passengers. The nature of competition will affect the fares and service choices available to passengers, and the efficiency with which those services are produced by air carriers. Code sharing may cause changes that leave passengers either better or worse off than before the agreement occurred. The net benefits accruing to U.S. passengers, or the net changes in consumers' welfare, are one important factor in assessing code-sharing agreements.

Code sharing may alter the competitive balance and outcomes among U.S. carriers in the affected international markets and in their domestic markets that feed traffic into international flights. In addition, these agreements alter the competitive balance between U.S. and foreign carriers. The net effect of code-sharing agreements on all U.S. carriers combined is likely to be of prime importance in weighing their desirability, though the distribution of gains and losses among carriers may be important in some circumstances.

These issues and concerns are reflected in the study objectives established by DOT and in the study approach adopted.

1.3 STUDY APPROACH

The overall study objective was to develop a methodology for DOT to use in assessing the effects of current and, importantly, prospective code-sharing agreements on U.S. and foreign passengers and on U.S. and foreign airlines. The capability of evaluating new proposals is a key element of the methodology developed. It will assist DOT in its review of proposed agreements and help determine whether they should be permitted to take effect.

The study began with a review of the literature on code sharing and related topics including airline alliances, airline networks, international airline competition, bilateral agreements, effects of the existing code-sharing agreements, and other subjects relevant to the project. The Study Team uncovered no broad-based studies of code sharing, and only a few studies which examined the effects of specific airline alliances.

The Study Team also conducted considerable outreach throughout the course of the study. Meetings were held with U.S. and foreign airlines to determine their positions on code sharing and to review data and analyses of the effects of code sharing. Meetings were also held with government officials responsible for code-sharing policy, and with individuals representing computer reservations systems, airports, organized labor and the Department of Defense. This diverse input helped the Study Team to refine the issues to be investigated as well as to identify likely sources of data with which to measure the effects of code sharing.

The Study Team developed a proposed methodology to assess the effects of code sharing on airlines and consumers. The methodology was based on a model to estimate consumer choices of airline service offers, including online service, code-sharing service and interline service, while controlling for other variables such as price, service quality and travel time. This model allows estimation of the effects of code sharing on carrier market share. The model also allows disaggregation of the market share changes into effects on U.S. and foreign airlines and U.S. and foreign consumers. The Study Team presented the proposed methodology, along with the data available to apply it, to the DOT's Volpe National Transportation System Center (VNTSC), who reviewed it on behalf of the project's sponsor, DOT's Office of Aviation and International Economics. The final methodology was approved by that office. More details on the specifics of the carrier choice model are presented in Chapter 6.

1.4 STUDY TEAM

GRA dedicated an in-house team to this study. Mr. Richard Golaszewski of GRA led the overall study effort. Dr. William Spitz of GRA developed and applied the methodology to measure the effects of code sharing, including development and estimation of the carrier choice model. Dr. Jerome Bentley of GRA assisted in the development of the methodology and in structuring the economic analysis. Mr. Christiaan Hogendorn of GRA assisted in many parts of the study, including examination of the antitrust aspects of code sharing. Mr. Joseph Phillips prepared much of the data used in the route choice model. Many other GRA staff participated during particular phases of the study.

GRA supplemented its in-house staff to assist in particular areas of the study:

- Professor Steven Morrison assisted the Study Team in developing the methodology to measure the effects of code sharing. He also contributed to the assessment of the future structure of the airline industry.

- Mr. Randall Malin, a GRA Aero Advisor, assisted the Study Team in the assessment of U.S. and foreign carrier positions on code sharing. In addition, he provided expertise on airline distribution and computer reservation systems issues.

- Mr. Erwin von den Steinen and International Transport Policy Associates assisted the Study Team in the area of bilateral agreements and the European regulatory framework for airlines.

- Mr. Mark Dayton, an independent consultant, assisted in the compilation of the final report.

Staff from the Volpe National Transportation Systems Center under the direction of Mr. John O'Donnell assisted in the development of the methodology and data for use in this study. These included Mr. Don Pickrell, Mr. Robert Church and Ms. Pamela O'Leary.

Project oversight was provided by Mr. James Craun, Director of the Office of Aviation and International Economics. He was assisted by Mr. Randall Bennett and Mr. William Boyd of the same office.

1.5 REPORT ORGANIZATION

The report begins with background on code sharing (Chapters 2 through 4) and goes on to explain an economic analysis of code sharing (Chapter 5). Next it turns to the development of the carrier choice model (Chapter 6) and applies that model to the calculation of consumer and producer welfare (Chapter 7). Finally it looks to the future of DOT's code-sharing policy (Chapter 8). A series of technical appendices contain supplementary material.

CHAPTER 2: BACKGROUND

2.1 DEFINITIONS OF CODE-SHARING ACTIVITIES

Code sharing is the placing of one airline's identification code on another airline's flights. Code sharing may exist by itself or in combination with other carrier agreements or alliances. For example, two carriers may agree to coordinate their flight schedules to facilitate interline connections in certain city-pair markets. This may be combined with agreements on baggage handling, one-stop check-in service, use of proximate gate locations, sharing of frequent flyer awards, joint marketing, etc. Code sharing may occur in conjunction with more extensive carrier alliances, as well, involving exchanges of equity and operations under grants of antitrust immunity.

Every airplane flight is designated by a two part code in flight timetables and airline reservation systems. The first part of the code consists of a unique two character designation for each airline offering commercial flight services. The second portion is the flight number assigned by the airline for the service offered, from the origin of the flight to its final destination. When code sharing is used, more than one air carrier assigns a flight number to a single airplane flight and then lists the flight with its airline designator.

For example, UA 940 and LH 6431 are listed as flights from Chicago to Frankfurt on United and Lufthansa respectively. In fact, the flights share the same aircraft. The plane is operated by United and carries United markings. Some passengers on the flight have tickets from United, issued for flight UA 940, while others have Lufthansa tickets, issued as flight LH 6431.

Some code-sharing agreements are organized like interline agreements. In such agreements, the operating carrier incurs all costs, and revenue is divided according to the terms of a prorate agreement. Other code-sharing agreements involve blocked-space arrangements, where one airline purchases a group of seats on another airline's flight. In these agreements, both carriers bear the cost and inventory risk, price and market the seats, and earn any profits or suffer any losses. The practice of blocked-space code sharing actually involves "plane sharing" rather than code sharing, though code sharing has evolved as the term applied to these operations.

2.1.1 Naked Code Sharing

Some observers have applied the term "naked" code sharing to the practice if the extent of the code-sharing agreement simply involves putting one airline's code on another's flight and nothing else. Absent any types of supplementary actions to coordinate service, a naked code share is no different in practice from connecting, interline services. Presumably, an airline would employ naked code-sharing arrangements because of the perceived marketing advantages of online versus interline service. Because the implied benefits of online service are likely to be absent, by definition, from naked code-sharing arrangements, the short-term marketing advantage is unlikely to be sustainable as consumers become aware of this tactic.

2.1.2 Corporate Alliances

Code-sharing agreements can be much more extensive, however, than an agreement to simply swap two-character codes on CRS displays. Code sharing occurs in conjunction with international air carriers' efforts to create large route networks that cover a broad geographic area. Legal, regulatory, and operating constraints, both domestic and foreign, restrict carriers' ability to directly enter new markets or merge with competitors to achieve these networks. (These issues are more fully explored in Section 2.3.5.) Alliances between international carriers involving joint marketing, operating, and ownership can substitute for more direct entry and merger activities, and code sharing is an integral part of these corporate alliances.

2.1.3 Joint Operating and Marketing Agreements

Joint operations and marketing agreements between two air carriers may create a large, *de facto*, online service network by seamlessly connecting passengers between the networks of the individual carriers involved. As part of this network strategy, the carriers may employ code sharing as a way to signal passengers that code-shared flights share the quality attributes of online service even though they involve connections between two carriers.

Online service has a number of attributes that distinguish it from interline service. These attributes include flight schedule coordination, through ticketing, single check-in, through baggage handling, proximate gate locations, and frequent flyer programs. Passengers will likely opt for online service if it is available because its attributes usually result in higher quality service than interline service.

Flight schedule coordination minimizes waiting times between flight legs while providing sufficient time for delays to avoid risking a missed connection. Further, carriers may hold connecting flights to await the arrival and transfer of delayed passengers. Through ticketing and single check-in simplifies and reduces the time necessary for passenger check-in. Through baggage handling either eliminates the need to retrieve and recheck baggage at the connecting location, or reduces the risk associated with interline handling of baggage in which no one carrier has sole responsibility for the baggage. In conjunction with schedule coordination, carriers can coordinate gate locations to minimize the time and effort for passengers to connect with their flights. Finally, coordination of frequent flier programs increases the value of awards to participants by increasing their destination options.

Creating these online service attributes requires coordination or sharing of operations that may also benefit the carriers involved by reducing their operating costs from more efficient use of shared facilities and services. Operational changes may include the development of joint programs to market their extended flight networks, the sharing of gate and check-in facilities, joint maintenance and plane servicing operations, shared personnel, and shared catering facilities and passenger service standards. Extensive joint operating activities may result in something akin to mini joint ventures among the code-sharing partners at one or more airports.

Carriers can, in principle, agree on any number of interline coordination and marketing activities without the use of code sharing and without requiring the approval of governmental aviation authorities. For example, Continental and Air France announced an extensive marketing agreement in July 1993 which did not include code sharing. However, Continental and Air France have failed to fully implement their arrangement, and all of the other major alliances appear to rely heavily on code sharing itself. At the same time, non-code-sharing carriers fiercely oppose the concept which would appear to indicate that the ability to share codes is perceived as an extremely important component of partnership arrangements. Many of the carriers which provided input for this study indicated that they would not undertake these types of coordination activities without a code-sharing agreement with the other carrier. One carrier noted that code sharing is the "glue" that holds these cooperative agreements together.

2.1.4 Exchange of Equity

Air carriers may enter into agreements that involve an exchange of equity between them. This exchange of equity yields a vested interest of each carrier in making certain that the marketing and operating agreements that define their alliance are effective and successful. If code sharing is the marketing glue that holds airline alliances together, equity investments are more like concrete in giving each carrier the incentive to continue and promote the agreement. Legal restrictions on foreign national ownership of domestic airlines create limits on the level of cross-equity ownership. In the U.S., foreign ownership is limited to 25 percent of a carrier's voting rights.

2.1.5 Antitrust Exemptions

The strongest type of airline alliance can be formed when two airlines are granted antitrust immunity. The granting of antitrust exemption permits carriers involved in international alliances to discuss and jointly decide on fare levels and the capacity deployed on their international flights. According to Northwest and KLM, two airlines that currently enjoy antitrust immunity for their alliance, one of the greatest benefits of immunity is the ability to set fares in very thin markets. Without antitrust immunity, the two airlines would have to set up official prorates in arm's length negotiations, a cumbersome process when thousands of city-pairs are involved. The antitrust immunity allows Northwest and KLM to develop formulas to set fares in all such markets at once. The result is that both airlines can aggressively market service in every city-pair market they serve.

Antitrust immunity is a powerful business tool in permitting carriers that exist as separate corporate entities to act as one business firm. Absent the legal ability to merge, antitrust immunity may yield many of the benefits of merger while avoiding prohibitions against international ownership. In the case of Northwest and KLM, the two carriers are not allowed to sell their services under a common brand name. However, their ability to coordinate marketing strategies allows them to present a unified image to the public. Northwest and KLM also say that antitrust immunity allows them to coordinate services such as baggage handling more closely than they otherwise could.

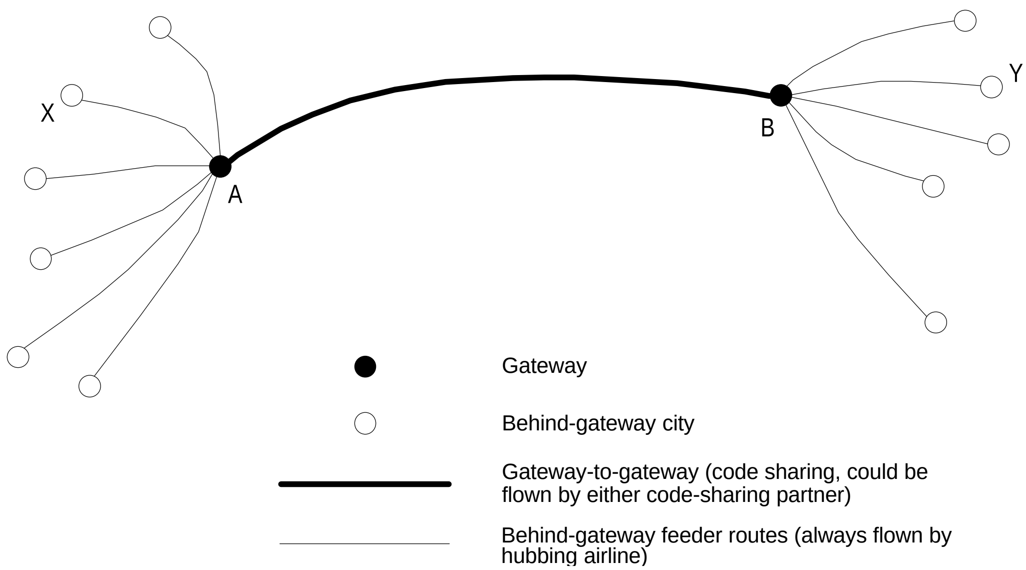
In some cases one airline might gain more than the other from a traditional alliance. Antitrust immunity allows alliance partners to share revenue equally, assuring that both carriers can capture the benefits of the alliance. Some observers are concerned that antitrust immunity might produce anti-competitive effects in markets where demand is thin and only one or two carriers can operate profitably. However, there is likely to be competition from other alliances in such markets because passengers will have the choice of more than one hub to connect through.

2.2 TYPES OF CODE-SHARING OPERATIONS

Code sharing can also be categorized by the type of flight operations to which it is applied. Specifically, code sharing may be used on gateway-to-gateway operations or on behind-gateway operations that connect at the gateways. Gateway-to-gateway flights connect principal origin and destination cities for international travelers. Figure 2-1 depicts a code-sharing alliance and illustrates the various operations to which code sharing may apply.

Figure 2-1

AN ALLIANCE



Carrier A operates out of Hub A in the United States, while Carrier B centers its operations on Hub B in, say, Europe. DOT recognizes three different possible types of code-sharing flights that the two carriers can engage in:

- Type 1: *behind-U.S.* code sharing in which Carrier B puts its code on Carrier A's spoke flights, for example from A to X;
- Type 2: *behind-foreign* country code sharing in which Carrier A puts its code on Carrier B's spoke flights, from B to Y for example; and
- Type 3: *gateway-to-gateway* code sharing in which Carrier B puts its code on Carrier A's transoceanic flight between B and A or vice versa.

If the two carriers code share on most of the routes they offer, many possibilities open up. Both carriers can offer on-line service from their hubs to a large number of foreign destinations as well as domestic ones. Furthermore, the carriers can together serve double-connect markets, such as X to Y in Figure 2-1. A double-connect flight begins behind one hub and ends behind the other hub. Passengers must change planes at both hubs. Double connect service allows the two code-sharing partners to serve an enormous range of city-pairs. Examination of the markets that comprise the current, major code-sharing agreements, however, show few double-connect markets with significant traffic (see Chapter 7). This may be, in part, a reflection of the increasing numbers of international gateways in the U.S. because of the creation of domestic hub-and-spoke systems.

The connection of two networks has a number of advantages:

- There are no aircraft that can economically fly trans-oceanic distances with very small loads of passengers. Therefore gateway- to-gateway routes must have dense traffic. (Note the B-767 has partially solved this problem and has opened up service from many smaller U.S. cities to European hubs.)

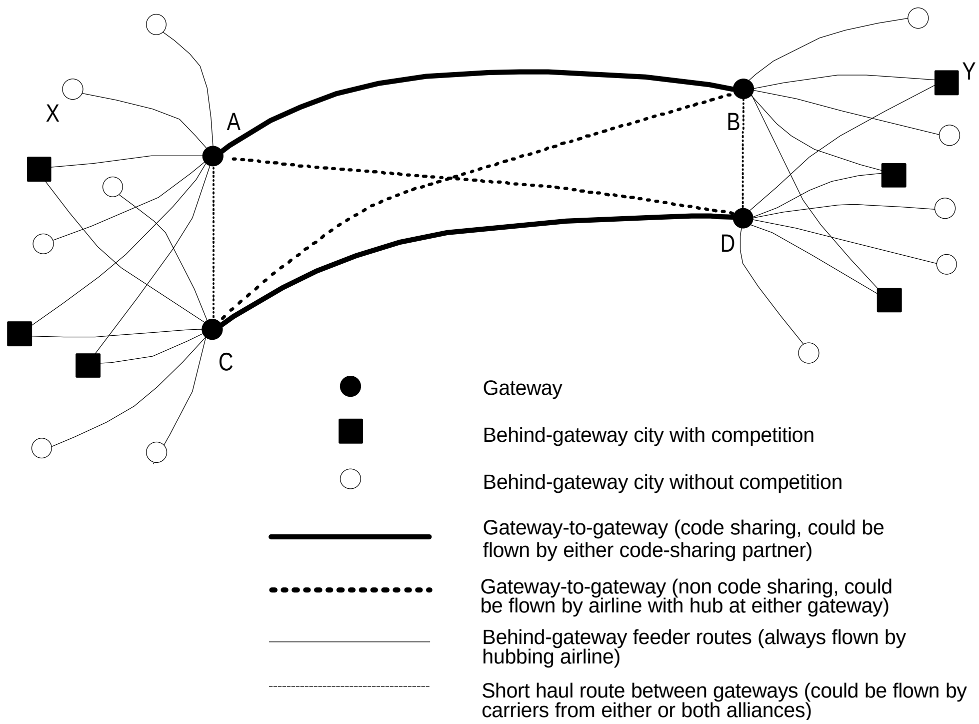
- Connecting networks reduces the economic risk to airlines of long-haul operations. By concentrating traffic at the two hubs, the airlines diminish the risk of local factors such as recession or political instability disrupting their entire service.

- The two networks allow for a large number of single connect routes (e.g., X to B in Figure 2-1) and an enormous number of double connect routes (e.g., X to Y in Figure 2-1). Carriers that join their networks can inexpensively serve very many markets.

- Connecting service is more competitive on international routes because connections take up a smaller percentage of total trip time when distances are very long.

International airline alliances can have pro-competitive effects as the alliances compete with one another. While the hub cities of each alliance may not see an increase in competition, those cities behind the hubs are likely to gain service offerings. In Figure 2-2 two alliances are shown. The passenger who wishes to make a double-connect journey from X to Y (or a single-connect journey from X to B) has the choice of using either alliance. Assuming X and Y are small cities, it is highly unlikely that there would have been online competitive offers between the two before the advent of code sharing.

Figure 2-2
TWO ALLIANCES



In addition to increasing competition at smaller cities, the development of hub-and-spoke networks and international airline alliances can increase non-stop international service. Historically, U.S. international traffic was funneled into a small number of gateway cities where passengers were concentrated for connection to international service. Gateways were established naturally in large coastal cities such as Boston, New York, and Miami that also generated large amounts of traffic as the origins and destinations for international travelers. With domestic airline deregulation in the United States, the growth in the number of domestic hubs has created concentrations of traffic at these hubs that make them viable as new gateways to international destinations. The result is that many more European and U.S. cities have direct service to each other through either non-stop (non-traditional) gateway-to-gateway service or through single connection service with or without code sharing. For example, suppose in Figure 2-2 that city A is New York and city C is Pittsburgh. In the past, all service from Pittsburgh to London stopped in other cities. The advent of the BA/USAir alliance has given Pittsburgh non-stop London service. Thus Type 3, gateway-to-gateway code sharing can provide consumer benefits in the form of more options, even though it does not improve any connections.

With further liberalization of airline service in European markets, a further increase in secondary gateway-to-secondary gateway traffic growth is possible and passengers could benefit from many more competitive options with non-stop and single-connect service. Code sharing has the potential to either increase or decrease the vigor of this competition depending on the partnerships created and the competitive options thereby opened or foreclosed.

2.3 MARKET CHARACTERISTICS THAT PROMOTE CODE SHARING

Airlines have adopted code sharing to avoid regulatory barriers and to expand their route networks. The following sections describe the airline regulatory environment and the economics of large networks. The interaction of these two forces tends to encourage code sharing.

2.3.1 Regulation and Deregulation

Up to the mid 1970's, airlines all over the world operated in regulated environments. Governments controlled which routes airlines could fly and doled out those routes with an eye toward managing competition at each airport. The result was that most airlines flew point-to-point routes, in which they connected their systems together city-by-city. When passengers wished to travel between two cities that did not have a direct flight, they were likely to have to switch airlines at some intermediate point.

On the international front, countries negotiated bilateral air services agreements with one another. These were also based on point-to-point services. Countries would agree on what gateways foreign carriers could serve. It was generally assumed that passengers continuing behind a gateway would have to change to a different airline at the gateway. The International Air Transport Association (IATA) set up a standard formula by which airlines would pro rate the revenues from these interline relationships.

In 1978, the U.S. deregulated its domestic airline industry. It also unilaterally ended IATA control over fares on international flights to and from the U.S. by requiring that airlines have the opportunity to charge independently developed fares. Since airlines were no longer subject to rules governing their domestic route networks, they attempted to restructure their service offerings to maximize their profits. The result was the hub-and-spoke system that is common today.

Deregulation of the U.S. domestic airline market led airlines to abandon their point-to-point networks in favor of consolidating their operations at one or more hub airports. From the hubs, the airlines send out flights to many spokes, resulting in a very large number of possible online connections. Airlines have found that they can reduce costs and increase the number of passengers through this system because it yields economies of scope and density.

2.3.2 Economies of Scope and Density

Economies of scope occur because an existing airline, by expanding its route network, can serve new markets at a lower cost than a new airline can serve them.[1] An airline might find, for example, that increasing the number of city-pairs it serves by 25 percent increases the direct costs of its entire network by only 20 percent. Such economies of scope are possible because airlines can use their capital more effectively. For instance, adding a new route might not involve buying a new aircraft but rather rescheduling the existing fleet to serve one more route. Therefore, rather than remaining idle, the aircraft is productively employed earning additional revenue. The new route may not need additional baggage handling or gate capacity either if the airline has existing stations at both points. Furthermore, if the flight goes into a hub, many new market pairs may be opened up.

Economies of density occur when it is less expensive to increase service on the existing network than it would be for some other carrier to provide additional service on the same routes.[2] For example, an airline might increase the available seat miles in a city-pair market by 25 percent, but find that the direct costs of all flights on that route increase by only 20 percent. The reasons for economies of density are similar to economies of scope. For example, an airline might fly larger aircraft on a given route. Larger aircraft have lower seat-mile costs than smaller ones.

When airlines in the U.S. first formed hub-and-spoke systems, they achieved both types of economies. Economies of scope came from the larger route networks that the airlines could offer through their hubs. The result was more service at many smaller

[1]Ethan Weisman, Trade in Services and Imperfect Competition, Dordrecht, Netherlands: Kluwer Academic Publishers, 1990, pp. 31-33.

[2]Douglas W. Caves, Laurits R. Christensen, and Michael W. Tretheway, "Economies of Density Versus Economies of Scale: Why Trunk and Local Service Airline Costs Differ," Rand Journal of Economics, vol. 15, no. 4, Winter 1984, pg. 474.

airports and lower prices on many routes.[3] At the same time, traffic density increased in many markets. A recent study by Bruekner and Spiller finds that economies of density were significant in the mid-1980's period of hub-building.[4]

The trend toward creating hubs may continue for some time. A paper by Bailey and Liu suggests that there is a tendency to create more hub-and-spoke systems than are needed.[5] Bailey and Liu argue that there are returns to network-related investments, so as markets grow, fewer airlines are needed to preserve competition. This happens because passengers value the online connections that networks provide and because average costs fall as airlines grow larger. The result is that over time the number of airlines in the industry declines as long as there is growth. In fact, the benefits of networks may be large but difficult to capture, so that airlines actually do not invest enough in creating networks. It could take as many as thirty years from deregulation to the achievement of a final equilibrium. In the meantime many large hub systems will be created, and then may need to be pared back and consolidated to reach the optimal network size.

2.3.3 Development of Networks and Code Sharing in the U.S.

The first code sharing in the U.S. occurred before deregulation. Its goal was to rationalize capacity and create a network that would provide feed for a larger airline. In 1967, Allegheny Airlines (now USAir) was shifting from propeller-driven aircraft to jets. The larger aircraft were uneconomical to operate on some of Allegheny's short routes, but the airline could not simply pull out of these markets because of CAB regulation. Allegheny's answer to this problem was to spin off the shorter routes to commuter airlines, creating the Allegheny Commuter System. The commuter flights in this system all carried Allegheny's "AL" code designation and were set up to make easy connections with Allegheny jet flights at hub airports. Since the aircraft operated by the commuters were essentially the same as those Allegheny had been using, passengers noticed little difference and the system was very successful.

It was not until 1983 that any other airlines took up the code-sharing concept, but after that date it spread rapidly, until there were 60 such agreements by 1986. These newer code shares were different from that developed by Allegheny Commuter. For

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[3]Weisman, pg. 20.

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

[5]Elizabeth E. Bailey and Dong Liu, "Airline Consolidation and Consumer Welfare," The Wharton School of the University of Pennsylvania, June 1993.

one thing, many involved new markets that jet airlines had never served. Others involved downsizing a former jet market to commuter aircraft, a tactic that usually provoked local opposition. Passengers would complain loudly when they found that their ticket on what they thought was a major jet airline actually was for a seat on a small propeller-driven commuter plane.

A major effect of domestic code sharing was to strengthen the hub-and-spoke system. There were three important reasons for this development:

- Economies of scale in baggage handling and other terminal operations;
- Economies of density from the ability to use larger aircraft on spoke routes than on point-to-point routes;
- The creation of "fortress" hubs that give the dominant carrier market power and deter new entrants.

Code sharing on commuter airlines fit into this system very well. The commuters could take advantage of the modest economies of scale in baggage handling because the code-sharing agreements provided for through baggage checking. They could handle the smallest routes, allowing the major airlines to play to their advantages in flying large aircraft on more heavily traveled routes. Finally, they could increase the profitability of a major hub operation. By feeding traffic into a hub, commuter carriers allowed their partners to achieve higher load factors or to use larger aircraft on jet spoke flights. While the hub-and-spoke system would probably have developed without code sharing, the practice served to strengthen the hubs.

Another effect of code sharing was to change the commuter airline industry. The commuters became vulnerable to the financial troubles of their partners. If the major airline went bankrupt, it was likely to pull the commuter down with it. Major airlines were also likely to push commuters into helping them compete for market share when they were trying to establish hubs. Some commuters tried to spread these risks around by serving more than one hub with more than one code-sharing partner. However, major airlines often demanded the undivided loyalty of partners. Commuters that did not code share found that their market share declined precipitously.

2.3.4 International Development of Large Networks

The same forces that pushed U.S. domestic airlines to create hub-and-spoke networks also exerted influence on the international market. Although regulation has persisted in that market to the present day, U.S. domestic deregulation has caused profound changes abroad as well. In the regulated era TWA and Pan Am were allotted many international routes while most other carriers received domestic routes. TWA had only a weak domestic route system while Pan Am had none, and after deregulation both carriers had difficulty establishing hubs. On the other hand, the traditional domestic carriers, among them American, Delta, and United, were very successful in establishing hubs. These hubs provided obvious U.S. gateways when the former domestic airlines expanded operations in the fast-growing international arena.

The former domestic carriers had a great advantage over TWA and Pan Am in international markets because they controlled their own U.S. feed. Unhindered by disadvantageous interline feed agreements, they quickly captured a large share of the international market to and from the U.S. Pan Am eventually went out of business because of this trend, and its routes were purchased by Delta and United. TWA was more successful at developing its own U.S. feed network, but it is currently on very shaky financial footing. Most of its London authority as well as other international routes were sold to American and USAir.

Foreign international airlines were in much the same position as TWA and Pan Am. They had no hubs, either in the U.S. or in their home countries, and they faced stiff competition on international routes from the large U.S. carriers. One response to this problem was for foreign international airlines to merge with other carriers in their home countries, which explains why British Airways purchased British Caledonian and why Air France bought Air Inter.

These changes occurred because it is very advantageous for an airline to control its own feed in the international market. It can then provide online service to many locations and achieve economies of scope and density, the same factors that promoted domestic hub-and-spoke formation. In the case of international traffic, there are two hubs to deal with, one in the U.S. and the other overseas. Controlling one hub is good, but controlling both would be ideal.

An international network brings many advantages. However, it is very difficult to set up such a network because of the prevailing international political and regulatory environment concerning aviation. The web of bilateral agreements and associated ownership restrictions that govern international air transport largely prevents airlines from taking the steps to create large networks.

2.3.5 The Bilateral Process is a Barrier to Creating International Networks

Currently, the right to provide air services between two countries is governed by bilateral air service agreements which are negotiated between governments.[6] Generally, bilaterals are based on the following principles of international aviation regulations:

- **Sovereignty**--Each state has control of the airspace over its own territory;

- **Equal Opportunities**--States have an equal opportunity to compete for traffic;

- **Non-Discrimination**--No distinctions are made based on the nationality of a carrier;

- **Freedom to Designate**--A country has the freedom to designate the carrier(s) that will operate air services.

In the exercise of their sovereign rights, countries may reserve the right for only domestic airlines to carry traffic between two points within their country. This right is guarded quite carefully, except that the European Union (EU), as a result of liberalization, will allow any carrier controlled by EU Nationals to provide airline services not only between EU countries but also within individual EU countries.

Countries negotiate the conditions under which airline services can be provided between them, and, in some cases, third countries. Some of these agreements are highly restrictive with the routes to be operated, the airlines to operate them, the level of capacity provided, and the prices charged by the airline of each country specified in detail. Other agreements are more liberal with more reliance placed on market forces to determine the level of services provided and the prices charged for them. However, both in restrictive and in liberal bilateral agreements, carriers must meet a nationality test which requires that they be owned and controlled by citizens of a country in order to benefit under that country's bilateral agreements.

When negotiating bilaterals, some countries attempt to balance the benefits of the agreement between the carriers of the two countries involved. Generally, this

[6]There are a number of good sources on the bilateral process and proposals to reform it. See, for example, Steven Wheatcroft, Aviation and Tourism Policies: Balancing the Benefits, London: Routledge, 1994, Chapter 2; and, Daniel Kasper, Deregulation and Globalization, Cambridge, MA: American Enterprise Institute, 1988.

means that if a country wants to obtain additional rights for one of its carriers in a bilateral, the other country will require something of comparable value for its airlines in return. Countries monitor the share of traffic carried by the airlines of each country to determine whether their carriers are achieving benefits comparable to foreign carriers under the bilateral agreements. In fact, when traffic becomes highly unbalanced and favors carriers from one country disproportionately, some nations may choose to renounce a bilateral agreement, or to threaten renunciation in order to obtain additional traffic rights for their carriers. While there have been calls to liberalize the trade framework for international airline services by replacing bilaterals with multilateral agreements for air services, it is not likely that this will be achieved in the near term.

Code sharing has been viewed by some countries including the U.S. as a new traffic right where approval is required. Other countries take the view that code sharing is more of a marketing tool used by carriers. This point of view is most often applied to situations where code sharing involves only those points which a carrier already has the right to serve under an existing bilateral agreement.

The U.S. position recognizes no other country can offer the value from code-sharing access that is equivalent to the value of broad-based code-sharing access to the United States, since no other country's domestic market today approaches the size of the U.S. market. Therefore, the U.S. initially authorized code sharing only on services already covered by bilateral route sights, and allowed broader code-sharing agreements only in exchange for additional bilateral considerations.

In the case of BA / USAir, code sharing was exchanged for allowing other U.S. carriers to replace Pan Am and TWA at Heathrow. In the case of KLM / Northwest, it was exchanged for an open skies agreement with the Netherlands. In the case of Lufthansa / United, code sharing was allowed only after Germany promised to consider a liberal bilateral in the future.

One purpose of this study is to estimate the value of code sharing to U.S. and foreign carriers and consumers so that the DOT can better understand what is at stake when it reviews proposals to exchange international code-sharing rights. This must be viewed in the context of the types of international airline services governed by the bilateral system. These services are classified by the rights that carriers are free to offer and are designated as various "Freedom" rights. First and second freedom rights (overflight and non-traffic stops) are largely, but not entirely, governed by multilateral agreements. The following freedom rights are more relevant to international services governed by bilateral relations:

- **Third Freedom**--The right to carry traffic from a carrier's home country to a foreign country;

- **Fourth Freedom**--The right to carry traffic from a foreign country to a carrier's home country;

- **Fifth Freedom**--The right of a carrier from one country to carry traffic between a second country and a third country as an extension of service between the home country and the second country;

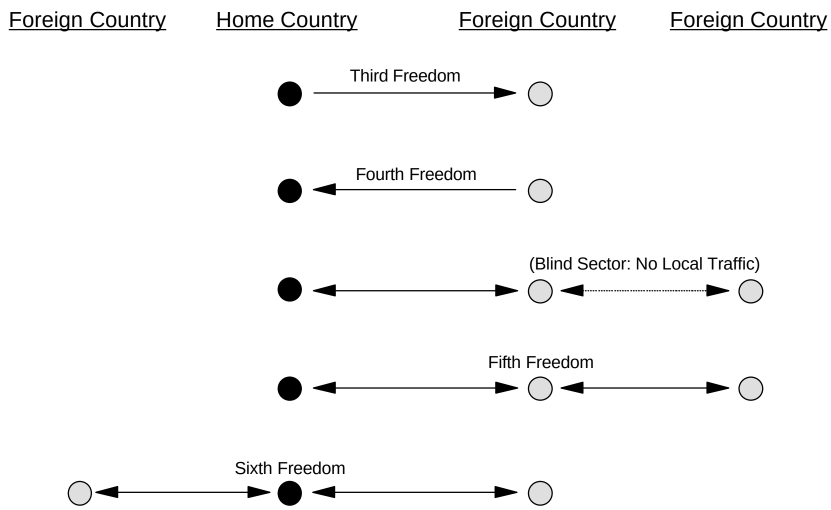
- **Sixth Freedom**--The ability of carriers to carry traffic from one foreign country to another foreign country as long as the traffic moves via the carrier's home country. This right is generally not treated in bilaterals since it represents a carrier's combining of third and fourth freedom rights.

In addition to the above, there are also "blind sector rights" where a carrier may carry traffic from its own country to a foreign country on a flight which makes an intermediate stop in another country. This differs from fifth freedom rights because the carrier is not allowed to transport local traffic between the two foreign countries. Figure 2-3 illustrates the different types of traffic rights.

As carriers seek to create large international networks, expansion of current services and entry into new markets would require securing new third and fourth freedom rights, while building an international hub system would require considerable fifth freedom rights. Although extensive fifth freedom rights would be essential for a single carrier to create and profitably operate its own international networks, they are particularly difficult to secure in the international negotiation process, especially on a bilateral basis. Governmental authorities have been especially cautious in granting fifth freedom rights because of the potential serious competitive effects on their own flag carriers. Furthermore, because fifth freedom rights involve third countries, the bilateral negotiation process is cumbersome and ill-suited to efficiently assembling the rights required.

The difficulty associated with establishing international networks by directly acquiring service rights ordinarily might lead carriers to seek access through mergers with carriers, in this case foreign carriers, that already possess the right to serve the markets. Restrictions based on national ownership laws, however, restrict mergers from playing the same role in international network building that they played in the creation of many U.S. domestic airline networks.

Figure 2-3: Examples of Traffic Rights



2.4 THE GOALS OF INTERNATIONAL CODE SHARING

The last two sections have shown that international networks are valuable, but that they cannot be created by one airline nor can two airlines merge to create one. Absent these alternative means of building extensive international networks, both U.S. and foreign carriers view alliances and joint operations as a means to secure many of the benefits of large-scale networks. Code sharing, in turn, is viewed as the best way to advertise such an alliance. Thus the major long-run goal of code sharing is to secure a place in the international marketplace, and airlines with no code-sharing partners risk being left out of this marketplace. A prime example of the network-expanding potential of code sharing is the recently proposed triad of agreements between United, Lufthansa, and Thai Airways International. The three together can serve a large portion of the globe.[7] If international hub-and-spoke networks become well enough developed, it may ultimately be possible to fly between any two regional airports in the world by making no more than two connections and flying on no more than two carriers.

There may be an anti-competitive side to this long-run trend. At hub airports there may have been many international carriers prior to code sharing. The advent of

[7]"Lufthansa, Thai Sign Code-Sharing Deal," Aviation Daily, October 12, 1994.

code sharing in effect merges two of these carriers and perhaps drives others from the market. In that case the choice of carriers for non-stop gateway-to-gateway flights could be curtailed. Competitive discipline could still be maintained by point-to-point flights on niche carriers and one-stop flights via other hubs.

While airlines see code sharing as a way to build and solidify international networks in the long run, code sharing also permits carriers to achieve many of their international business goals in the short run. These goals include entry into new markets, increased market share in existing markets, and reduced operating costs.

2.4.1 Entry into New Markets

A major objective of code-sharing airlines is to gain entry into new markets. Often, these markets are too small to support additional service, so code sharing is the only way for another carrier to serve the route. In other cases, the market might support additional service, but the airline cannot afford the start-up costs for the new route. A broad code-sharing alliance always carries this latter advantage–it offers a potentially large expansion of the route network with little investment. Code sharing may also lead to entirely new routes being created. For example, it is widely agreed that there would be no non-stop Cincinnati-Zurich service except that it connects the hubs of code-sharing partners Delta and Swissair.

An advantage unique to international code sharing is that it allows carriers to avoid some regulatory problems. For example, British Airways could never have set up its own extensive hub in Charlotte that both fed its trans-Atlantic flights and primarily served as a U.S. cabotage operation. Such an arrangement is simply prohibited under U.S. law. Likewise, Continental would have been unlikely to gain access to Rome without its code-sharing agreement with Alitalia.

2.4.2 Increase Market Share

The second short-run goal of code sharing is to increase market share in markets that are already being served. Code-sharing airlines could increase market share if code sharing resulted in enhancements to service such as better connections. Code sharing might reduce connecting times, eliminate multiple check-ins, and improve baggage handling. Of course, carriers could make these changes without code sharing, but it is possible that only with code sharing can they successfully appropriate the benefits of coordination.

As an example, consider a trip from Cedar Rapids, IA to Frankfurt via Chicago. The Cedar Rapids-Chicago leg can be flown on United Airlines, with a connection to a

Lufthansa flight at Chicago. United could market the interline service, but the code-sharing agreement between United and Lufthansa is likely to make the connection more attractive to those passengers who want to fly to Frankfurt or to Lufthansa destinations beyond Frankfurt. The result is that United's market share in the Cedar Rapids-Frankfurt O&D market should increase.

Airlines may also be able to gain market share if they can lower their fares. In some cases airlines are restricted to charging higher fares on international routes outside the U.S. because of IATA fare agreements. If code-sharing partners, such as KLM and Northwest, can more easily negotiate joint fares (instead of standard interline agreements), they can get around these restrictions. Northwest and KLM claim they have been able to significantly reduce fares on some routes, increasing their market share and also stimulating new traffic.

Competition from other alliances limits the use of code sharing as an anti-competitive tool in international O&D markets. However, code-sharing airlines might be able to reduce competition on individual spoke or gateway-to-gateway flight segments. A code-sharing partner might enter a thin domestic spoke market knowing that its code-sharing advantage will enable it to drive out the competition. The same sort of thing might be possible on international long-haul routes as well. In some cases the code-sharing partners may be former competitors, such as United and Lufthansa. By code sharing on routes the two both fly, two airlines might gain increased market power. Even if they are forced to set fares at arms' length, they may not compete aggressively with one another as they otherwise might have.

2.4.3 Reducing Operating Costs

The final short-run goal of code sharing is to reduce operating costs. Code sharing may reduce average operating costs if it generates more traffic and the airline can achieve some economies of density. For example, code sharing might give an airline enough feed to allow it to switch to a larger aircraft type. This would spread the cockpit crew costs over more passengers.

Other cost reductions could come from alliance agreements that are associated with code sharing. Airlines might achieve economies-of-scale if they jointly purchased advertising, handled baggage together, or combined their airport staffs. They might achieve economies-of-scope if code sharing led them to serve new markets but they did not have to expand other parts of their operation to accommodate the new markets.

2.5 LESSONS FROM THE U.S. DOMESTIC EXPERIENCE WITH CODE SHARING[8]

International code sharing is a relatively new phenomenon, but domestic code sharing has been around for some time. A comparison of the two can shed some light on what to expect in the international arena.

The two types of code sharing are similar in that they both serve to strengthen the hub-and-spoke system, though international code sharing typically involves two hubs rather than just one. As with domestic hubs, concentration at international gateways may have the same advantages, namely:

- Economies-of-scope in terminal operations, perhaps including customs procedures;
- Economies-of-density because of the greater feed and the ability to fly larger aircraft on trans-oceanic routes;
- Double "fortress" hubs creating market power, particularly on the long-haul route between them.

International code sharing is thus another element in the strengthening of the hub-and-spoke system.

Commuter airlines were clearly subsidiary to their major partners. In some international code-sharing agreements, such as USAir/BA, the U.S. carrier is clearly subsidiary to the foreign carrier. That means it can run afoul of the same difficulties as commuters: the U.S. carrier will be vulnerable to financial difficulties at the foreign carrier (or vice versa); it may be pushed into disadvantageous competitive stances in order to help the foreign carrier; or, if it tries to team up with more than one foreign carrier, it may anger its other partner. Finally, as has been clear from recent events, U.S. carriers worry that, if they are left without a code-sharing partner, they will be in no better condition than the commuters with no major partner. Of course all these points can apply to smaller foreign carriers that team up with larger U.S. carriers, such as LOT Polish with American or TAP Portugal with Delta.

As DOJ and DOT recognize, there may be competitive problems with international code sharing, just as there were with the domestic variety. Prior to code sharing, a hub-and-spoke carrier might provide good connections to two international

[8]This section is taken largely from Clinton V. Oster and Don H. Pickrell, "Marketing Alliances and Competitive Strategy in the Aviation Industry," The Logistics and Transportation Review, vol.22, no. 4, December 1986, pp. 371-387.

carriers at its hub (provided it is not one of the two carriers). If the hub airline then code shares with one of the two carriers, it will only provide good connections to one carrier. Passengers at smaller spokes will have fewer alternatives available at that hub, though they may have more choices available at other hubs.

It is also important to note the differences between domestic and international code sharing. Except for Allegheny Commuter, almost all domestic code sharing has taken place in a deregulated market. International code sharing, on the other hand, takes place in a highly regulated market. Another difference is that the commuter airlines almost never competed directly with the major jet carriers. With international code sharing it is common for the two partners to provide broadly similar service and to compete directly on the same routes. Finally, the larger size of even the smaller code-sharing partners means that they seldom are the only airlines to serve a spoke airport. Thus code sharing might mean that there is only one good choice of international carriers at Hub A, but passengers at one of Hub A’s spokes will probably have access on another airline to Hub B, where there are different international connections. This mitigates any anti-competitive effects of code sharing.

CHAPTER 3: HISTORY AND EFFECTS OF CODE SHARING

3.1 INTRODUCTION

The origins of international code sharing lie in the U.S. domestic market where code-sharing agreements proliferated between major airlines and commuter carriers following deregulation. The drive to join route networks across national borders has since led to the development of code sharing on international flights as well. Since 1983 there have been many international code-sharing agreements, but four major deals involving U.S. carriers have had the most important implications. This section describes the development of international code sharing from its start in 1983 and traces the details of the four major agreements. Then it looks at two very recently-proposed code-sharing agreements. It ends with an examination of the competitive effects of code sharing. The chronology in Table 3-1 sets the stage for the discussion.

3.2 RECENT DEVELOPMENTS IN DOMESTIC CODE SHARING

Since the mid 1980's, domestic code sharing has been further refined and expanded, even as international code sharing has captured the most industry and media attention. Table 3-2 shows the domestic code-sharing partners of U.S. Major passenger airlines.[1] Major airlines have added more commuter partners and have marketed their services under the major carrier's name by creating brands such as the Delta Connection and USAir Express. Recently there has also been some shuffling of these brands, leading to strange combinations. For example, in July 1993 United began code sharing on TW Express flights to New York's JFK airport. The flights provide feed for both United's trans-Atlantic services and TWA's domestic and international flights.[2]

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[1]Major airlines are those who have annual revenues of $1 billion or more.

[2]"TW Express Links with United," Aviation Daily, July 5, 1993.

Table 3-1
CHRONOLOGY OF CODE SHARING

1967	First U.S. domestic code share (Allegheny Commuter)
1978	Deregulation of U.S. domestic airline industry
1985	DOT states that international code sharing will be approved if both airlines have underlying authority
1988	United/BA code share approved, DOT calls for reciprocity
1989	KLM invests in Northwest
1991	US, Britain renegotiate Bermuda 2 bilateral - British carriers receive broad code-sharing rights
1992	US, Netherlands sign open skies agreement
1993	Northwest/KLM begin code sharing
	USAir/BA code-sharing agreement
	US, Germany sign transitional bilateral
	United/Lufthansa alliance
1994	United/Lufthansa begin code sharing

An important development in domestic code sharing has been the establishment of agreements between major jet airlines. As with international code sharing, the goal is to feed one airline's long-haul flights from the network of the other airline. An example is United / USAir code sharing on USAir flights from the Northeast to Miami. This arrangement provides passenger feed for United's Latin American flights out of its Miami hub.[3]

Another type of domestic code sharing between majors links two systems in different parts of the country. The prime example of this type of arrangement is the agreement between America West, Continental, and Mesa. America West had been in bankruptcy and was saved by cash infusions from Continental and Mesa. As part of this effort to save America West, the airline began code sharing with its two partners in October 1994.[4]

[3]"USAir, United Reach Code Sharing Deal," Aviation Daily, August 18, 1993.

[4]"North America Report," Air Transport World, October 1994, pg. 9.

Table 3-2

U.S. DOMESTIC CODE-SHARING PARTNERS OF MAJOR AIRLINES

Major Airline (brand name if any)	**Code-Sharing Partner**
America West	Continental
	Mesa
	Northwest
American	
(American Eagle)	American Eagle
Continental	America West
	GP Express
(Continental Express)	Continental Express
Delta	
(Delta Connection)	Atlantic Southeast
	Business Express
	Comair
	Sky West
Northwest	Alaska
	Aloha
	America West
	Business Express
	Horizon
	Trans States
	USAir
(Northwest Airlink)	Express Airlines I
	Express Airlines II
	Mesaba
TWA	
(Trans World Express)	Alpha Air
	Trans States
	Trans World Express
United	Aeromar
	Aloha
	Gulfstream International
(United Express)	Mesa
	Sun Air Express
	Trans World Express
	United Express
	Westair
USAir	Northwest
	USAir Shuttle
(USAir Express)	USAir Express

Source: Official Airline Guide, October 1994 edition and Business Travel News, August 29, 1994

3.3 DEVELOPMENT OF INTERNATIONAL CODE SHARING

3.3.1 International Code Sharing: 1985-1990

Code sharing first appeared in international markets in 1985. At that time, DOT stated that code sharing would be permitted in U.S. international markets without approval proceedings as long as the international carrier had underlying route authority to the cities involved. Under this policy, American and Qantas instituted code sharing on American's trans-continental flights because Qantas already had authority to serve major east-coast gateways. Continental and SAS soon began code sharing as well on flights from Newark to Copenhagen and beyond.

This policy changed in late 1987 when United Air Lines and British Airways (BA) proposed code-sharing on United flights in the Chicago-Seattle market as an extension of its London-Chicago service. BA already had rights to operate on a London-Chicago-Seattle routing, but DOT told United that it would need authorization for the proposed code sharing. United responded by filing for an exemption, claiming that the code-sharing agreement was in the public interest. In March 1988 DOT granted the exemption, saying that its regulations had been unclear and that the code-sharing agreement was indeed in the public interest. At the same time, DOT clarified its position on code sharing.

The 1988 DOT exemption for United/BA stated that, in the absence of provisions in a bilateral agreement, all code sharing would need DOT approval. It required a carrier to be responsible for passengers traveling under its code for their entire journey regardless of the carrier providing the actual service. It further stated that proposed code sharing must be in the "public interest." The public interest test was based on the extent to which the proposal was covered by bilateral authority, the extent to which the foreign country deals with U.S. carriers on a reciprocal basis, and benefits to the U.S.[5] Thus code sharing would not be approved under the DOT policy unless it was covered in a bilateral agreement or otherwise brought benefits to the U.S. and unless the foreign country allowed U.S. airlines code-sharing rights in its markets.[6]

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[5]Hadrovic, Carolyn, "Airline Globalization: A Canadian Perspective," Transportation Law Journal, vol. 19, 1990, pp. 197-198.

[6]"Code Sharing: An Evolution Outline," fact sheet provided by KLM Royal Dutch Airlines, June 21, 1994, pg. 5.

3.3.2 Code Sharing Becomes Part of Bilateral Negotiations: 1991-present

Although DOT began requiring reciprocity after its 1988 decision, code sharing did not become an issue in bilateral agreements until 1991. In that year, the U.S. and the U.K. renegotiated the aspects of the Bermuda 2 bilateral air services agreement. The major issue in the negotiations was the so-called "Heathrow succession." Under Bermuda 2, the only U.S. passenger airlines eligible to serve Heathrow were TWA and Pan Am. These carriers were under intense financial pressure in 1991, and American and United were interested in purchasing their operations at London's Heathrow Airport. The British government and British Airways were leery of this plan. American and United were potentially much stronger competitors for BA than TWA and Pan Am because both American and United controlled extensive U.S. networks that would feed passengers to their flights.[7]

In exchange for agreeing to amend Bermuda 2 so that the U.S. could transfer TWA's and Pan Am's rights to serve Heathrow to American and United, the British insisted on code-sharing authority in the U.S. for BA and other British carriers so that they could develop similar strong networks with other domestic carriers to feed their international flights. The Heathrow Succession agreement, signed in March 1991, gives any British carrier the right to code share to any U.S. city provided there is a competing U.S. carrier service from the U.K. to the U.S. interior city.[8] Because of the way the U.S. hub and spoke system is set up, the agreement means that British carriers can reach almost every major U.S. airport by teaming up with one of the major U.S. airlines. In July 1992, BA and USAir proposed a major cooperative agreement including extensive code sharing. The proposal was very controversial and a revised arrangement was not approved until 1993 and only then with additional conditions. (A description of the approved agreement is in the next section.)

The problems with the revised Bermuda 2 agreement helped spur U.S. efforts to develop "open skies" agreements with other countries. DOT stated that such agreements should include:

- Open entry on all routes;
- Unrestricted capacity and frequency on all routes;

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[7]Perry Flint, "Action on the North Atlantic," Air Transport World, vol. 28, no. 6, June 1991, pg. 26.

[8]U.S.-U.K. Air Service Agreement, para. 11, section 5, annex 1.

- The right to operate to any point in the U.S. and any point in the foreign country without restriction, including service to intermediate and beyond points, and the right to transfer passengers to an unlimited number of aircraft at the international gateway;

- Flexibility in setting fares;

- Open code-sharing opportunities; and

- A commitment for nondiscriminatory operation of and access for CRS's.[9]

Initially the U.S. hoped that an open skies agreement might be possible with the entire European Community. Failing that, if one European country would agree to open skies, perhaps the resulting competition and increases in service would lead the other European countries to liberalize as well.

In September 1992, the U.S. and the Netherlands signed an open skies agreement that included all the criteria outlined above.[10] As a result of the agreement, Dutch carriers have more U.S. code-sharing rights than carriers of any other nationality. KLM is the primary Dutch carrier, and the agreement strengthened the pre-existing alliance between KLM and Northwest (see Section 3.4.1 for description).

Lufthansa found competing with the Northwest-KLM alliance was difficult after the open skies agreement and challenged Northwest's code-share operations beyond Amsterdam into Germany. A German court granted an injunction against Northwest code sharing on these KLM routes. Thereafter, Northwest and KLM had to wait until the renegotiation of the US-German bilateral before they could resume code sharing to Germany.

The U.S.-German bilateral negotiations were the first in which code-sharing issues were among the primary points of contention rather than secondary issues.[11] Although the U.S. had been pushing for an open skies agreement, Germany wanted to protect Lufthansa to allow it to restructure its finances prior to privatization. In the end the two countries agreed on a four-year interim agreement with a commitment to

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[9]"U.S. Defines Open Skies," Air Transport World, September 1992, pp. 9-10.

[10]Joan Feldman, "It's Time to Lead, DOT," Air Transport World, October 1992, pg. 60.

[11]Mead Jennings, "The Code War," Airline Business supplement: The Skies in 1994, pg. 13.

consider a subsequent open skies agreement. The agreement was signed in October 1993.

The most contentious issue that the two countries faced was the German demand for capacity constraints. In the end, the U.S. agreed to a capacity freeze for the first two years of the agreement, followed by small increases in the last two years. The capacity freeze applies both to the number of flights and the number of code shares. The agreement also gives Germany access to many more gateways in the U.S. and, by its provisions, greatly increased the value of the simultaneously-announced United/Lufthansa code-sharing agreement. Some U.S. critics of the revised bilateral, such as Delta Airlines, felt that the U.S. had given away a great deal of market access without getting much in return; other observers felt that the concessions would make an open skies agreement with Germany much more likely in four years.[12]

While these major bilateral negotiations with Britain, Germany, and the Netherlands were in progress, a number of less extensive code-sharing proposals were approved. Table 3-3 below shows all code-sharing arrangements to date that have included U.S. carriers; however, many of these are now discontinued. The listing is longer than perhaps some might expect. The next section discusses the four most extensive international code-sharing alliances, and the following section covers some recent, prominent code-sharing proposals.

3.4 CURRENT MAJOR CODE-SHARING AGREEMENTS

This section discusses the three broad code-sharing agreements entered into by U.S. carriers: Northwest/KLM, USAir/BA, and United/Lufthansa. It also discusses Delta's code-share agreements with a number of European carriers.

3.4.1 Northwest/KLM

KLM invested $400 million in Northwest Airlines (NW) in 1989, injecting much-needed cash into the financially-troubled carrier. Despite this equity relationship, Northwest and KLM did not begin any joint marketing or code-sharing efforts until 1991 when KLM began flying daily flights on the Amsterdam-Minneapolis route. Northwest had a block-space and code-sharing agreement on these flights. Later KLM

[12] Mead Jennings and Mark Odell, "Lufthansa in Wolf Pact," Airline Business, November 1993, pg. 13.

Table 3-3

INTERNATIONAL CODE SHARING WITH U.S. AIRLINES

Airlines	Date Begun	Routes
American/Cathay Pacific	discontinued	Hong Kong- Los Angeles, San Francisco
Pan Am/Malev	discontinued	Hungary-New York-other U.S. cities
TWA/China Airlines	discontinued	Taiwan-Los Angeles, San Francisco, New York
USAir/Ladeco	discontinued	Baltimore-Montreal
American/Airbremen	discontinued	Brussels-Bremen
Continental/Ansett	discontinued	Auckland-Christchurch, Wellington
Northwest/Ansett	discontinued	Sydney-Melbourne, Brisbane
Pan Am/Adria	discontinued	Zagreb-Belgrade, Dubrovnik; Munich-Ljubljana
TWA/Gulf Air	discontinued	London-Gulf States
American/Air New Zealand	discontinued	Honolulu-Auckland
USAir/Cayman Airways	discontinued	Baltimore, Tampa-Grand Cayman
Air Florida/British Island	discontinued	Miami-London-European cities
Carnival/LAN Chile	?	Miami-New York
Hawaiian/Japan Airlines	?	Honolulu-Maui
USAir/All Nippon Airways	?	Washington-Orlando
American/Malev	?	Zurich-Budapest
TWA/Malev	?	Amsterdam-Budapest
Air L.A./Aeromexico	?	Los Angeles-Tijuana
Challenger Air Cargo/ Lufthansa	?	Frankfurt-Miami-Latin America
American/Qantas	1986	L.A.-Chicago, Washington, New York, Boston
Continental/SAS	pre-1988	suspended, 1992
United/British Airways	3/88 (disc.)	London-Chicago, Denver, Seattle
Delta/Singapore	1989	Singapore-Tokyo-Los Angeles-Dallas, New York
TWA/Philippines	7/89	New York-Los Angeles, San Francisco-Manila
Delta/Swissair	9/89	Zurich-New York, Atlanta, Cincinnati
USAir/Alitalia	5/90	Washington/Philadelphia-Boston-Rome
Delta/Aeroflot	1991	New York-Moscow
Midwest Express/Virgin	1992	via Boston to Milwaukee
United/British Midland	4/92	US-London-European cities

Airlines	Date Begun	Routes
America West/Aeromexico	6/92	Phoenix-Mexico City
United/Ansett	9/92	many routes in Australia
American/South African	11/92	New York-Johannesburg
Continental/Air Canada	4/93	Canada-Newark, Houston-other U.S. points
United/ALM Antillean	4/93	Miami-Curacao
USAir/British Airways	5/93	London-U.S. cities behind Pittsburgh, Charlotte, Baltimore, Philadelphia
American/British Midland	6/93	London-Amsterdam, Glasgow, Brussels
Carnival/Iberia	6/93	Spain-Miami-various U.S. cities
United/Transbrasil	7/93	US-Sao Paulo-Brasilia, Porto Alegre
United/Emirates	11/93	London-Dubai
American/Gulf Air	2/94	London-Abu Dhabi, Muscat, Doha, Bahrain
American/LOT Polish	5/94	
Delta/Malev	5/94	New York-Budapest (Malev aircraft)
United/Lufthansa	6/94	many routes
Delta/Aeromexico	6/94	many key routes
Delta/Austrian	7/94	New York-Vienna
Delta/Sabena	approved	US-Brussels (applied for extension to Germany)
Delta/TAP Air Portugal	approved 9/94	New York-Lisbon
Continental/Alitalia	approved 10/94	Newark-Rome
United/National Chile	10/94	Santiago-various Chilean cities
Northwest/Asiana	proposed	US-Korea
Delta/Varig	proposed	letter of intent signed
Delta/Virgin	proposed	on hold - no DOT approval or rejection
United/China Southern	proposed	still under study
United/Iberia	proposed	proposed to begin 7/94
United/Thai International	proposed	in planning stage
USAir/Qantas	proposed	Los Angeles-San Francisco; others

Sources: Airline Business, July 1994, Air Transport World, November 1993, and various other issues added an Amsterdam-Detroit route, thereby serving both of Northwest's hubs, and Northwest realigned its international route structure to take advantage of the alliance. As part of this restructuring, NW dropped seven European destinations, most of which were easily served via Amsterdam, and it added one flight from Boston to Amsterdam. As a result of these moves, traffic over these hubs had increased from 0 percent to 5.4 percent of all U.S. trans-Atlantic traffic by 1991.[13]

The critical point for the NW/KLM alliance was in 1992 when the U.S. and the Netherlands signed an open skies agreement. The agreement allowed for unlimited code sharing in the U.S. for Dutch airlines and vice versa. In addition, shortly after the agreement was signed, DOT granted anti-trust immunity to Northwest and KLM, allowing not only extensive code sharing but coordinated pricing as well.

Antitrust immunity makes the NW/KLM alliance much more comprehensive than any of the others. The two airlines not only code share to a large number of destinations, but they also cooperate in fares and promotions. Cooperation in fares gives NW/KLM a significant advantage because they can more effectively market many double-connect routes (e.g., behind Detroit to beyond Amsterdam). Prices on such routes are normally determined using IATA fare construction rules unless there is a specific pricing agreement between the carriers. There are so many of these double-connect markets that it would be burdensome to arrange a separate pricing agreement for each one. Only with antitrust immunity have the two carriers been able to establish a general pricing formula to set fares in double-connect markets.[14]

Northwest and KLM cooperate in other ways besides fare setting. For example, they attempt to provide identical in-flight service by having the same china, the same magazines, common frequent flier programs, and so on. The two carriers have a committee that evaluates every code-sharing route to ensure that it will achieve the same quality of service as online routes. Northwest and KLM maintain that they would never be interested in "naked" code sharing that did not include the other types of cooperation. They say they view code sharing as a key marketing tool by which the integrated service developed under their alliance is communicated to potential passengers.[15]

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[13]Martin Dresner, Sue Flicop, and Robert Windle, "Trans-Atlantic Alliances: A Preliminary Evaluation," University of Maryland, August 1994, pp. 9-10.

[14]Interview with Elliot Seiden of Northwest Airlines, July 18, 1994.

[15]Interview with Paul Misfud of KLM, June 21, 1994.

The NW/KLM alliance has been quite successful. Between 1989 and 1991, they increased their trans-Atlantic load factor from 67 percent to 76 percent, and their trans-Atlantic traffic increased by 28 percent.[16] Before the agreement, the two carriers had a combined 8 percent of the trans-Atlantic market, while today they have 12 percent.[17] Their lower fares have attracted 20 percent of the Germany-U.S. market.[18] Recently the two carriers have announced they will be moving from one to two flights daily on both the Amsterdam-Minneapolis and Amsterdam-Detroit routes. With load factors in the 90 percent range this past summer, extra capacity was needed.[19] KLM also will soon begin new service to Memphis, another Northwest hub.[20]

3.4.2 USAir/British Airways

No code-sharing alliance has generated as much controversy as the one between USAir and British Airways. As discussed above, the bilateral underpinning for this alliance was the 1991 agreement between the U.K. and the U.S. which gave British carriers broad code-sharing authority in the U.S. For a time, BA did not take advantage of these rights, as it searched for a U.S. partner. Then in July 1992, USAir and BA announced a very far-reaching deal. BA would invest $750 million in USAir, gaining 44 percent of USAir's equity and 21 percent of its voting stock. The airlines would coordinate operations and, eventually, merge into one brand name.[21]

This original proposal was so far-reaching that it predictably ignited a storm of controversy. U.S. airlines objected that BA would gain immense access to the U.S. market and effective control of a U.S. airline while U.S. access to the British market would remain very limited. It was reported that DOT planned to disapprove the deal on the grounds that it violated laws on foreign ownership of U.S. airlines, when at the last minute BA withdrew its proposal rather than face rejection of the agreement. A few weeks later, at the start of 1993, BA returned with a new $750 million, three-phase investment/cooperative arrangement. The first phase included an investment of $300 million for a 19.9 percent stake in USAir. This time BA went ahead and made the

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[16]Dresner, *op cit*., pp. 11-12.

[17]Misfud, *op. cit.*

[18]Seiden, *op. cit.*

[19]"Northwest, KLM to Double Service," Aviation Daily, October 4, 1994.

[20]"KLM, Northwest to Launch Memphis Service in June," Aviation Daily, December 2, 1994.

[21]"Clock is Running On DOT to Review BA/USAir Deal," Aviation Daily, July 31, 1992.

initial investment without waiting for any approval, since the new stake was less than the current 25 percent legal limit for foreign voting interest in a U.S. airline. [22] The agreement made provisions for BA to make further investments, subject to approval by DOT. The new agreement also deleted from the initial phase the common branding that had been proposed in the first deal.[23]

Although the initial phase of the new agreement complied with U.S. law and the terms of the bilateral code-sharing provision, it was still greeted with opposition from the major U.S. carriers. Nevertheless, DOT approved the agreement, but (together with DOJ which also reviewed the case) it attached the following conditions to the deal:

- BA's proposal to invest more money would be subject to approval by DOT;

- To promote competition, USAir had to divest its London route authorities from Charlotte, Baltimore, and Philadelphia to other U.S. airlines.

In conjunction with the agreement, BA upgraded its former one-stop service to Pittsburgh to non-stop, and introduced new non-stops to Baltimore and Charlotte. Combined with existing Philadelphia service, these new routes put BA into all of USAir's major hubs.[24]

The USAir/BA code-sharing agreement is different from the others in that BA puts its code on USAir flights but not the reverse. Because of this, BA is solely responsible for marketing the code-sharing service and both airlines sell seats out of a common USAir inventory (i.e. there is no blocked-space agreement). BA has indicated that it is very concerned with providing seamless service. For example, when the Metropolitan Washington Airports Authority would not let BA put its name on the signs outside USAir's terminal at Washington National Airport, BA decided not to code share on USAir's Washington National flights.[25]

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[22]Richard Whitaker and Mead Jennings, "BA and USAir Forge a New Deal," Airline Business, February 1993, pg. 20.

[23]"British Airways, USAir Jump Back Into the Fray with $300 Million Investment," Aviation Daily, January 22, 1993.

[24]Carole Shifrin, "USAir/BA Pact Faces New Fight," Aviation Week and Space Technology, February 1, 1993, pg. 29.

[25]Interview with Frank Cotter and others of USAir, July 7, 1994.

The USAir/BA code-sharing agreement's success has been mixed. USAir reportedly receives $30-$40 million in additional revenue, of which $17 million is payment for the wet leases.[26] This amount is small relative to USAir's recent large losses. However, BA estimates that it will gain incremental revenue of $112 million from the alliance, despite the fact that it will not receive dividends from USAir.[27] Because of USAir's financial problems, BA has put any further investments in USAir on hold for now. Recently, USAir announced that it will eliminate the B-767 from its fleet which will mark the end of BA's wet lease of these aircraft. BA plans to introduce its own aircraft on the former wet-leased routes.[28]

BA has attempted to expand beyond the current list of 104 U.S. cities through BA gateways into which it can code share, but DOT has not yet approved these requests. BA has also announced that it plans to increase frequencies on its London-Philadelphia flights. The new flights are aimed at providing better connections with USAir domestic flights. It is unlikely that the Philadelphia market could support two daily London flights by BA without the USAir/BA alliance. American Airlines also provides daily service in this market.

3.4.3 United/Lufthansa

In 1993 the bilateral relationship between the U.S. and Germany broke down, and Germany came very close to renouncing the bilateral agreement. Among other issues was Lufthansa's poor performance and its inability to compete effectively with U.S. carriers. Thus the bilateral negotiations that followed focused on a number of ways to help Lufthansa compete more effectively, including code sharing and Lufthansa's ability to enter into a code-sharing agreement with a U.S. carrier. Lufthansa explored potential relationships with both United and American, but waited until the bilateral negotiations were concluded before making its choice.[29]

In October 1993, United and Lufthansa signed an agreement establishing their alliance. This alliance differed from the others in that both airlines have a large

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[26]Mead Jennings, "Snowed Under," Airline Business, April 1994, pg. 29.

[27]Carole Shifrin, "British Airways Posts Record Profits," Aviation Week and Space Technology, November 14, 1994, pg. 26.

[28]"USAir, Pilots Deadlocked as Company Prepares to Scrap 767 Fleet," Aviation Daily, October 11, 1994.

[29]Jeffrey Lenorovitz, "Lufthansa to Choose U.S. Strategic Partner," Aviation Week and Space Technology, September 13, 1993, pg. 30.

presence in the North Atlantic market, and were direct competitors on some routes. Other U.S. airlines generally opposed the agreement, pointing out that USAir had been forced to divest itself of some routes before it could code share with BA and that perhaps United should as well. Delta was particularly frustrated because it had paid hundreds of millions of dollars for Pan Am's fifth freedom routes out of Frankfurt, and it believed United was getting similar access for virtually nothing.[30] The implementation of the United / Lufthansa agreement was delayed due to a bilateral dispute between Germany and the U.S. over whether the U.S.-German agreement covered all the types of code sharing proposed by United and Lufthansa. The dispute was settled when a more expansive agreement was signed by the U.S. and Germany in May 1994, and United and Lufthansa began code sharing in June 1994.

As the alliance began, 41 U.S. cities and eight German cities were subject to code sharing. Over the summer, many new U.S. cities were added to the code-sharing arrangement. The U.S. gateways over which these points are served are Washington, Chicago, and San Francisco, while the sole German gateway is Frankfurt, over which German points are served. All domestic flights are operated by the relevant domestic carrier. International flights are operated by Lufthansa except that United operates some of the flights from Chicago and Washington. (In an unusual twist, both United and Lufthansa fly these routes and they both code share on them.) The traditional alliance measures, such as common frequent-flier programs, common lounges, and coordinated schedules were already in place when code sharing began.[31] United and Lufthansa have plans in place for a major expansion of code sharing to more European and U.S. cities. So far the alliance appears to be quite successful. Lufthansa recently announced that its bookings over the summer increased by 300,000 passengers as a result of the alliance.[32] More recently, Lufthansa has announced that it will move to United's terminal at Chicago O'Hare airport, further cementing the alliance.[33]

3.4.4 Delta's Worldwide Partners

Delta Air Lines has never formed a broad code-sharing alliance with a major foreign airline, perhaps because its existing international network is so extensive. Instead, Delta has pursued alliances with a number of smaller airlines, filling in the gaps in this network. Recently Delta has decided to market its array of blocked-space,

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[30]Interview with Scott Yohe and John Maloney of Delta Airlines, September 22, 1994.

[31]"United, Lufthansa Launch Code Sharing Flights," Aviation Daily, June 2, 1994.

[32]"Fantastic Triumvirate," Air Transport World, November 1994, pg. 7.

[33]"Lufthansa Moving Chicago Operations to United Terminal," Aviation Daily, October 25, 1994.

code-sharing arrangements under one brand, called "Worldwide Partners." Delta emphasizes that the partnership offers consumers high quality service throughout the system and the convenience of "one-stop shopping" for air transport to many destinations. Currently the Worldwide partners include Swissair, Sabena, Varig, TAP Air Portugal, Malev, Aeromexico, Aeroflot, and Austrian Airlines.[34]

The largest of Delta's alliances is with Swissair, with which it began code sharing in January 1993. The Delta / Swissair agreement was initially confined to transatlantic flights only. Delta blocks space on Swissair flights to Zurich and Geneva from New York and from Zurich to Atlanta, while Swissair blocks space on a Cincinnati-Zurich flight that Delta began as part of the alliance.[35] The addition of this flight was one of the reasons the alliance was approved, and it was widely viewed that neither airline would have flown this route without the alliance.[36] Prior to the code-sharing part of the alliance, no new hub-to-hub flights were launched. Instead, Delta added a large amount of European service that competed with, rather than complemented, Swissair's service. In fact, the hub-to-hub share of the two airline's transatlantic traffic actually declined after the alliance was first signed.[37]

Delta's alliance with Sabena is also fairly well developed. Delta and Sabena code share on flights from Boston, New York, Chicago, and Atlanta to Brussels. Delta operates the Atlanta flights; the rest are operated by Sabena. Delta also puts its code on some Sabena flights beyond Brussels. The alliance with Sabena has been somewhat controversial because Sabena has received state aid in the past and because Delta already has many routes to European cities both over its own Frankfurt hub and via code sharing with Swissair.[38]

3.5 MAJOR RECENTLY-PROPOSED CODE-SHARING AGREEMENTS

This section reviews the issues surrounding two recent code-sharing agreements involving Delta / Virgin Atlantic and Continental / Alitalia.

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[34]"Delta," Aviation Daily, October 26, 1994.

[35]"Delta-Swissair Code Sharing Agreement," Aviation Daily, January 20, 1993.

[36]Joan Feldman, "Naughty or Nice," Air Transport World, June 1994, pg. 173.

[37]Dresner, *op. cit*., pp. 11-12.

[38]Pierre Sparaco, "Sabena, Delta Expand Joint Operations," Aviation Week and Space Technology, October 17, 1994, pg. 27.

3.5.1 Delta/Virgin Atlantic

In April 1994, Delta and Virgin Atlantic announced plans for a code-sharing agreement. Under the agreement, Delta would put its code on Virgin flights from London's Heathrow Airport to New York, Los Angeles, and San Francisco, and from London Gatwick to Miami, Orlando, and Boston. The deal would be highly advantageous to both carriers. Virgin would get a guaranteed $150 million per year from a blocked-space agreement with Delta, and for the first time, Delta would be able to offer online service to Heathrow, one of the airline's long-time objectives.[39] If the agreement were approved, Virgin would likely seek to expand service to more U.S. gateways, giving Delta even more Heathrow access.

Delta and Virgin asked that the agreement be approved quickly, but instead it ran afoul of the continuing bilateral negotiations between the U.S. and the U.K. over further revisions to Bermuda 2. Other U.S. carriers want to use approval of the Delta/Virgin alliance as leverage to get more access to the British market. Each of the major airlines has attempted to use the deal as a way to secure London route authorities for itself.[40] The code share received approval from the British government in May and was cleared by DOJ in June. However, DOT has linked approval of the proposal to liberalized access to the British market and is standing firm on that position.[41] In September DOT said that no approval or disapproval was likely soon because it did not want to increase "the imbalance of benefits facing UK interests." Delta objected to this policy since Delta would only block space on Virgin's flights, no new flights would be added by either airline, and no Delta flights would be transferred to Virgin. Virgin's code would not be added to any Delta U.S. domestic flights. As a result, Delta believes the agreement does not favor UK interests and thinks it is not comparable to the USAir/BA deal.[42] Other U.S. airlines counter that traffic would be diverted from their flights to the Delta/Virgin flights. They say this is unfair because their ability to compete is hampered by restricted access to Heathrow.

The most recent movement on the Delta/Virgin proposal was a new British initiative. In October 1994, the UK Department of Transport unilaterally opened up access to all British airports except Heathrow and Gatwick for U.S. carriers. The

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[39]Douglas Nelms, "Battling Giants," Air Transport World, June 1994, pg. 191.

[40]"Delta, Virgin Say Code Share Opponents Have Their Own Agendas," Aviation Daily, June 13, 1994.

[41]"Delta, Virgin Atlantic Postpone Code Sharing," Aviation Daily, June 13, 1994.

[42]Yohe and Maloney, *op. cit.*.

initiative included a proposal to liberalize both U.S. and British code-sharing policy. The initial reaction in the U.S. was negative. U.S. carriers and DOT noted that London access is of crucial importance and that British carriers continue to have a major advantage over U.S. carriers in that market. It now appears unlikely that the initiative will get the stalled talks moving again.[43]

3.5.2 Continental/Alitalia

In May 1994 Continental signed a pact with Alitalia. This agreement includes daily Alitalia service from Newark to Rome using an aircraft that is wet-leased from Continental. It also includes Alitalia code sharing on Continental flights from Newark to Houston, Detroit, San Francisco, and Cleveland. Plans are in the works for additional code-sharing flights from Newark to Milan and from Houston to Rome.[44] After the Continental/Alitalia announcement was made, the other U.S. international carriers made the same demands for the Italian market as they had for the British market in the Delta/Virgin proposal. They said that the Italians should liberalize their market before code sharing is approved.[45]

This proposal was on hold throughout the summer travel season. Then, on September 6, 1994, DOT announced that it planned to approve it. DOT said that although the Italian market remained restricted, the alliance is consistent with U.S. code-sharing policy and should further U.S. objectives by providing increased competition and consumer benefits. It also would increase service to Italy by a U.S. carrier at a New York gateway, an objective that had previously appeared impossible.[46] Other carriers questioned the approval immediately, noting that all new flights, both current and planned, are Alitalia flights. They did not, however, note that at least the first Alitalia flight is actually a wet-lease from Continental.[47]

[43]"UK Offers - And DOT Dismisses - Regional Airports for Transatlantic Flights," Aviation Daily, October 12, 1994.

[44]"Continental, Alitalia Sign Alliance Agreement," Aviation Daily, May 3, 1994.

[45]"United, American Want Alitalia/Continental Alliance Held Up," Aviation Daily, May 31, 1994.

[46]"Continental Alitalia Proposed Alliance Moves Forward," Aviation Daily, September 7, 1994.

[47]"Opponents See Policy Flaws in Continental/Alitalia Approval," Aviation Daily, September 22, 1994.

3.6 ISSUES RAISED BY CODE SHARING

3.6.1 Introduction

Because code sharing is a competitive tool involving an alliance between two airlines, it can have a profound effect on market structure and on the level of competition in markets. The advent of code sharing in international aviation, therefore, naturally provokes concern that such activity may be anti-competitive. Approval for such alliances, as for other industries and sectors of the economy, will depend on regulators' views of the net competitive effects of an agreement, and its implications for economic efficiency and the welfare of market participants.

Concern with the level of competition in aviation markets arises because of the welfare benefits that competitive markets can produce for the economy and consumers. The level of competition in a market is often gauged by such indicators as the number of competitors, evidence of price collusion, or the relationship between price and cost. However, changes in the level of competition are themselves useful as indicators of the potential effects of market changes on the underlying welfare of the market participants and on production efficiency.

A number of the pro-competitive and anti-competitive aspects of code sharing are briefly considered here, followed by an examination of the competitive implications of code sharing in international markets in which structural barriers to competition exist. The chapter concludes with a discussion of how code sharing affects the competitive marketing of aviation services.

The potential impact of code sharing on competition and, consequently, on passengers and air carriers is examined more fully in Chapter 5 for various market structure scenarios and types of code-sharing operations. In the model developed and applied in Chapters 5, 6 and 7, "economic welfare" is addressed directly and, in particular, the degree to which code sharing causes changes to consumer and producer surplus.

3.6.2 Competitive Effects of Code Sharing

Pro-competitive effects of code sharing include such benefits as cost and fare reductions, service improvements, and new route and market options. Anti-competitive effects may result from the foreclosing of route options and the concentration of market power in fewer market participants.

Pro-Competitive Potential of Code Sharing--Consumers will benefit if code sharing encourages carriers to offer a better service at the same fare or the same service at a lower fare. Coordination activities under code-sharing alliances may affect passengers directly by improving the flight attributes that consumers care about, such as the number of available flights, the ease of connections, total travel times, reliability of baggage handling, etc. Or they may do so indirectly by reducing the costs of already efficient interline service that is subsequently reflected in lower fares. Consumers may even benefit from code sharing on what is, by all other attributes, an interline flight if they can earn frequent flyer mileage credits on both segments rather than just one.

In markets where O& D demand is relatively thin and where it may not be profitable for any one carrier to offer online service, code sharing may allow consumers to enjoy the benefits of single-carrier service without either code-sharing partner needing to introduce any additional flights. Code sharing, by coordinating flights, may effectively create a route that did not previously exist, increasing consumers' choices.

As an example, consider a code-sharing arrangement for travel from A to B to C. Carrier 1 provides service on the international leg from A to B while Carrier 2 provides service on the domestic leg from B to C. It may be that, even with underlying route authority, there is too little demand for either carrier to offer online service from A to C. Furthermore, while Carrier 1 can profitably carry international traffic from A to B, demand is not sufficient to allow Carrier 2 to also enter that market. Finally, the B to C flight may make sense for Carrier 2 because point B is a hub in its domestic route network and C is one of its spoke destinations. In this example, code sharing allows "online" service to be provided in the A to C market even though it is not profitable for either carrier to do so individually. The only incremental costs incurred by the participating carriers are coordination costs because there are no additional flight costs. In this way, networks can provide online service in thousands of markets.

Code sharing can also have pro-competitive effects if it allows carriers to avoid bilateral restrictions. For example, Delta's alliance with Varig allowed it to market service to Brazil. Likewise, Continental can offer service to Rome through its alliance with Alitalia. These services would not have been offered without code sharing because of constraints in bilateral agreements.

Anti-Competitive Potential of Code Sharing--Anti-competitive behavior may arise in any market where the participants have market power. This may well be the case in many international markets where restrictive bilateral agreements thwart the competitive discipline that comes from either actual entry or the threat of entry. Anti-competitive behavior also could occur where infrastructure constraints are a barrier to entry. (See the following section.) It is important to recognize, however, that this potential for harm may exist independently of code sharing. Code sharing may or may not exacerbate the anti-competitive effects of bilateral restrictions on underlying route authorities that deny carriers entry to markets through true online service.

Thin markets may have anti-competitive potential as well as the pro-competitive potential described above. If the code-sharing partners are the only ones offering "online" service in thin markets, they may be able to utilize their market power to extract monopoly rents. In such situations, any agreement for code sharing or service coordination could reduce competition by allowing competitors to essentially engage in a market-sharing arrangement that restricts flight offers.[48] In practice, then, the overall net welfare impacts may depend significantly on the nature of existing competition in the city-pair market in question.

The potential for anti-competitive behavior is presumably somewhat less in more competitive, larger markets where more than one carrier offers comparable service. In such markets, the discipline imposed by competition may inhibit code-sharing partners from extracting supra-normal profits from their code-sharing flights. On the other hand, if the partners were the primary competitors prior to a code-sharing agreement, the overall impact on market welfare could be adversely affected.

U.S. Versus Foreign Competitive Impacts--What constitutes a beneficial code-sharing arrangement from a U.S. policy perspective may depend on who captures the benefits. A code-sharing agreement may be pro-competitive, but all of the benefits may accrue to foreign passengers and carriers. While it is unlikely that a code-sharing agreement that produces passenger benefits would only benefit foreign passengers, it is very possible that only a foreign carrier would benefit from a code-sharing alliance because the benefits to the U.S. partner may be more than offset by losses to other U.S. carriers.

Whether such code sharing should be allowed will likely depend on its net impact on U.S. passengers and carriers and competition in the code-sharing markets. Furthermore, U.S. government decision-makers will need to determine the weight to be given to U.S. interests versus the long-term desire for global open skies. Unfortunately, this issue has been clouded by some opponents of code sharing who presuppose that any transfer of traffic from U.S. to foreign carriers is necessarily undesirable, without any consideration of the possibility that such transfers may be pro-competitive on balance. To weigh these effects, DOT must be able to measure the impacts that code

[48]Except for the Northwest/KLM agreement, which has specific authority to coordinate fares, DOT has generally prohibited code share partners from discussing or agreeing on prices through a variety of "signalling" techniques.

sharing and other related coordination activities have on competition, market shares, and foreign and domestic consumer and producer-welfare. This is addressed by the model developed to measure the impacts of code sharing on U.S. airlines and U.S. consumers.

3.6.3 Infrastructure Barriers To Entry And Effective Competition

In many air transportation markets, the available aviation infrastructure is limited and various forms of rationing occur. Some carriers may obtain a competitive advantage, thereby, if they have rights to use the limited infrastructure. Code sharing may be pro-competitive if it allows carriers to circumvent these barriers to entry or expansion. On the other hand, code sharing may be anti-competitive if it allows a carrier to solidify its position behind such barriers. Key types of infrastructure barriers are airport landing and take-off slots, limited gate capacity, and restricted access to airport ground services.

Slots--Because of excess demand to use some airports, the available landing and take-off capacity is allocated by awarding landing and take-off rights. The right to land or take off at a particular time is usually called a landing slot or simply a "slot." Because the available slots are in short supply, slots are either allocated to carriers administratively by a government, or they are bought and sold by the airlines, often at very high prices. While few U.S. airports have slot constraints, many foreign airports do.[49] Therefore, procuring slots tends to be more of a problem for U.S. carriers that are trying to enlarge their international networks and enter foreign markets than it is for foreign carriers seeking to do the same in the U.S.[50] Code sharing can be a quick way around these problems. A U.S. carrier can team up with a foreign carrier that already has slots at an airport, thereby gaining the ability to serve that airport. The result is that an additional carrier is added to the market without any new flights.

Gate Capacity--Even when U.S. airlines can fly into an airport, they may have difficulties in securing gates and terminal space. Sometimes U.S. airlines are relegated to older terminals while national carriers enjoy brand new ones. This was the case for

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[49]Historically the U.S. has guaranteed the availability of slots to foreign carriers at airports governed by the High Density Rule.

[50]Michael F. Pustay, "Toward a Global Airline Industry: Prospects and Impediments," The Logistics and Transportation Review, vol. 28, no. 1, March 1992, pg. 118.

some time at Tokyo's Narita airport.[51] As with slots, code sharing can get around this problem by allowing U.S. carriers access to the facilities of their foreign code-sharing partners. Again, this advantage could be used anti-competitively if it helped an alliance solidify its position keep out competition.

Access to Ground Services--Another barrier to entry is how ground services are provided at some foreign airports. Many foreign airports will not allow U.S. carriers to employ their own baggage handlers, caterers, and so forth. Instead the airport authority or the national airline has a monopoly on such operations. The result is that U.S. carriers pay very high prices for ground services.[52] Once again, code sharing may avoid this problem, particularly if the code sharing is with a national carrier that has a monopoly on ground services.

3.6.4 Competitive Implications of State-Owned Carriers

Many countries maintain a state-owned carrier, usually because their markets are (or, at least, initially were) too small to support a private airline. In some cases, such as Singapore Airlines, the national airline is a successful profit-maker, but in many other instances it loses money. Small countries that subsidize their airlines do not necessarily act irrationally. A national airline can guarantee links with the rest of the world in times of crisis. For example, national airlines were very important to the Persian Gulf states in the Gulf War. National airlines can also serve as tourism marketing tools and can facilitate technology transfer to developing countries.[53]

Although subsidizing national carriers may be economically rational, there are special concerns when a subsidized, state-owned foreign carrier seeks to expand its network via code sharing with a U.S. carrier. The major concern is that such carriers may be insulated from market forces, and that, therefore, the most efficient carrier may not provide the jointly marketed service. For example, the foreign carrier may do most of the long-haul flying even though it has a cost disadvantage. This may adversely affect fare levels and efficiency incentives in the market, and employment opportunities for U.S. workers.

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[51]Mead, Kenneth M., "International Aviation: New Competitive Conditions Require Changes in DOT Strategy," General Accounting Office, Testimony before the House Subcommittee on Aviation, May 5, 1994, pp. 9-10.

[52]Mead, *op cit*, pg. 10.

[53]International Air Transport: The Challenges Ahead, Paris: OECD, 1993, pp. 61-63.

Code sharing can be a potent competitive tool that has the potential to help U.S. airlines avoid barriers to market entry, but it also has the potential to reinforce those barriers. Much depends on the nature of the competition between the code-sharing partners prior to the code-sharing agreement, and to the number of competitors and the vitality of their competition after code-sharing. How code sharing is marketed to travel agents and consumers may also affect the ability of non-code-sharing airlines to compete and of consumers to secure the services they desire. These marketing issues are examined below.

3.7 CRS SCREEN EFFECTS

Opponents of code sharing say that there are several marketing distortions associated with the listing of code-sharing flights in airline computer reservations systems (CRSs). CRS issues, in fact, appear to be the crux of many critics' complaints about DOT approval of code-sharing agreements. These distortions are classified here as either screen effects, that is, related to how flights are displayed in CRSs, or as marketing biases, related to how code-sharing flights are marketed to and perceived by passengers.

3.7.1 Computer Reservation Systems

Computer reservations systems are integral to the distribution of flight information and sale of air transportation to passengers. These systems are used by travel agents to book passengers on flights, and because travel agents write over 70% of all airline tickets, the CRSs are very important to the airlines' marketing strategies.[54]

CRS systems consist of computer terminals in travel agencies on which all available flights are displayed. When a passenger requests a flight for a particular city-pair and at a desired departure time, the travel agent can call up on the display screen all of the flights that meet the passenger's needs. To display all of the flight options near the requested departure time may require more space than is available on the screen at one time, and, therefore, require the agent to scroll down to second and third screens of information. Because studies have shown that travel agents tend to

[54]Daniel M. Kaspar, Deregulation and Globalization: Liberalizing International Trade in Air Services, Cambridge, MA: American Enterprise Institute/Ballinger, 1988., pg. 34.

suggest flights from the first screen, the order in which flights are displayed is likely to affect their probability of selection by the passenger.[55]

3.7.2 Treatment Of CRS Operations

Internationally, ICAO has established a "Code of Conduct" for the regulation and operation of CRSs.[56] The key clause regarding code-sharing is one that requires CRS vendors to design their display algorithm to "ensure that no carrier obtains an unfair advantage through misrepresentation of services." A literature search found no signs that any CRS vendor has been challenged on this basis, which seems to imply that the asterisk most CRSs use to indicate code-sharing flights is adequate to avoid charges of "misrepresentation."

ICAO's discussion of its Code of Conduct acknowledges that code-sharing connections vary. They can resemble either online connections (especially if the carrier owns its code-sharing partner) or interline ones. The member states are unable to agree on whether code sharing engenders misrepresentation, so ICAO cannot develop specific guidelines for a worldwide code.

Domestically, DOT regulates the use of CRSs. Regulations require that "systems shall not use any factors directly or indirectly relating to carrier identity in constructing the display of connecting flights in an integrated display."[57] This clause appears to have been designed to prevent carrier-specific display bias; however, its wording appears to have implications for how code-sharing is handled. CRSs are prohibited from discriminating (by display bias or any other means) against any carrier on the basis of whether that carrier code shares.

Discussion of code sharing in the Federal Register acknowledges that "code-sharing arrangements often provide for a better linking of flights between the code-sharing partners and for better coordinated services that result in travelers receiving improved service."[58] DOT also mentions a potential display bias that other sources did

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[55]Clinton Oster and Don Pickrell, "Marketing Alliances and Competitive Strategy in the Airline Industry," The Logistics and Transportation Review, vol. 22, 1986, pg. 376.

[56]Policy and Guidance Material on the Regulation of International Air Transport, International Civil Aviation Organization, 1992, pp. 31-34.

[57]14 C.F.R. § 255.4 (c).

[58]Computer Reservation System Regulations, 57 FR 43780, September 22, 1992.

not -- specifically, the fact that code sharing is sometimes used to "pad" displays by listing a single routing several times under different combinations of carrier codes. However, DOT declined to take action against this usage.

3.7.3 Screen Effects From Display Algorithms' Preference For Online Flights

At one time, the most important source of advantage for code-sharing carriers was CRSs' display preference for online routings. Online and code-sharing routings were listed ahead of interline connections, and thus, a code-sharing service could take precedence over an interline service. In the late 1980's, United's Apollo CRS treated all code-sharing flights as online connections. American's Sabre used a penalty point system, with 60 points for an online connection and 90 for an interline, while TWA / Northwest's PARS also used points, with 30 for online and 120 for interline.[59] More recently, Sabre and Apollo have eliminated online preference for international services, and in the European Union, regulations have been adopted by the European Commission that force CRSs to rank flights by objective criteria and to treat all connecting services, including code-sharing flights, in the same display category.

3.7.4 Screen Clutter

A somewhat related complaint is based on the idea that code-sharing flight offers may show up two or even three times as separate listings on CRS displays: once as an interline flight and twice more as offers of each of the code-sharing partners. Code sharing, therefore, may retain an advantage over interline connections on CRSs even with neutral display algorithms. The multiple listings of the same flight option create "screen clutter" that forces other flight alternatives off the first CRS display screen and makes it more likely that a travel agent will pick one of the code-sharing flights rather than competing services. Several airlines have urged DOT to limit the number of CRS listings for a code-sharing flight to two or even one listing.

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[59] U.S. Department of Transportation, Study of Airline Computer Reservation Systems, DOT-P-37-88-2, 1988.

3.8 MARKETING EFFECTS

Some critics have argued that code sharing simply allows interline service to be marketed misleadingly as online service. Consumers may think they are purchasing a true online ticket, but in fact are being systematically misled by sellers (travel agents and the airlines themselves) who fail to reveal what is being purchased.

There are two different aspects to this type of marketing bias that may occur with code sharing. First, passengers may unwittingly select a code-sharing flight believing that it is online service and not be aware that the flight will require an inter-carrier connection. Second, passengers may knowingly select a code-sharing flight, but be mistaken in their belief that the code-sharing partners will provide service equivalent to, or perhaps even superior to, alternative single-carrier service.

In the first case, it is possible that airlines may be able to deceive passengers in the short run, but they are unlikely to do so in the long run. If, in fact, this marketing bias exists, passengers presumably will discover the interline nature of the code-sharing service during their first trip. One would expect, therefore, that on future trips, passengers will ask the travel agent or airline whether the flight involves code sharing or not, and will choose accordingly.[60]

In addition, DOT already has a long-standing policy statement that requires carriers to give passengers reasonable notice of the existence of code-sharing arrangements. This policy statement was adopted in 1985 in the context of domestic code sharing. The policy statement requires: (1) the specific identification of code-sharing flights in written or electronic schedule information provided to the public; (2) notice of code sharing in any direct oral communication with a consumer; and (3) frequent notice in advertising media that conveys to potential customers the existence of a code-sharing relationship between carriers. DOT has recently released a draft rule to further ensure the disclosure of code-sharing services. Among the provisions of this proposed rule are written as well as oral notification. The draft rule also announced that DOT was considering the requirement of printed notification on the tickets themselves.[61]

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[60]Empirical support for this proposition is provided by the 1993 *Air Travel Survey* produced for the Air Transport Association, which found that 8 percent of travelers accounted for 44 percent of all air trips.

[61]"Code-Share Carriers Recommend Moderating Disclosure Rule," Aviation Daily, November 14, 1994.

In the second case, that is, failure to provide single-line service quality, the benefits accruing to the code-sharing carriers are not likely to be sustainable either. The effect of the divergence between passengers' expectations and the service actually provided could produce a number of outcomes, few of which are beneficial to the code-sharing partners. Some passengers may avoid future code-sharing flights altogether, regarding the risk of poor service to outweigh the potential benefits. Others may continue trying code-sharing flights to learn which alliances provide the desired service, but these passengers are unlikely to give carriers more than a few chances to prove the value of these partnerships. Passengers may find the information gathering process to be costly for determining the true attributes of the flight options they face because each code-sharing alliance incorporates different service coordination activities and because the level of carrier commitment to service quality may fluctuate over time. Delta Airlines appears to have recognized this problem, and has begun an active campaign to inform passengers of the nature of its code-sharing services and the benefits they provide.

CHAPTER 4: CURRENT VIEWS TOWARD CODE SHARING

4.1 INTRODUCTION

Code sharing has generated a great deal of discussion and controversy among airlines, government, and others interested in air transport. In order to understand the effects of code sharing better, it is essential to address the various opinions that are put forth by these parties. This section examines airline views both for and against code sharing, labor's attitude toward code sharing, and the policy toward code sharing of the Departments of Defense, Justice, and Transportation.

4.2 AIRLINE ARGUMENTS FOR CODE SHARING

Airlines that engage in code sharing argue that there are a number of positive effects from the practice, and they cite both the long-term and short-term goals of airline alliances and code sharing discussed in the previous chapter. Airlines claim that code sharing is essential for their participation in large international networks. They say that code sharing allows them to enter new markets and to compete more effectively in existing markets. They also claim that code sharing will reduce their costs and thus consumers will benefit from lower prices as well as an enhancement of service. In addition, they note that code sharing rationalizes capacity on trans-Atlantic routes. Finally, they say that they need code sharing as a way to appropriate the benefits of forming alliances. The following presentation of carrier views concerning code sharing reflects positions expressed during a series of carrier interviews.

4.2.1 Creation of Large Networks

Airlines view code sharing as their best avenue to participate in the creation of large, integrated networks. Lufthansa, for example, noted that there is a "tendency of airlines to form associations," and that if Lufthansa were left out of all associations, its future viability would be endangered.[1]

Northwest and KLM have gone furthest toward creating a large, integrated network, and they are especially enthusiastic proponents of the network concept. Northwest believes the "synergies" of such networks are "indisputable," and KLM noted that code sharing is all about "extending the network."[2] Northwest and KLM have been able to use their antitrust immunity to take fullest advantage of their international network.

4.2.2 Entry Into New Markets

Airlines often feel that they must enter new markets to grow and survive in a competitive marketplace. In some cases they need code sharing to surmount regulatory obstacles to expansion. For example, Delta states that it needs an alliance with Virgin because it must have "the ability to sell Delta seats in the London Heathrow market, or it will be at a significant competitive disadvantage versus other transatlantic carriers."[3] Other carriers note that code sharing allows them to enter relatively obscure double-connect markets. Northwest noted, for example, that the Omaha-Cairo market was largely untapped, but that by reducing price and offering "online" service they could stimulate considerable demand in it.[4] For some airlines, the promotional reach may be more important. United noted that its code-sharing Chicago-Frankfurt-Nairobi service was similar in quality to the previous interline service. However, having a desk in Nairobi and having Nairobi in the frequent flier literature was important in establishing an international presence.[5]

4.2.3 Increase in Market Share

Airlines also stated that code sharing allows them to increase their market share. However, domestic airlines typically claim that they take share from foreign carriers, while foreign airlines claim that they primarily compete with each other. Delta feels

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[1]Interview with Fred Reid of Lufthansa, October 12, 1994.

[2]Interviews with Elliot Seiden of Northwest Airlines, July 18, 1994 and Paul Misfud of KLM, June 21, 1994.

[3]Interview with Scott Yohe and John Maloney of Delta Airlines, September 22, 1994.

[4]Seiden, *op. cit.*

[5]Interview with Cyril Murphy and Michael Whitaker of United Airlines, October 13, 1994.

that its alliance with Swissair diverts double-connect traffic from more typical transatlantic routings such as New York-London to its Cincinnati-Zurich service.[6] Northwest says that its alliance with KLM has captured a considerable part of the Germany-U.S. market. Some of these travelers take code-sharing flights from Germany to Amsterdam, but others are willing to drive into the Netherlands to take advantage of NW/KLM's lower fares.[7] Another European airline noted that moving to its code-sharing partner's U.S. hub allowed it to capture more origination and destination (O&D) traffic as well as greater feed, and thus increase its market share.

4.2.4 Reducing Costs

Many carriers say that code sharing results in economies of scope and density. Economies of scope occur when serving more markets does not require a proportionate increase in inputs. Economies of density occur when increased traffic on an existing route does not require a proportionate increase in inputs. For example, Northwest noted that baggage handling and check-in desks at many smaller airports have extra capacity that can be used by a larger operation. By combining operations, fewer staff using less equipment can perform the same amount of work as before the alliance.[8]

KLM noted that code sharing has the effect of reducing overcapacity on transatlantic routes.[9] Many airlines may actually consider rationalization of capacity as the most important reason for code sharing; certainly it seems to explain why KLM supports liberal code sharing authority for its European competitors. Until recently the North Atlantic routes were flown by major U.S. airlines, major European airlines, and also the smaller flag carriers of many European nations. Too many airplanes were crossing the ocean each week with empty seats, and carriers were losing money. Code sharing allows smaller carriers to continue offering transatlantic service without actually flying so many planes. It also allows previous competitors, such as United and Lufthansa, to consolidate into fewer flights. While this trend may or may not benefit the public, it is sure to increase load factors and thus should benefit the airlines.

The code-sharing airlines claim that these cost-reductions result in lower fares. Northwest and KLM, in particular, are fond of saying that their cooperative efforts and

[6]Yohe and Maloney, *op. cit.*

[7]Seiden, *op. cit.*

[8]Seiden, *op. cit.*

[9]Misfud, *op. cit.*

the reduction of transaction costs in fare setting have led to lower fares. In turn, they say they have stimulated a great deal of new traffic from passengers who previously could not have afforded to fly.[10] In a similar vein, United claims that it has stimulated U.S.-Africa traffic by reducing the difficulties involved in making interline connections.[11]

4.2.5 Capturing Benefits of Alliances

Most airlines acknowledge that the advantages of code sharing cited here can occur without code sharing. For example, airlines could share baggage handling, coordinate schedules, and operate joint offices even if they did not code share. However, British Airways summed up the airlines' position by saying that code sharing is the “wrapping on the product” offered by an alliance.[12] Airlines believe that the only way they can appropriate to themselves the benefits of an alliance is through code sharing. Otherwise travel agents and the general public would not be aware of how much an alliance product differs from a traditional interline arrangement.

The preceding discussion clearly indicates that airlines currently engaged in code sharing view it positively and as a source of cost saving and revenue enhancement. Every code-sharing airline can put forward a great number of legal and economic arguments in favor of code sharing. However, as the next section shows, if the code-sharing proposal involves other carriers, these same airlines can advance many reasons why it should not be allowed.

4.3 AIRLINE ARGUMENTS AGAINST CODE SHARING

Each of the major code-sharing agreements has caused a storm of controversy. The critics of each code-sharing proposal are nevertheless the same airlines that have their own code-sharing alliances. Just as airlines find many reasons to support their own code-sharing proposals, they find many reasons to oppose the proposals of their competitors. The one exception is American Airlines which has been a steadfast opponent of code sharing (though even American participates in limited code-share agreements).

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[10] Seiden, *op. cit.* and Misfud, *op. cit.*

[11] Murphy and Whitaker, *op. cit.*

[12] Interview with Mark Dunkerly and Dick Eberhart of British Airways, June 20, 1994.

Criticisms of code sharing mainly fall into two broad categories: 1) code sharing is anti-competitive, and 2) the U.S. gives away too much in bilateral negotiations. American Airlines and non-airline critics furthermore complain that code sharing is simply a practice that deceives the air travel consumer.

4.3.1 Potential Anti-Competitive Effects of Code Sharing

Opponents believe there are a number of ways in which code sharing can be anti-competitive.

International Networks-- On a worldwide scale, international airline alliances might try to dominate the market and drive out any non-aligned carriers. This seems to be American Airlines' worry. American notes that the three big alliances, when fully extended to all possible destinations, can serve five times more city pair markets than American and its few small partners have authority to serve.[13] If online preference is strong enough -- and if code-sharing service can be made equivalent to online service -- this disparity could lead to American losing market share in international markets.

Individual Markets--Code sharing could also be anti-competitive in individual markets. An alliance of two major carriers in a market could deter new entrants because the combined power of the two large airlines may be too much to compete with. Furthermore, the existing level of competition could be reduced if code sharing were allowed between two carriers that previously were competing in a market. Delta opposed the United/Lufthansa linkup for this reason. Delta felt that United and Lufthansa were major North Atlantic competitors and that they would enjoy monopoly power on some routes. In particular, Delta (and many other observers) found it difficult to understand why United and Lufthansa were permitted to continue flying the same routes from Chicago and Washington to Frankfurt.[14] A similar problem arose in the BA/USAir case, but there entry was restricted by the bilateral agreement between the U.S. and the U.K. USAir gave up some of its route authority in the agreement with BA, apparently to avoid antitrust problems.

Antitrust--Antitrust is another consideration when carriers seek to combine networks via code sharing. At present, both DOT and the Department of Justice review code-sharing agreements to gauge whether they may lead to anti-competitive outcomes. This is a consideration when the code-sharing carriers control a large part of the traffic in markets affected by their agreement. In some cases, one of the partners

[13] Interview with Jeffrey Campbell and others of American Airlines, June 9, 1994.

[14] Yohe and Maloney, *op. cit.*

has divested certain operations to avoid antitrust objections. For example, USAir undertook such divestiture before it sought approval for its agreement to code share with British Airways.

Delta has stated that it objects to the antitrust immunity that has been given to NW/KLM but to no other alliance. Delta feels that the immunity gives NW/KLM an unfair advantage and that antitrust immunity should either be available to all alliances or to none.[15] Northwest and KLM agree with Delta and have publicly stated that they would favor an expansion of antitrust immunity to other alliances.[16]

4.3.2 Bilateral Give-Away

The other common objection to code sharing is that it is a bilateral give-away. Many observers believe that code-sharing approvals should be used as leverage for lowering barriers to U.S. carriers' access to foreign markets.

Reciprocity--American Airlines believes there can never be an effective reciprocity of rights with international code sharing.[17] When the U.S. gives a carrier code-sharing rights, it gives access to half the world’s aviation market. When a European country gives code-sharing rights, it gives access to a small market and nothing more. U.S. airlines then have to seek additional authority for either direct or code-sharing access beyond the European country. American asserts that this fundamental asymmetry colors all code-sharing agreements involving U.S. airlines. Carriers consequently believe that new code-sharing approvals should be accompanied by concessions from the foreign country. For example, Northwest believes that the Delta/Virgin proposal should not be approved until the U.K. gives U.S. carriers more access to its markets.[18]

Infrastructure--Infrastructure availability can be used to limit the access of U.S. carriers to overseas markets; this is the stated reason that additional U.S. carriers are not allowed to operate at London's Heathrow Airport.[19] Other countries, which have restrictive bilateral agreements, also seek to limit the access of U.S. carriers. DOT may

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[15]Yohe and Maloney, *op. cit.*

[16]Misfud, *op. cit.*

[17]Campbell, *op. cit.*

[18]Seiden, *op. cit.*

[19]The U.S. DOT argues that there is sufficient capacity to allow increased access by U.S. carriers.

want to continue to weigh the opportunity provided to the U.S. in relation to what is granted to foreign carriers. Additional access to overseas markets can be important to the U.S. because its carriers are cost-efficient and should do well in a more open environment.

It may also be instructive to look at the prior positions of the carriers that have established broad-based code-sharing agreements. In most existing cases (e.g., BA-USAir and KLM-Northwest), the foreign carrier already had a much larger share of transatlantic long-haul flying prior to the agreement. If a U.S. carrier with a large transatlantic presence enters into a code share with a smaller European carrier, it could be expected that the U.S. carrier would emerge with most of the long-haul flying.

4.3.3 Deception

Airlines that participate in code sharing do not criticize the existence of code sharing, only its application in particular markets and circumstances. However, American and non-airline critics point out that code sharing, by its nature, can have deceptive qualities.

CRS Screen Clutter--American feels that an important motivation for code sharing is obtaining multiple listings for the same flight on CRS displays. Screen clutter with code sharing has become an issue because carriers seek to show all possible combinations of online, interline and code-sharing flight offers in computer reservation systems. As discussed in Chapter 3, the number of lines taken to represent a single service offer multiplies rapidly with a multi-segment code-sharing flight. For example, a code share involving a double connection (from behind a U.S. gateway to behind a foreign gateway) can be shown up to eight times on the CRS screen. Because a single CRS screen only displays up to six flight offers, some argue that code sharing has the effect of cluttering up CRS screens. If, as some assert, travel agents book most flights from the first screen, other travel choices may not be considered if code sharing causes them to be moved to subsequent CRS screens. DOT could address the issue of code sharing effects on CRS displays as part of its review of CRS policies and practices.[20]

Deceptive Marketing--Some have argued that code sharing can be a form of deception for air travel consumers. This occurs when the consumer believes that the flight is on one airline when the service is really on a different carrier. DOT recently announced that travel agents and airlines will be required to improve disclosure for code-sharing flights. While continued DOT oversight may be required in this area,

[20]The European Union has established regulations which limit the CRS displays in Europe to two listings for a single flight offer.

there appear to be ample means available to protect consumer interests. In addition, carriers may have incentives to avoid deceptive practices because of their negative effects on customer loyalty.

British Airways (BA) has recognized this problem in its decision not to code share out of Washington National Airport. Because BA planes do not fly into National, airport authorities would not permit BA to put its own signs on the roadways outside the terminal building. BA feared that passengers would drive up with BA tickets and not understand that they should find the USAir gates. Still, the potential does exist for consumers to be unpleasantly surprised and inconvenienced if they do not fully understand the code-sharing concept.

The bottom line with opponents of code sharing is that airlines will oppose the agreements of their competitors. Even American, which appears consistent in some respects, has courted major code-sharing partners in the past. It remains very difficult to sort out true concerns from competitive posturing in debates over code sharing.

4.4 AIRPORTS' VIEW OF CODE SHARING

An interview with the Airports Council International was conducted to determine how airports view code sharing.[21] The Council indicated that airports are examining three issues with regard to code sharing: whether code sharing is a substitute for new service, whether new route authority is held up because code-sharing issues slow down bilateral negotiations, and whether code-sharing airlines should receive terminal signs even though they do not directly serve an airport.

Airports expressed concern that airlines will offer code-sharing service through their partners rather than offering new service at an airport. In most cases this possibility is unlikely since airlines would already offer service if it was both profitable and allowed under existing bilateral agreements. However, code sharing does offer airlines the potential to achieve economies of density. Such economies might be obtained by one code-sharing partner flying larger aircraft in a market rather than both airlines offering service.

Code-sharing agreements often result in increased service at the hubs of the code-sharing partners. Airports that are the hubs of other airlines do not receive any benefit. The result is that airports react to code-share proposals in the same way as

[21] Interview with Marty Parrella and others of Airports Council International, October 12, 1994.

airlines -- they favor code-sharing by their own hubbing airlines but see little advantage in other proposals.

A related airport concern is that bilateral negotiations may become bogged down in controversy over code sharing. Airports would prefer that bilateral negotiations result in expanded route authority. They view code sharing as a distraction from the "hard" rights that allow new routes to be flown.

Code sharing also presents airports with problems concerning signage. In many cases code-sharing airlines ask that their names be placed on signs outside an airport terminal even though they do not fly their own planes into the airport. For example, at Washington National Airport British Airways requested a sign on the terminal because it wanted to market code-sharing service with its partner USAir. BA felt that signs were necessary to guide ticket holders to the proper gates.[22] The airport disagreed, reasoning that it would be misrepresentation to erect a BA sign even though BA does not fly to Washington National. Both sides believed that their position prevented consumer deception, making it difficult to reconcile their differences.

4.5 LABOR'S VIEW OF CODE SHARING

U.S. airline labor unions are concerned about code sharing. They are concerned that code shares may lead to a reduction in flying by U.S. carriers with negative effects on airline employees. In an interview, the Airline Pilots Association (ALPA) indicated that its greatest concern is the potential of code sharing to replace fifth freedom operations by U.S. carriers, primarily in Europe.[23] ALPA is concerned that the amount of U.S. fifth freedom activity in Europe is declining, in part because European feed can now be obtained from code-sharing partners. If this traffic declines there would be fewer employment opportunities for U.S. flight crews.

A much larger source of employment for pilots are the international gateway-to-gateway routes. If foreign code-sharing partners begin serving these routes instead of domestic carriers, the impact on U.S. labor could be more severe. ALPA, however, has not done significant study of this possibility.

Labor has been concerned that U.S. government contracts go only to U.S. airlines. Currently the government will not book flights on foreign airlines when there

[22] Interview with Frank Cotter and others of USAir, July 7, 1994.

[23] Interview with Harry Hoaglander and Lynne Hyatt of ALPA, October 19, 1994.

is a U.S. airline alternative. However, it does not distinguish between flights actually operated by U.S. airlines and those operated by foreign code-sharing partners. The AFL-CIO has recently urged the government to begin making this differentiation.[24]

4.6 DOD'S VIEW OF CODE SHARING

The Department of Defense (DOD) maintains a Civil Reserve Air Fleet (CRAF) that consists of commercial airline aircraft. The CRAF is used to transport military personnel and cargo in times of crisis. DOD is concerned that code sharing might affect the U.S. wide-body airliner fleet. If code-sharing agreements shifted long-haul flying to foreign carriers, U.S. airlines would buy fewer wide-body aircraft and would train fewer pilots to fly them. This reduction in capacity could adversely affect the CRAF.[25]

For the time being, the net effect of code sharing on the CRAF seems to have been neutral. In fact, it is possible that code sharing has allowed some U.S. airlines to stay in business when they might have otherwise failed. The issue will continue to be important to DOD in the future.

4.7 DOJ’S EVALUATION OF CODE SHARING

The Department of Justice (DOJ) took over responsibility for approving airline mergers from DOT in 1989. That shift meant air transport is now subject to the same merger and antitrust regulation as other industries, rather than being subject to special regulation by DOT. The Department of Transportation retains the right to challenge any merger that is approved by DOJ, though, in practice such a challenge is unlikely. Although DOT has the final authority to approve or disapprove a code-sharing agreement, DOJ also reviews code-sharing proposals for potential antitrust violations. However, unlike other industry sectors, DOT has the power to grant antitrust immunity in international aviation agreements.

4.7.1 The DOJ Merger Guidelines

[24]"Labor Objects to Government Travel on Foreign Code-Share Flights," Aviation Daily, October 24, 1994.

[25]Department of Defense interview, September 29, 1994.

When DOJ evaluates a proposed merger, it follows a set of guidelines published in 1992.[26] A 1994 addition to the guidelines specifically addresses mergers involving international companies.[27] DOJ also follows these guidelines when it begins evaluating a joint venture such as a code-sharing agreement. The guidelines begin the evaluation process with market definition and measurement of market concentration, and then move on to defenses of the merger.

Market definition is probably the most important step, particularly for a transportation company. DOJ seeks to find the relevant market or markets in which the merging firms do business. It first finds the products that make up the market and then determines the market's geographical area. For airlines these steps would often be one and the same.

The all-important question that defines a market is, "Would a single seller of this product in this location be able to sustain an increase in price?" If the single seller (a monopolist) could sustain a higher price, then the product and location qualify as a market. As an example, suppose the proposed market is air travel between Philadelphia and London. DOJ would determine what would happen if just one airline served this market. Perhaps the airline would not be able to raise prices because of competitors serving the New York-London route. In that case DOJ would widen the market definition to include air travel between Philadelphia or New York and London. If a single airline serving both these city-pairs could sustain a price increase, DOJ would define this as the relevant market. Note that the market includes foreign as well as domestic firms.

Once DOJ has found a market, it measures concentration within it. DOJ uses the Herfindahl-Hirschman Index (HHI) to interpret market share data. The HHI is the sum of squared market shares of every company in a market. DOJ defines markets with an HHI of less than 1,000 as unconcentrated. HHI's between 1,000 and 1,800 define moderate concentration, and markets with an HHI above 1,800 are considered highly concentrated. DOJ is likely to challenge mergers that raise the HHI by at least 100 points in moderately concentrated markets or by at least 50 points in highly

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[26] Horizontal Merger Guidelines, U.S. Department of Justice and Federal Trade Commission, April 2, 1992.

[27] "Antitrust Enforcement Guidelines for International Operations," U.S. Department of Justice, 1994.

concentrated markets. In 1992 US airlines had a national HHI of 1,246, but the hub-and-spoke system put the average HHI of US airports at 4,007.[28]

The DOJ guidelines make clear that the HHI is to be used along with more subjective measures of market concentration. The HHI limits are not to be interpreted as a "bright line." For example DOJ will treat a market with an HHI of 1,750 approximately the same as a market with an HHI of 1,850. Table 4-1 shows the other criteria DOJ uses in determining market concentration.

Firms can offer arguments in defense of their mergers. For example, two firms can show that one or both of them would fail without the merger. For this defense to be successful, the failing firm must show that it could not successfully complete a Chapter 11 reorganization and that it has no other willing buyer. Alternatively, the firms can show that the efficiencies resulting from the merger outweigh the anti-competitive effects. Efficiencies might include economies of scope or density. However, the firms must show that the efficiencies could only be gained if the merger took place.

DOJ views its guidelines as an analytical framework for examining all antitrust issues. Even though international airline code sharing cannot, by law, lead to a merger, DOJ approaches code-sharing agreements from the same perspective as a merger. If it determines that a code-sharing proposal would cause anti-competitive effects, it may place conditions on the code sharing or prohibit it altogether.

Table 4-1

DOJ CRITERIA FOR DETERMINING MARKET CONCENTRATION

Criterion	Description
Firm Finances	Unhealthy firms may have less oligopoly power.
Barriers to Foreigners	Foreign firms will not have oligopoly power if limited by quotas.
Ease of Entry	In contestable markets, concentration may not be a problem.
Nature of the Product	Product-specific considerations must be taken into account.
Homogeneity	If the product is undifferentiated, cartelization is easier.
Substitutes	If no good substitutes exist, concentration is more of a problem.
Merging Firms	If merging firms are similar, a merger is more anti-competitive.
Buyer Market	If terms of sale are public knowledge, cartelization is easier.
Fringe Firms	If small firms cannot expand, concentration is a bigger problem.

[28]Julius Maldutis, "Airline Concentration - Herfindahl-Hirschman Revisited," Avmark Aviation Economist, vol. 10, no. 5, June/July 1993, pg. 12.

Efficiencies	Mergers that produce efficiencies may be treated leniently.

Source: Horizontal Merger Guidelines, U.S. Department of Justice and Federal Trade Commission, 1992.

4.7.2 International Air Transport has Special Characteristics

The DOJ evaluation takes account of the special circumstances involved when the merging or code-sharing airlines fly on international routes or when one of the airlines is foreign. The most important difference is that international routes continue to be heavily regulated. Contestability is much less important because airlines cannot quickly enter a market. Because DOJ has reservations about contestability theory, the argument is unlikely to be persuasive in international merger or code-sharing proceedings.

The regulation of international air service previously extended to fares. This led some observers to claim that antitrust was not important because prices were already government-controlled. Airlines nevertheless found ways to compete on international routes. Although they could not change fares on the international portion of the flight, they could change fares on the U.S. domestic portion. Even gateway cities could have lower fares if the flight was simply routed through another domestic airport. Airlines also competed by altering the commissions they paid travel agents. Since the agents passed on higher commissions as discounts to consumers, the airlines could indirectly lower their fares.[29] These forms of competition continue in cases where fares are not market-determined.

Market definition is also somewhat different in international markets. Most countries have a few gateway cities that receive feed from smaller locales. Because a minority of passengers typically live in the gateway itself, defining the market as a city-pair may not make sense. Instead the market may well be region to region or even nation to nation. On the other hand, some cities are such important destinations that they have no good substitutes. Tokyo and London are examples of such cities.[30]

4.7.3 DOJ's View of Previous Code-Sharing Agreements

[29]Franklin Fisher, "Pan American to United: the Pacific Division Transfer Case," Rand Journal of Economics, vol. 18, no. 4, Winter 1987, pp. 499-500.

[30]Fisher, *op. cit.*, pg. 496.

DOJ has used its authority to review the code-sharing agreements between USAir and British Airways, Northwest and KLM, and United and Lufthansa. In all cases it has found that the agreements are permissible.[31] The Northwest/KLM agreement is special, however, because it is immune to the antitrust laws. DOJ appears to have viewed the United/Lufthansa agreement as a stepping stone to a more liberal, and thus more pro-competitive bilateral.[32]

The agreement between USAir and BA involved BA acquiring a 20% equity share in USAir, and therefore it received the closest scrutiny from DOJ. Under the agreement, USAir and BA agreed to implement code sharing on flights to London from various U.S. gateways. DOJ was concerned that the agreement would lessen competition in particular cities and at the national level. Its analysis was consistent with its earlier work.[33]

As mentioned above, DOJ views London as a destination with no alternatives. For this case it divided the U.S. into two relevant markets, the Mid-Atlantic states (apparently including states as far south as South Carolina or Georgia) and the Northeastern States. DOJ found that the merger would change the Northeast-London HHI from 2,150 to 2,499. The Mid-Atlantic-London HHI would go from 1,993 to 2,459. Both markets are considered “highly concentrated” without code sharing, and the change in HHI is more than high enough to warrant further attention. DOJ does note, however, that the HHI’s may overstate concentration because they are calculated only from gateways and do not take into account the various connections (both online and off-line) to various interior points.

In keeping with its precedents, DOJ separated the market for non-stop flights from the market for one-stop and connecting flights. The fact that BA and USAir provided the only non-stop service to London from BWI and Philadelphia was thus very important to DOJ, despite the many connections that were available. DOJ was also concerned with the barriers to entry in international service and the fact that the airlines "are permitted to meet under the aegis of the International Air Transport Association to agree on the prices they will charge."[34]

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[31]"Naughty or Nice?" *op. cit.*, pg. 174.

[32]Interview with U.S. DOT, October 21, 1994.

[33]DOJ's analysis is described in Robert Young, "Competitive Impact Statement" for United States vs. USAir Group, Inc., Civil Action No. 93 0530, U.S. Department of Justice, March 15, 1993.

[34]Young, *op.cit.*, pg. 7.

Although it had concerns, DOJ was receptive to the potential efficiency benefits for this alliance. It recognized that the agreement would allow new non-stop London service from Pittsburgh and that it would greatly increase the online connections to London from US cities. Therefore it sought a solution that would mitigate the anti-competitive effects without eliminating the benefits of the agreement. It accepted a BA suggestion that USAir give up all its route authority to serve London so that other U.S. airlines could compete in the market.[35] This final judgment essentially removed some barriers to entry without otherwise changing the agreement.

4.8 CURRENT DOT CODE-SHARING POLICY

On November 1, 1994, DOT unveiled a new aviation policy statement.[36] The statement was favorably disposed toward code sharing as long as the foreign country involved provided U.S. carriers with liberal access to its market. DOT stated that it would pursue liberal bilateral agreements with foreign countries and that such agreements could include unlimited code sharing.

DOT recognizes the economies of scope and scale that make hub and spoke networks desirable. It also notes that it is not possible for most airlines to create their own international networks. DOT feels that code sharing will allow carriers to achieve these economies while benefitting consumers by increasing service choices. U.S. carriers stand to gain from increased international operations because of their competitive advantages. Therefore DOT generally approves of the practice of code sharing. It does note, however, that code-sharing service must be disclosed to passengers.

As part of its new policy, DOT has announced that the U.S. will attempt to negotiate liberal bilateral agreements with several small European countries. It is believed that these countries are Norway, Sweden, Denmark, Belgium, Finland, Switzerland, Austria, Luxembourg, and Iceland.[37] The intent of these agreements is to get the ball rolling with the larger European countries. The strategy builds on the open

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[35]Interview with U.S. DOT, October 21, 1994.

[36]"U.S. International Aviation Policy Statement," U.S. Department of Transportation, November 1, 1994.

[37] James Ott, "U.S. Targets Europe for Free Trade Pacts," Aviation Week and Space Technology, November 7, 1994.

skies agreement already signed with the Netherlands. Open skies agreements provide for unlimited code sharing behind the gateways of both countries.

For countries that do not agree to liberal bilaterals, DOT is prepared to use code sharing as a bargaining chip. Applications to code share will be accepted or denied based on several factors including their effects on:

- Pricing and service options available to consumers;
- Access to international markets for individual cities;
- The U.S. airline industry (including whether the U.S. carrier does the long-haul flying); and,
- The U.S. policy goal of liberalizing international air transport markets.

CHAPTER 5: CONCEPTUAL ECONOMIC ISSUES IN THE ANALYSIS OF INTERNATIONAL AIRLINE CODE SHARING

5.1 INTRODUCTION

International airline code sharing may affect air carriers and passengers by altering the competitive nature of the code-sharing markets themselves or by affecting competition in the overall market for airline services. Determining and reducing any anti-competitive effects of marketing practices associated with code sharing can be relatively straightforward and has been examined elsewhere in this report. Determining the potential competitive effects of code-sharing agreements on the production and purchase of airline services is more complex. It requires an examination of the different markets to which code sharing might be applied and modeling the impacts of code sharing on producers and consumers in those markets. This chapter establishes a theoretical framework for investigating the potential impacts of code-sharing agreements on the domestic and international airline markets. The following two chapters show the results of a quantitative analysis of code sharing on carrier choice.

5.2 FRAMEWORK FOR THE ANALYSIS

This section of the chapter reviews the assumptions underlying the theoretical analysis and follows with an examination of the economic effects that code sharing may have on airlines and passengers. Various scenarios of potential code-sharing agreements and their likely impact on passengers and air carriers are examined in the next section of the chapter. For ease of presentation, the scenarios considered are those in which a U.S. carrier flies the domestic segment of the trip and a foreign carrier flies the international segment. The arguments and conclusions are symmetrical for service behind a foreign gateway.[1]

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[1]This is not to say that market conditions behind foreign gateways are the same. We recognize, of course, the difficulties U.S. airlines have in obtaining authorities behind foreign gateways because of trade

5.3 ASSUMPTIONS

Several reasonable assumptions about the markets and carriers involved are adopted for the analysis. These assumptions are that:

- Neither partner agrees to prorate terms that are not in its perceived best interests;

- Code sharing creates net value for at least one of the partners either by decreasing costs through economies of scope and density or by increasing revenue; and

- Markets are not perfectly contestable.

The implications of the assumptions are examined below.

The first assumption states that both parties to a code-sharing agreement pursue their own perceived best interests. This implies that neither partner would enter into an agreement that would leave it in a worse position than its expected position without the agreement. Note that this assumption does not necessarily imply that both parties earn greater profits after the agreement than before. It only states that the parties earn greater profits after the agreement than they would have earned if they had not entered into it.

Consider, for example, the case in which a single foreign carrier has the choice of negotiating a code-sharing agreement with one of two U.S. carriers providing service on the U.S. domestic segment of the trip. Suppose further that at least one of the two U.S. carriers believes that if the foreign carrier negotiates an agreement with its domestic competitor, it will be forced to exit the market because of the marketing advantage conferred by code sharing. In this case, the domestic carrier might negotiate an agreement that leaves it worse off than before the agreement, but better off than the perceived alternative of competing against code-sharing carriers. This is not to suggest that such agreements have occurred or will occur, but rather that such a possibility can not be ruled out.

The second assumption states that the code-sharing agreement creates net value for at least one of the partners in that expected incremental revenues and cost reductions exceed the incremental coordination costs of the agreement. Incremental

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restrictions between two or more foreign markets (countries).

revenues can be derived from either higher fares, increased traffic, or both.[2] Code-sharing partners could charge higher fares if passengers believed they were buying a higher quality product as a result of service coordination, or if the partnership had some monopoly power. Traffic volume for the partnership could increase through new passengers entering the market because of perceived improvements in service quality or through passenger diversion from competing carriers. Cost reductions could occur through economies of scope or density. Economies of scope would be possible if network expansion brought a lower cost per point served. Economies of density could be achieved if greater traffic on an existing route did not raise costs proportionately.

The assumption that markets are not perfectly contestable implies that actual competition imposes more discipline on the market than the threat of potential entry. Furthermore, imperfectly contestable markets imply that carriers can earn above-normal profits, both before and after code sharing.[3] Long-run economic profits, therefore, could flow out of the U.S. economy if traffic is diverted from a U.S. carrier to a foreign carrier.[4]

5.4 ECONOMIC IMPACTS OF CODE SHARING

This section examines the bargaining position of U.S. carriers entering code-sharing agreements, the direct and indirect effects of code sharing on U.S. carriers, and the effects of code sharing on passengers.

5.4.1 Bargaining Position

Market structure can affect the bargaining position of carriers negotiating code-sharing agreements, and the relative bargaining strength of the carriers may, in turn, affect the service and fare-prorate terms of the agreement. The fare and service aspects of a code-sharing agreement will determine each carrier's potential revenue and costs and, ultimately, how profitable the agreement is for each carrier.

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[2]Both fares and traffic volume could increase simultaneously because of marketing effects and perceived improvements in service quality.

[3]The assumption of imperfectly contestable airline markets is consistent with conclusions reached in much of the recent economic literature.

[4]If markets were perfectly contestable, all carriers would earn just normal profits in the long run. Under this situation, traffic diversion from U.S. carriers would not cause any economic profits to flow from the U.S. economy. However, there still could be a loss for some factors of production, such as labor.

The effects of market structure on bargaining position can be seen through two simple examples. First, consider the case in which a U.S. and foreign carrier are negotiating an agreement in a market where no competitors operate. That is, the U.S. carrier which flies the domestic segment of the trip faces no competition in the domestic market and, similarly, the foreign carrier is the sole operator on the international segment. In this case, there is no reason to believe that either party has a superior bargaining position, and, absent other factors, the partners would negotiate on equal footing.

Next, consider a market in which two domestic carriers compete on the domestic segment, but as before, the foreign carrier operates alone on the international segment. Here, the foreign carrier would have a superior bargaining position. Either of the two domestic carriers is likely to recognize that the marketing advantages conferred by the code share will result in a loss of traffic for the airline that fails to negotiate an agreement. Because of the threat of being "left out," the competing domestic carriers might make concessions in the negotiation that they otherwise would not.

It is also possible that the financial health of the carriers negotiating the code-sharing agreement may affect the terms of the agreement because a carrier in poor financial health might be in an inferior bargaining position.

5.4.2 Effects on U.S. Carriers

There are both direct and indirect effects of code sharing on U.S. carriers. Code sharing directly affects the U.S. carriers that negotiate and participate in an agreement and indirectly affects other U.S. carriers competing on either the domestic or international segment of the trip.

In most cases, the effects of code sharing should be positive for the U.S. partner in the agreement. Presumably, the marketing advantages conferred by code sharing will result in increased demand for this type of air travel, thus creating larger traffic volume. The extent to which increased revenues and cost savings from the larger volume offset incremental coordination costs (and marginal passenger costs) depends, in part, on the terms of the negotiated agreement. As noted above, it is possible that the U.S. code-sharing partner could find itself in a position worse than its pre-agreement position if the U.S. carrier, because of an inferior bargaining position, negotiates an agreement with adverse terms.

The effects of code-sharing agreements on other U.S. carriers not party to the agreement should generally be negative. U.S. carriers competing with the code-sharing service are likely to suffer reduced traffic as passengers are diverted to the code-sharing alternative. The extent to which this occurs, of course, is an empirical issue that is investigated in the following chapters.

5.4.3 Effects on Consumers

Because passengers care about service quality and fares, consumer welfare will improve if code sharing results in:

- The same or improved service offered at lower fares;
- Improved service offered at the same fares;
- The creation of new, previously unavailable travel alternatives that give passengers more travel choices.

There are, of course, several ambiguous cases in which fares increase (decrease) while service quality also improves (declines) or when code sharing replaces an existing travel alternative. In these cases, the impact on consumer welfare is an empirical issue that cannot be resolved on *a priori* theoretical grounds.

Whether code sharing causes changes in service quality is an important issue in evaluating impacts on consumer welfare. Consumers presumably opt for code-sharing flights because they prefer the quality attributes of online service, and they believe that code-sharing flights offers these attributes. Consumers' flight preferences may be affected, however, by a number of distortions in the distribution, or ticket marketing, process. These distortions may be termed "screen effects" and "marketing effects."

Screen effects occur because of the manner in which computer reservation systems (CRSs) display flights in a market. Those that give priority to online flights will list code-sharing flights ahead of other flights. Furthermore, a code-sharing flight may be listed as an online flight for each of the code-sharing partners and as an interline flight for them as well. One flight offer, therefore, may consume a large amount of space on the CRS display. These combined effects may push competing flights to subsequent screen displays that are less likely to be selected by travel agents for consumers. Screen effects can affect consumers' choices of flights independent of the underlying service attributes of the flights, thereby affecting consumer welfare.

Marketing effects are made up of two related elements. First, consumers may mistakenly opt for a code-sharing flight believing that it is truly single-carrier service.

This deception is easily remedied and not likely to be duplicated for repeat customers.[5] A more serious marketing effect may arise if the passenger is fully aware of the nature of code-sharing agreements, but assumes that the code-sharing flight will deliver service quality equal to online service. If this assumption is not borne out in practice and consumers do not capture the expected benefits, expected consumer welfare gains will not materialize and instead will be captured by producers. This type of effect may persist longer than other distribution effects if consumers keep trying the service, in spite of previous experiences.

Code sharing may serve to solidify the corporate relationships that make service coordination on code-sharing routes equivalent to single-carrier service. In this sense, code sharing may be viewed as "causing" the service improvements that consumers value. Nevertheless, service coordination and improvements can occur in the absence of code-sharing arrangements.

The combination of screen and service effects can be illustrated in the following three cases:

- **Optimistic Case**: No screen effects (either because no CRS bias exists or because passengers costlessly monitor travel agents) and service quality improves as a result of code sharing.

- **Intermediate Case**: Screen effects exist, but service quality changes occur as a result of code sharing.

- **Pessimistic Case**: Screen effects are present and, although code sharing, *per se*, does not cause changes in service quality, such changes may occur coincidentally with code sharing.

The pessimistic and intermediate cases are distinguished by whether code sharing produces changes in service quality. In the pessimistic case, changes in service quality may occur coincidentally with code sharing, but are not caused by it. In the intermediate case, code sharing causes changes in service quality.

[5] The U.S. Department of Transportation has recently proposed requiring travel agents to inform passengers of the interline nature of code-sharing flights.

5.5 ALTERNATIVE CODE-SHARING SCENARIOS

Five alternative code-sharing scenarios can be constructed that define the competitive market structure prior to and after code-sharing agreements are established. The relevant market includes traffic on the specific trip in question as well as reasonable substitute trips. For example, a narrowly defined market for a specific trip might be Philadelphia-Boston-Rome, but the more general definition used here would include Philadelphia-New York-Rome as a reasonable substitute. In short, the general market definition recognizes the possibility of competition among routes on the behind-U.S. gateway segment of the trip.

The five code-sharing scenarios are the following:

- **Scenario 1**: Two airlines previously providing interline service agree to code share. The code sharing does not divert any traffic from other airlines.

- **Scenario 2**: Two airlines previously providing interline service agree to code share (as in Scenario 1). The code-sharing agreement does cause traffic diversion, but only behind the U.S. gateway.

- **Scenario 3**: Two airlines previously providing interline service agree to code share (as in Scenario 1). The code-sharing agreement diverts traffic from other carriers on the international trip segment.

- **Scenario 4**: Two airlines not previously providing interline service agree to code share. The code sharing does not divert any traffic from other airlines.

- **Scenario 5**: Two airlines previously competing on the international segment agree to code share.

Of course, there are a large number of other possible scenarios that could be considered. Those selected for detailed analysis represent a reasonable range of possibilities and include polar cases that place likely bounds on code-sharing impacts. The expected effects on carriers and passengers in each of the five scenarios are examined below.

5.5.1 Scenario 1: No Traffic Diversion

Scenario 1 is a simple scenario. Suppose two fictitious airlines, Air U.S. and EuroAir, combine for interline service between Rome, Boston, and Philadelphia. Air U.S. flies the Boston-Philadelphia segment, while EuroAir provides service on the Boston-Rome segment. Now, suppose that the two airlines enter into a code-sharing agreement, and that by virtue of the agreement, the value of the Rome-Boston-Philadelphia service to passengers increases, creating $1 in economic surplus per passenger. In this scenario, the surplus is created not because the two airlines divert traffic from other carriers, but because of the increased value to passengers of the service provided by the code-sharing agreement. The code share may create the surplus either by generating new traffic, by producing improved service for which consumers are willing to pay more, by reducing costs through joint production activities, or by a combination of these.

Scenario 1: Bargaining Position--How the two carriers will share the $1 in newly created economic surplus in their prorate agreement is uncertain, but several possibilities exist. The two carriers may split it with fifty cents per passenger going to each carrier. In this case, the prorate might seem "fair" and both carriers are better off than before the agreement. In fact, even if Air U.S. received only one cent of the newly created economic surplus, and EuroAir took the other ninety-nine cents, Air U.S. would still be better off, relative to its pre-agreement position, though it would appear that Air U.S. negotiated the terms of the fare splitting poorly.

Scenario 1: Effects on U.S. Carriers--Overall, the welfare of U.S. carriers is unambiguously improved. Air U.S. has improved its position, and because no other airline has lost traffic, no other U.S. carrier is worse off.

Scenario 1: Effects on Consumers--The effects on U.S. consumers depend on whether the increased value represents only screen effects or whether it reflects actual improvements in service quality. In the optimistic case (i.e., no screen effects and improved service), consumer welfare clearly improves because code sharing is superior to the interline service it replaced. However, consumer impacts could be adverse under the pessimistic case in which screen effects serve to misinform passengers and improved service quality would have occurred anyway.[6] The results of the

[6]Note that the screen effects, combined with no causal link to improved service, always render the pessimistic case problematic for consumers. The problem is that screen effects, as noted above, might "trick" consumers into making choices they would not otherwise have made.

intermediate case are mixed: consumer choices are affected by screen effects, but travelers are better off because of improved service quality.

5.5.2 Scenario 2: Traffic Diversion Behind U.S. Gateway

Scenario 2 is the same as Scenario 1, but code sharing causes traffic diversion behind the U.S. gateway. Suppose that a second U.S. carrier also offers service on the Boston-Philadelphia segment of the trip and competes with Air U.S. to capture the EuroAir passengers at Boston before the code-sharing agreement. Further suppose that, once a code-sharing agreement becomes effective, one of the two U.S. carriers does not survive on the Boston-Philadelphia segment.

Scenario 2: Bargaining Position--Scenario 2 has important implications for the bargaining position of U.S. carriers. EuroAir has a bargaining edge in negotiating the prorate and service terms of the agreement. Specifically, if EuroAir could convince Air U.S. that failure to negotiate an Air U.S./EuroAir code-sharing agreement would result in EuroAir going to the second U.S. carrier for such an arrangement, EuroAir might be able to negotiate very favorable terms for itself. In this case, Air U.S., acting in its own best interest, might negotiate away any profits that the second U.S. carrier currently earns. Or worse, if the threat were credible that Air U.S. might be forced to abandon the Philadelphia-Boston market were EuroAir to conclude an agreement with the second U.S. carrier, EuroAir might be able to extract all the economic profits, including any profit that Air U.S. earns on the interline service before the agreement.

Scenario 2: Effects on U.S. Carriers--The impacts on U.S. carriers under this scenario depend on the terms of the agreement. Clearly, the "left out" U.S. carrier will lose because of traffic diversion. The domestic code-sharing partner could be better off if the increased traffic volume, diverted from its competitor, more than offsets its inferior bargaining position. However, if the U.S. partner negotiates an adverse agreement in which any economic surplus that was earned by either itself or the second U.S. carrier goes to the foreign carriers, the code-sharing arrangement could leave both U.S. airlines worse off from a welfare perspective. A necessary condition for the U.S. to lose welfare under this deal is that either of the U.S. carriers was earning an economic profit before the code-sharing agreement was negotiated.

Scenario 2: Effects on Consumers--The effects on consumers again depend on screen effects and service quality. Also, consumers could be adversely affected by the code share if traffic diversion results in the exit of one or more of the airlines that were previously serving the market. In this case, consumers would have fewer choices and, possibly, higher fares because of reduced competition. However, if no exit occurs, consumers would be better off if the quality of the code sharing is superior to the interline service that it replaces.

5.5.3 Scenario 3: Traffic Diversion on the International Segment

In Scenario 3, the U.S. carrier does not face any competition on the domestic segment of the trip, but the foreign carrier competes with one or more carriers on the international segment. In the Air U.S.-EuroAir example, EuroAir's competitor on the international segment is likely to be a U.S. carrier because of the nature of the bilateral exchange of route opportunities.

Scenario 3: Bargaining Position--Scenario 3 reverses the bargaining positions of the U.S. and foreign carriers. Here, the U.S. carrier serving the domestic segment can credibly threaten to agree to code share with other airlines flying the international segment. Accordingly, the domestic U.S. carrier should have a superior bargaining position in negotiating the terms of the agreement.

Scenario 3: Effects on U.S. Carriers--The welfare of the U.S. carrier serving the domestic segment is likely to improve in this case. If other U.S. carriers are competing on the international segment, their welfare could decline because of traffic diversion. The net effect on all U.S. carriers will depend on whether the increased profitability of the domestic U.S. carrier offsets losses to the U.S. carrier competing on the international segment. However, given the superior bargaining position of the U.S. carrier, a net increase in economic profits earned by U.S. carriers can be expected. If both carriers competing on the international segment are foreign carriers, the welfare of U.S. carriers should improve. In this case, the domestic U.S. carrier has superior bargaining position, and traffic is not diverted from U.S. carriers, but from one foreign carrier to another in the international segment.

Scenario 3: Consumer Impacts--The Scenario 3 impacts on U.S. consumers are analogous to Scenario 2 impacts; they depend on screen effects, service quality improvements, and the competitive effects of potential exit from the market. Assuming the optimistic case and no exit from the market, consumers are unambiguously better off. Passengers have the advantage of a superior service by virtue of the code share, otherwise traffic would not have been diverted, while at the same time, alternative competing service on the international segment is still available.

If exit does occur, however, the impacts on consumers are less clear, because the passengers have fewer choices and competition has been reduced. Consumers may be better off initially because the code sharing would not have driven the competing service from the market if consumers did not find the code-sharing service to be superior. However, given imperfectly contestable markets, the code-sharing partners might be able to raise fares after the other carriers exit, thus offsetting some or all of the benefits of improved service.

5.5.4 Scenario 4: Code Sharing Introduced as a New Service

In Scenario 4, two carriers introduce code sharing as a new service. Unlike Scenario 1, the new partners did not previously provide interline service in the market. As in Scenario 1, code sharing does not cause traffic diversion so that the benefits of the agreement are derived from newly generated traffic.

Scenario 4: Bargaining Position--As in Scenario 1, neither carrier is expected to have a superior bargaining position.

Scenario 4: Effects on U.S. Carriers--Because the U.S. carrier is expected to negotiate a prorate in its own best interest, its profitability should increase. Also, the welfare of other U.S. carriers will not be harmed because no traffic diversion occurs.

Scenario 4: Effects on Consumers--In this scenario, the welfare of U.S. consumers should improve unambiguously for the optimistic case (no screen effects and improved service). The code-sharing agreement provides a new service in the market, thus offering consumers more choices. This conclusion would hold even if traffic diversion occurred, so long as exit from the market did not occur.

5.5.5 Scenario 5: Competing Carriers Code Share

Scenario 5 presents a situation in which two competing carriers enter into a code-sharing agreement. Using the Air U.S.-EuroAir example, the carriers in this scenario compete on the international segment of the Philadelphia-Boston-Rome trip prior to the code-sharing agreement. They may also interline, with Air U.S. providing service to some EuroAir passengers for the Boston-Philadelphia segment. The impacts of this code-sharing arrangement depend on whether Air U.S. continues to provide service on the international segment after the agreement.

Scenario 5: Bargaining Position--As in the previous scenarios, the bargaining position of the domestic carrier will depend on the alternative code-sharing opportunities on both the domestic and international segments of the trips. The domestic carrier should have a strong bargaining position, because, at a minimum, it would expect compensation for any traffic diverted from its own international flights competing with the foreign carrier.

Scenario 5: Effects on U.S. Carriers--Because of the strong bargaining position of the domestic carrier, it is likely to negotiate an agreement that will increase its profit level. The effects on other U.S. carriers depend, of course, on the extent to which the code sharing causes traffic diversion.

Scenario 5: Effects on Consumers--The consumer impacts of this code-sharing agreement depend on several factors. If the two carriers continue to compete vigorously on the international segment and traffic diversion does not cause exit from the market, consumers will be better off. In this case, consumers have the benefit of improved service without any reduction in competition in the market.

The situation, however, is more ambiguous if the two partners reduce competition on the international segment after the agreement. In the extreme, the domestic carrier could drop its international flight, thus reducing competition on the international segment of the trip. The domestic carrier might agree to this if it could negotiate a code-sharing agreement that compensated it for doing so. In this situation, code sharing is being used to create a measure of monopoly power in the market and consumer welfare would likely decrease as a result. The extent to which the agreement creates monopoly power for the partners depends on the quality of alternative travel choices available to consumers after the code sharing takes effect.

5.6 CONCLUSION

This chapter has presented a theoretical framework for examining the potential effects of code-sharing agreements on international and domestic airline markets. In particular, it has been shown how existing market structures and potential competitive impacts of code-sharing affect carrier bargaining strategies and likely U.S. consumer and producer welfare. In the following chapters, an empirical model is developed which implicitly embeds the various types of market structures and carrier bargaining outcomes found in existing code-sharing markets. The results of the model are then used to project ex post competitive impacts and attendant effects on consumer and producer welfare.

CHAPTER 6: CARRIER CHOICE MODEL FOR ESTIMATING WELFARE EFFECTS OF CODE SHARING ON DOMESTIC AND FOREIGN PRODUCERS AND CONSUMERS

6.1 INTRODUCTION

The net effects on the U.S. economy of a code-sharing agreement depend on its potential effects on competition and ultimately, its effects on the welfare of U.S. producers and consumers. Estimating these effects requires a methodology that can separately identify consumer and producer welfare impacts, and can also distinguish between U.S. and foreign impacts. This chapter describes a model constructed to estimate these effects. The chapter begins with a model overview, followed by a discussion of the data sources. The nature of the available data influences the definitions of the markets analyzed and of the flight choices faced by passengers. These issues are examined next, followed by a more detailed description of the modeling techniques. The chapter concludes with a discussion of the basic model results. The model is applied to the estimation of U.S. and foreign consumer and producer welfare impacts of specific code-sharing agreements in Chapter 7.

6.2 MODEL OVERVIEW

An econometric model was developed to assess the impact of code sharing on consumers' choices of flights. This carrier choice model attempts to identify how passengers in international origination and destination (O&D) markets choose among competing flight alternatives. The specific method entails estimating a "discrete choice" model over a sample of city-pair markets where passengers must make a choice between two or more flight options.[1] The results of the model are employed to

[1]Discrete choice models have been used in numerous econometric studies since the mid-1970's. Such models, also called "qualitative response" models, are relevant for situations where a decision-maker must make a choice between two or more "discrete" options, e.g., whether or not to purchase a new car, which candidate to vote for, whether to enter the labor force, etc. In the context of an econometric

generate predictions of the market share gained by each flight option under a variety of scenarios relating to how code-sharing options are treated in each market.

The model is designed to answer the following questions: Does the advent of code sharing in a market change a passenger's flight choice? If so, what is the effect on each carrier's market share? How do these changes in flight selection affect consumer and producer surplus? Finally, how are these welfare effects divided among U.S. and foreign air carriers and passengers?

A detailed description of the statistical foundations of discrete choice models is provided in Appendix A.

6.3 DATA SOURCES AND DEFINITIONS

The primary data sources for the analysis are the DB1A ten percent ticket sample, published by the U.S. Department of Transportation (DOT), and the Official Airline Guide (OAG). The limitations of the available data serve to define the markets examined and the characterization of the choices that passengers face in selecting their air carriers and flights.

6.3.1 Data Sources

The DB1A provides complete ticket itineraries for individual passenger trips and is the main source of observed passenger flight choices. The DB1A data are compiled and published on a quarterly basis. The latest quarter available for this analysis was the first quarter of 1994 (1994Q1), which represents a period of time during which the BA/USAir code-share arrangement was just beginning to take hold. It is likely that both this arrangement and the Northwest/KLM relationship have matured and continued to grow since then. Thus, the estimates of the overall impact of these code-sharing agreements reported below are likely to be understated.

The estimates also do not take account of the competitive response to code-sharing agreements. For example, American Airlines acquired London route authority from USAir as part of the BA/USAir agreement. It took some time for American to begin serving its three new routes, and the effects of this service are not reflected in the

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analysis, one is interested in relating the decision to a set of explanatory variables.

1994Q1 data. These new offerings provide additional online choices in behind-U.S. gateway markets.

The international OAG is the main data source for observed carrier offerings in each market. It would be preferable to use the actual computer reservation system (CRS) listings that passengers encountered at the time they selected their flights. CRS listings, however, are only available for current and future flights and no historical record is kept of previous listings. Therefore, the international OAG is used to construct the alternative flight choices that were available (and that passengers might have chosen) in each market for comparison with the actual choices observed in the DB1A sample.

6.3.2 Market Definitions

A necessary first step in the modeling process is defining the relevant market. In this analysis, markets are characterized in the following way. First, because the DB1A does not list individual flight numbers, but only the O&D airport codes and the carriers involved, markets are broadly defined by the origination and destination points. Therefore, each O&D market may contain any number of intermediate points and itineraries between the endpoints. For example, traffic data for the St. Louis-Amsterdam market may include passengers who traveled via Detroit (St. Louis-Detroit-Amsterdam) and those who traveled by way of Boston (St. Louis-Boston-Amsterdam).

Second, markets are further identified by the direction of travel. That is, St. Louis to Amsterdam is a different market than Amsterdam to St. Louis. Third, multiple airports in a city are treated as being in the same market. For example, Newark-Gatwick, Newark-Heathrow, JFK-Gatwick, and JFK-Heathrow would all be considered part of the New York-London market.[2]

6.3.3 Markets Selected For Analysis

The initial universe of O&D markets is from the list of DOT-approved code-sharing agreements updated through April 30, 1994. An initial sample of markets was

[2]The present approach makes the simplifying assumption that consumers do not distinguish between different airports in the same city. This assumption could be relaxed in future work efforts.

chosen randomly from the DOT list.[3] In practice, however, many of the O&D city pairs appearing on the list do not yet have any code-sharing service offered; this may be due to marketing considerations of the carriers involved, or in the case of service behind foreign gateways, the need to obtain third-country approval to initiate code-sharing service. After drawing the initial sample, it was found that a significant proportion of the markets in fact did not involve code-sharing flight options. This factor and the desire to concentrate on the BA/USAir and Northwest/KLM arrangements led to the addition of several more markets served by these carriers to the sample.

In the case of BA and USAir, their OAG listings were reviewed for the first three months of 1994. It was apparent that they were in the process of adding code-sharing offerings during this time, and so the markets chosen for the sample included only those for which code sharing was offered for the entire three month period.

The composition of the initial sample was as follows:

Number of markets:	117
Number of code-sharing markets:	76
Number of NW/KL code-sharing markets:	37
Number of US/BA code-sharing markets:	22

The DOT list of approved code-sharing markets covers three basic types of code-sharing service: Type 1--service between foreign gateways and cities behind US gateways, Type 2--service between US gateways and cities behind foreign gateways, and Type 3--service between US and foreign gateways. These approvals implicitly give sanction to a great number of additional "behind-behind" markets which also may be served via code sharing. These latter markets are not included in the sample for two reasons. First, many of these markets have few passengers and therefore would not be adequately represented in the DB1A ticket sample; second, alternative service offers in many of these markets would be difficult to construct because they are not published in the OAG. (In Chapter 7, however, the aggregate size of these markets for BA/USAir and Northwest/KLM have been estimated and allow a reasonable estimate of the total impact of these code-sharing arrangements.)

It is important to note that some markets that have been approved for code sharing do not currently have code-sharing alternatives available. Nevertheless, some

[3]It was not practical to include all code-sharing markets because much effort was involved in constructing the choice sets available in each market from OAG data. This effort is discussed in more detail below.

of these markets are included in the data sample. In addition, except for markets involving USAir and British Airways and Northwest and KLM, very few code-sharing markets show a sufficient number of passengers from the DB1A to support inclusion in the sample. As a result, the sample is heavily dominated by the markets involving these two major code-sharing agreements.

6.3.4 Passenger Flight Choices and Alternatives

An individual "choice" in any given market is defined by the air carrier and the O&D market as listed in the DB1A. As noted above, the O&D market may include any number of intermediate points so that a choice is constructed by aggregating over the multiple routings possible for each individual carrier (or group of carriers in the case of interline service) in each O&D market. For example, one can fly from Pittsburgh to Frankfurt on Delta via either Cincinnati or New York. These flights together comprise just one choice in the model. This type of aggregation is necessary because the data in the DB1A are based on flight coupons issued as tickets for airline flights. Each coupon corresponds to a specific flight number associated with a specific plane (although the flight number itself is not identified in the DB1A), yet that plane may make several stops under the same flight number. A new coupon is not issued to a traveler making an intermediate stop unless a plane change is involved. Hence, the ticket sample only identifies intermediate points where a plane change is also made. Furthermore, because the DB1A data do not identify specific flight numbers or dates of travel, there is no way to assign tickets to individual flights.

The DB1A provides information on observed choice of carriers made by passengers. The OAG then is used to define the options available in each market. The choice set in each market includes the actual observed flight flown and those alternatives available to the passenger which were not selected. This is a complex issue in the case of interline flight options, in particular, because interline connections are built up from individual point-to-point flights. Because the great majority of tickets are sold through travel agents using CRSs and these systems differ in their display algorithms, it would be advantageous to have the various screen options presented to passengers during 1994Q1 for the sample markets. However, as noted above, there are no historical records of the CRS displays used during 1994Q1. One might try to reproduce these displays using the display algorithms for constructing interline flight options that were employed by the CRS systems at the time. Such an effort, however, is well beyond the scope of this study; instead, choice sets are constructed in each relevant market by manually coding the options listed in the printed version of the OAG for January, February and March of 1994.[4]

It is important to recognize that only actual physical flight offers are used to construct the options available to consumers. Thus, the carrier IDs for a given alternative are coded according to who actually flew the flight(s); moreover, if a given flight offer is listed more than once in the OAG due to code sharing, it is still treated as just a single flight offer. (The incorporation of any multiple-listing effect on passenger choice decisions is discussed below.)

For any given O&D market, the observed market share estimate for each choice is obtained from the ticket sample. It is important to note that actual O&D market data cannot be obtained directly from the raw data submitted by carriers for inclusion in DB1A because a ticket with a specified itinerary may represent more than one O&D trip. The "trip break" indicators incorporated into the DB1A survey file are used to ascertain origin-destination demands.

Based on DOT requirements, the ticket sample identifies the actual carrier on each leg of an itinerary; thus, a two-leg code-sharing ticket involving, say, Northwest and KLM should have these two carriers listed regardless of how the ticket was sold. Based on this principle, each O&D listing in the ticket sample could be accurately assigned to the appropriate alternative in the choice set. In practice, however, the ticket sample includes some tickets indicating travel on a given carrier which could not have taken place. For example, a number of passengers are identified as travelling online with KLM from Boston through Amsterdam to Athens, but KLM does not fly from Boston to Amsterdam; it is likely that these passengers actually flew on Northwest for the Boston to Amsterdam segment, and then switched to KLM for the Amsterdam-Athens leg. For the two major code-sharing alliances of interest, all of those tickets

[4] A problem with this approach is that carriers must pay to list connections in the OAG for smaller markets. Northwest and KLM in particular have typically chosen not to pay for such listings; on the other hand, BA and USAir code-sharing listings are much more common. To ascertain which connections might be missing, the OAG data was cross-referenced with the DB1A data to find those options which showed sizable market shares (> 5%) according to the ticket sample but which were not listed in the OAG; these connections then were manually constructed based on the major connecting points listed in the DB1A data and the underlying point-to-point flights. Connections were made using the standard OAG-listed layover and waiting time criteria at the relevant airports.

indicating online service where only interline code-sharing service was actually available were recoded in the appropriate manner.[5]

6.3.5 Pure Foreign Flight Alternatives

In principle, the DB1A ticket sample provides coverage of Type 1 code sharing (service between foreign gateways and cities behind U.S. gateways marketed as a foreign carrier's online service), Type 2 code sharing (service between U.S. gateways and cities behind foreign gateways marketed as a U.S. carrier's online service), and those Type 3 code-sharing services (international gateway-to-gateway) flown by U.S. carriers but marketed as a foreign carrier's service. However, DB1A data are derived only from those tickets where at least one segment involves service provided by a U.S. carrier to or through some point in the U.S. Thus, they do not provide a random sample of consumer route choice decisions in international O&D markets beginning or ending at U.S. gateways because the choices available in such markets include not only those sampled by DB1A but also flight offers flown entirely by foreign carriers (pure foreign alternatives). These pure foreign flights can be written on tickets that do not include any U.S. airline on any coupon and, therefore, these flights are not sampled by DB1A. Such tickets may include Type 3 code-sharing flights flown by foreign carriers but marketed by U.S. carriers or code-share flight offers.[6]

There are no sources of data for foreign carrier tickets comparable to the DB1A sample. Because of this limitation, pure foreign flight alternatives are excluded from the choice sets in those markets beginning or ending at U.S. gateways.

However, the pure foreign alternatives are added back after the model estimation to obtain market-share predictions. Were these alternatives not included, the model predictions for gateway-to-gateway markets would overestimate the market share that domestic alternatives may lose to code-sharing choices. This is because code-sharing flights could only attract traffic away from the domestic alternatives and not the excluded foreign carrier choices.

[5]If DOT wants to monitor individual code-sharing agreements, it should place additional emphasis on accurate reporting of DB1A ticket sample data.

[6]DOT may want to consider requiring foreign carriers to file DB1A data for these types of flights.

6.3.6 Other Adjustments to Markets and Choice Sets

Alternative flight choices with very small market shares, based on observed DB1A passenger counts, are also removed from the estimation because the model is unlikely to yield reliable results for these alternatives.[7]

Finally, those markets which involved only a single alternative are by necessity excluded because there is no choice decision to make in such markets. This left the following final sample composition:

Number of markets:	91
Number of code-sharing markets:	50
Number of NW/KL code-sharing markets:	25
Number of US/BA code-sharing markets:	21

A list of these O&D markets is given in Appendix B.

6.4 DETAILS OF THE MODEL AND MODEL RESULTS

Passengers presumably choose among competing flights in a market based on the attributes of the flights such as the fare, overall trip time, service quality, and online versus interline service. The sum of all passenger choices produces various market shares for the carriers in the market. A "discrete choice" econometric model, therefore, can be constructed that relates these market shares in a particular O&D market to the attributes that characterize the flight offerings.

The model attempts to estimate the separate effect of each attribute on a passenger's choice, and by including code sharing as one of these attributes, it can estimate the effect of code sharing on market share. The model employed is a "conditional logit" model.[8] This type of model is appropriate to estimate individuals' selection among a number of discrete choices where that selection depends on the

[7] See Daniel McFadden, "Quantitative Methods for Analyzing Travel Behavior of Individuals: Some Recent Developments," in D. Hensher and P. Stopher, eds. Behavioral Travel Modelling, Lexington, Mass: Lexington Books, 1979.

[8] There is some confusion in the literature when referring to the conditional logit model and its close cousin, the "multinomial logit" model. A discussion of the distinction between the two can be found in William H. Greene, Econometric Analysis, New York: Macmillan, 1993.

values of a number of "explanatory" variables. In this case, the model seeks to determine the extent to which carriers' market shares (passengers' selections of carriers' flights) are explained by observable flight attributes.

The model can only explain differences in market share among the alternatives. It can not explain changes in the overall size of a market due to code sharing; that is, market size is taken as fixed. This assumption appears reasonable for non-stop and single-connect markets, because code sharing does not introduce an entirely new class of service. And, as noted earlier, the model does not attempt to predict shares in small markets where double-connect service may be the best alternative.

6.4.1 Explanatory Variables And The Expected Signs Of Their Coefficients

Passengers are assumed to choose the alternative that makes them best off, based on which alternative provides the combination of attributes they prefer. The attributes, or explanatory variables, used in the model are each alternative carrier's seat share for online, interline, and code-sharing flights, average time between departures, the average fare, the percent of a carrier's seats that are first or business class, the average elapsed time of flights, and whether the flight connects to a carrier's hub.

The relative availability of online, interline, or code-sharing service for each airline is measured by that airline's share of seats on each type of flight within a market. Seat shares are derived from the OAG listings of aircraft type and seating configuration. Separate seat-share coefficients are estimated in the model for the following five types of seats:

1. Online code sharing;
2. Other online;
3. Interline code sharing;
4. Interline commuter; and
5. Other interline.

Online code sharing includes online seats that can be listed more than once on CRS displays because of code sharing (mnemonic is ONCS_SS). *Other online* include seats on all other online flights (ONREG_SS). *Interline code sharing* comprises seats on interline flights that could be multiple-listed and / or receive preferential listing as online service due to code sharing (INCS_SS). *Interline commuter* are seats on interline flights involving a commuter carrier, whether or not treated as domestic code sharing (INCOM_SS). *Other interline* include seats on all other interline flights (INREG_SS).

For any offer involving one or more connections, seat offers are calculated using the smallest aircraft on the itinerary. Based on the above listing, the expected ordering of the seat share coefficients is 1 > 2 > 3 > 4,5. Consistent with prior research, it is expected that consumers will prefer online to interline service. The expectation that consumers will be more likely to choose online code-sharing options relative to other online offers is due to two factors. First, there may be a pure multiple-listing effect--that is, code-sharing offers can be listed twice on CRS displays, once under the actual carrier's code and once under the code-sharing partner's code. Second, consumers may enjoy more flexibility with respect to other unobservable carrier-specific attributes, e.g., assignment of frequent flyer miles. This line of argument is even stronger when comparing interline code-sharing offers to other interline options; in this case, code-sharing partners may be able to arrange more reliable baggage transfers, one-stop check-in service, use of proximate gate locations, and other unobserved attributes that passengers prefer.

In general, one expects that increases in seat share will be correlated with increases in market share; thus, it is tempting to conclude that the signs of the estimated seat share coefficients themselves should be positive. However, because the model disaggregates seat shares into different types, it may well be that some of the variables measuring lower-ranked seat types (based on the expected ordering shown above) will exhibit negative coefficients. For example, carriers that offer a relatively large share of the seats in a market, most of which are interline seats, may obtain relatively small market shares if passengers have a strong preference for online service. Such a result might well occur if individual alternatives are typically comprised of only one type of seat. This in fact is the case in most city-pair markets examined here where any given carrier (or pair of carriers in the case of interlining) offers only a single type of service.

The average time between departures (ATBD) is used as a measure of service convenience through its impact on average schedule delay (the delay incurred by passengers when flights do not leave at the most preferred departure times). The expected coefficient sign is negative since more frequent service will reduce ATBD.

The average fare (FARE), developed from the DB1A ticket sample, is used as the price variable in the model. For interline tickets, the overall fare is allocated to individual coupons based on standard IATA prorates.[9] The expected sign is negative.

The percent of a carrier's own seats offered as first-class or business class (FIRSTPCT) is used as another measure of service quality. This measure is developed

[9] Prorate Factor Manual, International Air Transport Association, 1994.

on a carrier and aircraft-specific basis using OAG-listed seating configurations. The expected sign is positive.

The average elapsed time of flights (TIME_FLT) allows for differences in overall travel time among alternatives. This measure is also developed from the OAG listings. The expected sign is negative.

To account for the ability of carriers to feed traffic to their international flights from hubs, a dichotomous variable is used. Its value is one if either the origination or destination point is a major hub of the carrier. For interline flights, it is also set to one if either end-point is a hub for either carrier involved in the interline service. Otherwise, the value of the variable is zero. Mnemonics are constructed using each carrier's two letter code, e.g., NWHUB, KLHUB. The expected signs are positive.

The results from the model can be used to assess the extent to which code sharing alone has any significant impact on consumer flight choices, while taking account of the effects of the other observable flight attributes.

By implication, the attributes of an unchosen alternative for a given passenger are assumed equal to the values relevant to those who did choose it. With regard to fare, for example, the observed average fare for a given alternative is determined by the fare paid by those who actually chose that alternative. It is assumed that, on average, this same fare would apply to other passengers were they to choose that alternative.

6.4.2 Basic Model Results

Econometric estimation of the model described above yields coefficient estimates for each of the explanatory variables. In carrying out the estimation, each observation (representing an observed market share) is weighted according to the overall number of passengers in the market to which it belonged. The statistical significance of the estimates can be assessed based on their t-statistics and corresponding p-values. The p-value indicates, on a scale from zero to one, the confidence level with which one can conclude that the true coefficient value is in fact different from zero; p-values close to zero indicate a high degree of confidence, while those close to one indicate a low degree of confidence. The estimates are presented in Table 1.

With one exception, all coefficients have the expected sign / ordering and are highly significant. In particular, the seat share coefficients indicate that passengers indeed prefer online service to interline service (all other things equal). We interpret this result to be indicative of the unobservable benefits associated with online service (one-stop check-in, better baggage handling, etc.) that are not directly measured in the other explanatory variables. (As noted in Chapter 5, this also could, in part, reflect the pure marketing advantage gained from better CRS listings.)

The coefficients on average time between departures, fares and average elapsed time per flight are all negative, indicative of the fact that passengers prefer more flights rather than less, lower prices and quicker travel time. The FIRSTPCT coefficient is positive, which is consistent with the view that passengers prefer better classes of service (again, holding all else constant).

Finally, with the exception of BAHUB, the hub coefficients are all positive and statistically significant, indicative of the advantage gained by carriers who typically have a strong market presence at their major hubs.

The negative sign on BAHUB may be indicative of some unobserved effect that is negatively impacting BA's market shares at its London hub. In interpreting the coefficients, it is important to recognize that they do not represent the marginal effects one is accustomed to evaluating in a linear regression model. Further discussion of this issue is contained in Appendix A.

One doubtful result, however, is the magnitude of the implied value of (in-flight) time, which is computed by taking the ratio of the coefficient of TIME-FLT divided by the coefficient of FARE; this results in an unrealistically high value of passenger time. The FARE coefficient is important because it can be used to compute the marginal utility of income which is needed to obtain consumer surplus estimates; however, given this result, surplus measures based on FARE are not likely to be reliable. In its place, we use an external estimate of the value of time to compute a corresponding value of the marginal utility of income relevant for our sample. This is discussed in further detail in Appendix A.

Table 6-1

ESTIMATED MODEL COEFFICIENTS

Variable	Coefficient	t-statistic	p-value
ONCS_SS	1.134	4.572	0.000
ONREG_SS	0.240	2.302	0.021
INCS_SS	-0.628	-3.020	0.003
INCOM_SS	-1.464	-2.619	0.009
INREG_SS	-5.088	-12.154	0.000
ATBD	-0.034	-17.840	0.000
FARE	-0.728E-3	-8.064	0.000
FIRSTPCT	4.492	22.939	0.000
TIME_FLT	-0.433	-42.294	0.000
USHUB	0.484	2.147	0.032
BAHUB	-0.490	-5.135	0.000
NWHUB	0.803	9.740	0.000
KLHUB	0.528	3.628	0.000
AAHUB	1.476	24.479	0.000
COHUB	1.524	13.654	0.000
DLHUB	1.890	15.052	0.000
TWHUB	0.950	12.429	0.000
UAHUB	1.323	32.360	0.000
SKHUB	1.472	6.832	0.000

The in-sample predictive accuracy of the model can be assessed by computing the weighted root mean squared error (RMSE), which is 0.117. This statistic gives a measure of the "average" deviation between the observed and predicted values of the dependent variable, which is market share; this particular statistic penalizes large errors more than proportionately relative to small errors. The measure should be interpreted in light of the relative magnitude of the dependent variable, which ranges from 0 to 1.

Overall, the model appears to be reliably estimated. This is an important conclusion because the coefficient estimates are used repeatedly in the following chapter to assess the impacts of code sharing on market share and the magnitude of the corresponding changes in consumer and producer surpluses.

CHAPTER 7: ASSESSMENT OF CODE SHARING IMPACTS

7.1 USING THE MODEL TO PREDICT MARKET SHARES

The coefficient estimates described in the previous chapter can be used to predict the market share that would be obtained by any specified alternative in a given O&D market. In practice, one must specify the values of all of the independent variables associated with every alternative in the choice set for the market of interest in order to predict market shares. As a simple example, suppose there are three carrier choices available in a given market and that there are just two independent variables, labelled as Variable #1 and Variable #2. Define X_{11} as the value of Variable #1 for Alternative #1, X_{21} as the value of Variable #2 for Alternative #1, and so on; the associated coefficient estimate from the model for Variable #1 is given by $\hat{a}_1$, and $\hat{a}_2$ is defined similarly for Variable #2. Then under the logit specification employed here, the predicted market share for Alternative #1 is given by:

$$p_1 = \frac{e^{\hat{a}_1 X_{11} + \hat{a}_2 X_{21}}}{e^{\hat{a}_1 X_{11} + \hat{a}_2 X_{21}} + e^{\hat{a}_1 X_{12} + \hat{a}_2 X_{22}} + e^{\hat{a}_1 X_{13} + \hat{a}_2 X_{23}}}$$

By repeating this calculation for Alternatives 2 and 3, one can see that the predicted market shares collectively add up to one, as they should.

If one changes the values of any of the independent variables for any of the choices, all of the predicted market shares will change. Note also that if one were to add a new alternative to the choice set, this would be reflected by an additional term in the denominator of the above equation. In principle, such an alternative could be added in even if it was not used in the estimation of the $\hat{a}$ coefficients; it would require knowledge of the values of the independent variables for the new choice. This procedure was in fact followed for choices involving only foreign carriers (recall that such alternatives were initially excluded from the choice sets because they are not adequately represented in the DB1A ticket sample which is used to estimate the $\hat{a}$

coefficients.) Except for the FARE variable, the values of all of the independent variables for these choices were obtained from the OAG in the same manner as for the included choices. For the FARE variable, each of the added choices was assigned the (weighted) average fare of the included choices. After adding in these alternatives, the above equation is used to generate market share estimates for all choices in each of the sample markets.

7.1.1 Assessing the Market Share Impacts of Code-Sharing

The resulting market shares represent estimates under the baseline scenario (Scenario A), which reflects code-sharing offers as they existed during the first quarter of 1994. To estimate the impacts of code sharing, one could ask the question: How do these market shares compare with those that might be observed if there were no code sharing? The answer to this question obviously depends critically on what assumptions are made regarding likely changes in service offers, fares, and other aspects of the competitive environment in each market. In the context of the present analysis, one can use the model coefficients to project new market shares under a counterfactual scenario with no code sharing by re-specifying the choice sets and their associated variable values. It is important to keep in mind that such an exercise is inherently a static analysis which focuses only on how the sample markets might have looked during the first quarter of 1994 if there were no code sharing. Such an analysis is not intended to assess changes in market share over time due to code sharing. (However, it does avoid the problem of attributing effects over time to code sharing which are due to changes not controlled for in the model.)

The "no code sharing" counterfactual scenario (Scenario B) is specified by treating online code-sharing offers in each sample market as regular online offers and interline code-sharing offers as regular interline offers. This entails adding the code-sharing seat shares into the ONREG_SS and INREG_SS variables and setting the corresponding code-sharing variables (ONCS_SS and INCS_SS) equal to zero. The average elapsed time of code-sharing interline flights is also changed to equal the average of observed non-code-sharing interline offers. All other attributes are left unchanged. These adjustments imply that passengers now do not differentiate between code-sharing and non-code-sharing offers (assuming other observed attributes are equal). Note that this specification implies that there is no change in capacity offered (i.e., number of seats or flights) due to code sharing; observed seat shares are simply moved into different categories.

The projected difference in market shares between the two scenarios for those choices involving code-sharing offers can be interpreted as the "impact" that code sharing had on market shares during 1994Q1. The scenario results indicate that, across all BA / USAir code-share markets in the sample, the aggregate projected market share for BA / USAir flights is about 8 percentage points less under the counterfactual (no code-share) scenario compared to the baseline scenario--BA / US gets a 2.9 percent market share when code sharing is turned off versus an 11.2 percent market share with code sharing. Across Northwest / KLM code-sharing markets in the sample, their aggregate projected market share falls by about 10½ percentage points when code sharing is turned off--a 34.4 percent market share without code sharing versus a 45.0 percent market share with code sharing. Again, it is important to remember that these impacts represent a static result under the assumption that code-sharing partners would be offering the same amount of service (measured by seat offers) observed during 1994Q1 even if they were not allowed to code share. In addition, the market share percentages apply only to the code-sharing markets and not to all markets served by these carriers. It is also important to note that projected changes in market share represent net changes and do not correspond directly with the share of passengers who may purchase code-sharing tickets since some of these tickets may be purchased by those who would choose the partners' service offer even without code sharing.

7.1.2 Assessing the "Effectiveness" of the BA/USAir and Northwest/KLM Code-Sharing Alliances

The model also can be used to obtain a quantitative measure of how effective each of the two major code-sharing alliances has been. To accomplish this, a new counterfactual scenario is defined where interline code sharing is assumed to have the same effect as true online service (Scenario C); this entails adding the interline code-sharing seat shares into ONREG_SS, setting INCS_SS equal to zero, and setting the average elapsed time of the corresponding flights equal to the average of actual online offers.

The "effectiveness" of code sharing then can be assessed by comparing these new projected market shares with those predicted under the previous baseline and "no code sharing" scenarios. Summing across each alliance's sample markets, the aggregate results for all three scenarios are shown in Table 7-1.

The model predicts that BA / USAir shares would increase by about eight points under the new scenario compared to the baseline. If the "effectiveness" of a code sharing alliance is viewed as the ability of the partners to offer a service that is as close to true online service as possible, we can say that current BA / USAir code-sharing "effectiveness" (as of 1994Q1) is about 50 percent (the relative distance of Scenario A between Scenarios B and C).

In comparison, the model predicts that Northwest/KLM could achieve further market share increases of only about 1½ points if their interline code sharing were viewed as fully equivalent to true online service; thus, their current code-sharing "effectiveness" is almost 90 percent.

Table 7-1

SAMPLE CARRIER CHOICE MODEL MARKET SHARE RESULTS
(Based on 1994Q1 Data)

Scenario	Description	BA/USAir (in percent)	KLM/Northwest (in percent)
B	Without Code Sharing	2.9	34.4
A	With Code Sharing (Baseline)	11.2	45.0
C	Interline Code Sharing Equivalent to Online	19.2	46.4

7.2 WELFARE EFFECTS OF CODE SHARING

7.2.1 Calculation of Consumer and Producer Surplus

One of the objectives of the present research is to assess the impacts of code sharing by estimating the costs and benefits accruing to affected consumers and producers. Both consumers and producers of airline services can enjoy benefits or suffer losses from code-sharing agreements. The impact of a code-sharing agreement on U.S. welfare is the net effect of these gains and losses. Policymakers must be concerned with these economy-wide net benefits while code-sharing partners and their competitors are concerned with, and understandably focus on, only the net benefits that accrue to them from these agreements.

In considering net benefits, a partial equilibrium framework is adopted meaning that only the changes in net benefits accruing to consumers and producers are considered and not the potential downstream effects on, for example, aircraft manufacturers. A formal measure of the effects on consumers is available using the economic concept of "compensating variation" (CV).[1] If income effects are small, then CV can be accurately approximated by the change in consumer surplus. An advantage of the logit specification used here is that it allows direct computation of consumer surplus impacts that arise when moving between any two scenarios. (Details on the theoretical underpinnings for the logit model are presented in Appendix A.) The surplus, measured in dollars, is calculated on a per capita basis for each passenger in a given market. It is important to note that the calculation of consumer impacts discussed below implicitly assumes the "Optimistic Case" regarding CRS and service effects described in Chapter 5. If there are significant CRS biases or if the implicit service quality differences embedded in the code sharing coefficients reflect changes that would have occurred anyway, then the consumer surplus estimates presented below will be overstated.

After the per capita consumer surplus is estimated in each market, a disaggregation into U.S. and foreign components is carried out based on Immigration and Naturalization Service (INS) data indicating U.S. citizen passenger shares for specific carriers and gateway-to-gateway flight segments.[2] These data do not allow one to infer true O&D-specific citizen shares; instead, an aggregation is performed across carriers and cities within each country to obtain direction-specific segment-based estimates of U.S. passenger shares by country of origin or destination. Each sample market is then assigned to the appropriate U.S./foreign country category. For example, the aggregated INS data indicate that 47.7 percent of passengers travelling on flights originating in the U.S. and terminating in the UK are U.S. citizens, while the remaining 52.3 percent are foreigners. Thus, the total consumer surplus calculated for any sample market beginning in the U.S. and ending in the UK is divided into U.S. and foreign components based on these shares.

The net change in economic rents earned by U.S. producers is the appropriate welfare measure of producer benefits. As a practical matter, this measure can be approximated as the change in above-normal profits earned by producers.[3]

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[1]For a given change in the price or some other attribute of a given product or service, the compensating variation is defined as the amount of income that must be given to (or taken from) a consumer to make him or her just as well off after the change as before.

[2]I-92 Database, provided by DOT/Volpe National Transportation System Center, First Quarter 1994.

[3]A fuller accounting of producer net benefits would also include any changes in economic rent earned by travel agents and changes in labor rents earned by airline and travel agent employees. Changes in economic rent earned by travel agents are likely to be small if code sharing does not significantly affect the total volume of air traffic as opposed to affecting the distribution of traffic. Changes in airline labor rents could be significant, however, if U.S. airline employees earn significant

The effect on producer surplus is measured as the change in carrier net profits for each alternative (revenues minus costs) when moving between any two scenarios. Given the assumption of no change in market sizes, gross revenue for a given alternative in any sample market is computed using the following formula:

Gross Revenue = Fare (excluding tax) · Estimated Market Share · Market Size

Each alternative in a given O&D market is assigned to the U.S. or foreign category based on the carrier's corporate location; cross-carrier ownership shares are ignored in making this assignment. In the case of interline alternatives involving both U.S. and foreign carriers, standard IATA prorate factors are used to divide the revenue based on which carrier flew which leg of a given flight offer. These prorates are then aggregated across individual flights to obtain a single revenue division for each alternative in any given market.

In the case of code-sharing flights, comprehensive information regarding revenue divisions which presumably are part of the code-sharing agreements is not available. Nevertheless, certain industry sources indicated that, on average, the divisions in at least some of the agreements may be close to what would occur if IATA prorates were applied anyway. Thus, the same prorate procedure used for regular interline flights also is used for interline code-sharing offers. For online code share offers where only one of the carriers does the flying, the code-sharing carrier is assumed to receive fifteen percent of the fare on the share of tickets estimated to be a result of the code sharing (i.e., the difference in passengers between the baseline and "no code sharing" scenarios.)

On the cost side, an important assumption noted earlier is that when moving between scenarios, there is no change in capacity; thus, the only incremental costs incurred would be passenger-related. These costs are divided into two categories: (1) ticketing, sales and promotion, and (2) passenger services.

Ticketing, sales and promotion costs include all cost items related to reservations, ticketing (including ticket commissions), sales and promotion activities, accommodation costs, and agency fees for outside services. The largest component is commissions on ticket sales, which are related directly to the dollar value of each ticket sold. Thus, an estimate of the average ticketing, sales and promotion cost per dollar of

rents before code sharing, and if code sharing causes a significant redistribution of traffic toward foreign carriers. Changes in labor rents are not addressed directly in this analysis. However, a broader discussion of the effects of code sharing on U.S. employment is presented in Section 7.3.

revenue was computed for each carrier using ICAO data where available[4]; otherwise, U.S. or foreign averages are used. (ICAO data for major U.S. carriers are broken down by region; costs (and revenues) from Pacific operations for these carriers were excluded from the calculations since commissions tend to be significantly higher on Pacific routes than on domestic and Atlantic routes which dominate U.S. carriers' code-sharing markets.)

Passenger servicing costs include expenses related to cabin attendants and other passenger service personnel, meals and accommodation, etc. Unit costs are developed for this category as a percentage of revenue-passenger-miles flown. The unit costs developed for both ticketing and passenger servicing are presented in Table 7-2.

As with revenues, the per passenger cost calculated for each alternative in a given O&D market is assigned to the U.S. or foreign category based on the carrier's corporate location. In the case of interline alternatives (code-sharing and non-code-sharing) involving both U.S. and foreign carriers, costs are calculated for each leg of each itinerary and assigned to the appropriate category.

For online code-sharing offers, the code-sharing agreements typically call for the ticketing carrier to pay the ticketing commission cost, which is the largest component of fare-related costs, as noted earlier. For the present analysis, it is assumed that the code-sharing carrier incurs costs equal to ten percent of the fare for each code-sharing passenger gained as a result of online code sharing.

Both consumer and producer welfare effects apply on a per capita basis for each passenger in a given market; average per capita impacts are developed for each of the two major code-sharing deals based on each alliance's code-sharing markets which appeared in the sample. The per capita consumer and producer surplus estimates are shown in Table 7-3.

Table 7-2

ESTIMATED UNIT PASSENGER-RELATED COSTS

Foreign Carrier	Ticketing Expenses (per $ Revenue)	Passenger Servicing Expenses (per RPM)
Qantas	0.2293	0.0144
AUA	0.2711	0.0380
Varig	0.3648	0.0272

[4] Civil Aviation Statistics of the World, ICAO, 1992.

Air Canada	0.2167	0.0202
Canadian	0.2805	0.0207
Egyptair	0.0890	0.0061
Finnair	0.1162	0.0216
Air France	0.1862	0.0442
Air Inter	0.1148	0.0396
Olympic	0.2042	0.0259
Indian	0.1037	0.0051
Alitalia	0.2407	0.0347
All Nippon Airways	0.1625	0.0442
Jal	0.2127	0.0303
Japan Air System	0.1363	0.0556
Japan Asia	0.2382	0.0486
Aeromexico	0.1689	0.0075
Mexicana	0.2288	0.0186
Air New Zealand	0.2644	0.0194
TAP	0.1941	0.0377
SAS	0.2236	0.0465
SIA	0.1980	0.0208
Aviaco	0.1494	0.0320
Thai Airways	0.1910	0.0174
Air UK	0.1544	0.0720
British Airways	0.1970	0.0284
British Midland	0.1174	0.0417
Cathay Pacific	0.0688	0.0201
Virgin Atlantic	0.2411	0.0106
Air Afrique	0.2167	0.0369
Average	**0.1952**	**0.0284**

US Carrier	Ticketing Expenses (per $ Revenue)	Passenger Servicing Expenses (per RPM)
Alaska	0.2087	0.0197
American	0.2000	0.0158
America West	0.1875	0.0085
Continental	0.1949	0.0120
Delta	0.2241	0.0182
Northwest	0.2100	0.0139
TWA	0.2056	0.0149
United	0.2209	0.0158
USAir	0.1939	0.0211
Average	**0.2085**	**0.0158**

Note: US carrier ticketing expenses exclude Pacific region data.

Table 7-3

ESTIMATED PER CAPITA CONSUMER SURPLUS FOR MAJOR CODE-SHARING MARKETS

	Consumer Surplus	U.S. Share of Passengers
BA/USAir	$9.77	47.8%
Northwest/KLM	$31.12	48.0%

ESTIMATED PER CAPITA PRODUCER SURPLUS FOR BA/USAIR CODE-SHARING MARKETS

	Revenue	Cost	Net
USAir	7.48	-2.15	5.33
Other US Carriers	-39.52	14.16	-25.36
US Total	**-32.04**	**12.01**	**-20.03**
British Air	43.43	-17.67	25.76
Other Foreign Carriers	-1.27	0.51	-0.76
Foreign Total	**42.16**	**-17.16**	**25.00**
Grand Total	**10.12**	**-5.15**	**4.97**

ESTIMATED PER CAPITA PRODUCER SURPLUS FOR NORTHWEST/KLM CODE-SHARING MARKETS

	Revenue	Cost	Net
Northwest	28.22	-9.78	18.43
Other US Carriers	-29.30	11.36	-17.94
US Total	**-1.08**	**1.58**	**0.49**
KLM	21.34	-9.17	12.17
Other Foreign Carriers	-18.91	9.07	-9.84
Foreign Total	**2.43**	**-0.10**	**2.33**
Grand Total	**1.35**	**1.48**	**2.82**

7.2.2 Estimated Welfare Impacts for BA/USAir and Northwest/KLM

Given per capita estimates, the overall welfare impacts can be found by scaling the results by overall market sizes. To accomplish this, the BA / USAir and Northwest / KLM per capita figures are scaled by estimates of the total annual gateway-gateway, Behind U.S.-Europe and Behind Europe-U.S. O&D traffic across all BA / USAir and Northwest / KLM code-sharing markets based on the DB1A 1994Q1 ticket sample. (This excludes "behind-behind" markets, but includes DOT-approved single-connect markets where the partners may not yet be offering code-sharing service.)

Two adjustment factors are applied to these traffic estimates. First, the quarterly traffic totals obtained from the first quarter DB1A are scaled up by a factor of five rather than four to obtain annualized estimates because international traffic increases significantly during the summer months. Second, as noted earlier, the DB1A sample severely undercounts passengers on alternatives that do not involve any U.S. carrier. In the sample markets, choices that involve at least one U.S. carrier account for about 69 percent of total seats; assuming passenger counts are approximately proportional to seat offers, the DB1A undercounts total traffic in these markets by a factor of 1 / .69 = 1.44. This factor is applied to the estimated DB1A traffic totals for all of the BA / USAir and Northwest / KLM code-sharing markets.

The estimates which follow do not include "behind-behind" markets where the code-sharing partners could offer double-connect service. However, based on a review of the types of flights in the ticket sample, it is estimated that a doubling of the following projections may provide a reasonable gauge of the overall annual dollar impact of these two code-sharing alliances.

This conclusion is derived by examining the potential double-connect markets that could be served by Northwest / KLM and projecting passenger totals (from the ticket sample) in these markets. Specifically, a count was made of the total number of passengers excluding non-stop or one-stop online tickets, since it is unlikely that two-stop code-sharing service would be attractive to these passengers. The remaining passenger totals across all of the Northwest / KLM double-connect markets are approximately equal to the total number of passengers in their single-connect and gateway-to-gateway markets. Thus, if code sharing has the same relative effect in both types of markets, then a doubling of the model results provides a reasonable estimate which accounts for double-connect traffic. Although a similar analysis was not carried out for USAir / BA, we would expect comparable results since the passenger totals in the single-connect markets are similar for both alliances.

The results in Table 7-4 show that the BA/USAir code-sharing alliance has benefitted foreign carriers at the expense of U.S. carriers. The annual decline in U.S. producer surplus is estimated to be about $21.2 million. Even after accounting for benefits to US consumers, the overall net impact on the U.S. is negative. This is not surprising given the one-way nature of the code sharing (BA puts its code on USAir flights, but not vice versa) and the fact that BA does virtually all of the long-haul flying between the U.S. and London.

In contrast, as shown in Table 7-5, the Northwest/KLM alliance provides sizable benefits to U.S. passengers and small (but positive) benefits to U.S. carriers as a group. Again, it is important to emphasize that the results presented here may be understated because they are based only on a single "snapshot" of code-sharing markets at a relatively early point in their development.

Based on reports filed by Northwest since the first quarter, it is also likely that the overall share of traffic accruing to U.S. vis-à-vis versus foreign carriers due to the Northwest/KLM alliance is much more favorable to U.S. interests than is indicated by the results shown here, which are based only on first quarter data. Specifically, these reports indicate that code-sharing traffic over Northwest's Minneapolis and Boston hubs is growing significantly faster than traffic flowing over their Detroit hub.[5] Since Northwest does all of the flying on the Minneapolis-Amsterdam and Boston-Amsterdam legs, while KLM flies only the Detroit-Amsterdam leg, Northwest is undoubtedly receiving the lion's share of the traffic increase since the first quarter of 1994. Thus, overall traffic shares and probably revenue shares of U.S. carriers will be higher than is indicated here for the Northwest/KLM code-sharing agreement.

7.3 IMPACTS ON U.S. EMPLOYMENT

As noted in Chapter 4, there are concerns about the potential effects of code sharing on U.S. employment. The results of the model developed for this study cannot be used to directly address potential effects on U.S. employment, because the model assumes no changes in flight offers. However, employment issues can be addressed qualitatively. First, it is clear that code-sharing impacts from shifts in behind-U.S. gateway traffic are likely to be negligible on U.S. employment overall. Any shift in traffic would be from one U.S. carrier to another. Similarly, for traffic shifts behind-foreign gateways, impacts are likely to be small because any shift in flying is likely to be from one foreign carrier to another.

Table 7-4

[5]Data provided by DOT Office of Aviation Analysis.

ESTIMATED ANNUALIZED IMPACTS OF THE BA/USAIR CODE-SHARING ALLIANCE (Based on 1994Q1 Data)

Carrier	Producer Revenue ($Mil)	Producer Cost ($Mil)	Net Producer Surplus ($Mil)	Consumer Surplus ($Mil)	Net Social Surplus ($Mil)
USAir	7.9	-$.3	5.6		
Other U.S. Carriers	-41.7	14.9	-26.7		
U.S. Total	**-33.8**	**12.6**	**-21.1**	**4.9**	**-16.2**
British Airways	45.8	-18.6	27.2		
Other Foreign Airlines	-1.3	0.5	-0.8		
Foreign Total	**44.5**	**-18.1**	**26.4**	**5.4**	**31.8**
Grand Total	**10.7**	**-5.5**	**5.3**	**10.3**	**15.0**

Table 7-5

ESTIMATED ANNUALIZED IMPACTS OF THE NORTHWEST/KLM CODE-SHARING ALLIANCE (Based on 1994Q1 Data)

Carrier	Producer Revenue ($Mil)	Producer Cost ($Mil)	Net Producer Surplus ($Mil)	Consumer Surplus ($Mil)	Net Social Surplus ($Mil)
Northwest	$24.6	-$8.5	$16.1		
Other U.S. Carriers	-25.6	9.9	-15.7		
U.S. TOTAL	**-1.0**	**1.4**	**0.4**	**13.0**	**13.4**
KLM	18.6	-8.0	10.6		
Other Foreign Airlines	-16.5	7.9	-8.6		
Foreign Total	**2.1**	**-0.1**	**2.0**	**14.1**	**16.1**
Grand Total	**$1.1**	**$1.3**	**$2.4**	**$27.1**	**$29.5**

Any meaningful impacts on U.S. airline employment are likely to result from shifts in long-haul flying caused by code sharing. The increase in market share associated with code-sharing flights will be at the expense of the other carriers in the market. These are likely to include both U.S. and foreign carriers.

Therefore, the effects of any particular code-sharing agreement on U.S. employment will depend on: a) the extent to which the code-sharing partners add service in the relevant markets; b) the extent to which other competitors reduce service; and c) the relative amount of flying performed by U.S. and foreign carriers in each case.

Although the model does not project changes in the number of carrier flight offers, it does project changes in passenger revenue, and it is likely that induced changes in capacity would be closely correlated to changes in revenue. As shown above in the analysis of the USAir/BA agreement, nearly all the revenue losses are by U.S. carriers and all the gains are by BA. In the case of the Northwest/KLM agreement, both carriers gain revenue at the expense of other U.S. and foreign carriers. In fact, Northwest's revenue gain is about equal to the revenue lost by other U.S. carriers.

Another factor which must be considered in the analysis of potential effects on U.S. employment is that code sharing often is but one part of a broader strategic alliance between U.S. and foreign carriers. In the case of both USAir/BA and Northwest/KLM, foreign carriers made substantial capital infusions in their U.S. partner. As such, the U.S. carriers may have been able to avoid other types of restructurings which could have negatively affected U.S. airline employment.

7.4 APPLICATIONS TO OTHER CODE-SHARING PROPOSALS

The present analysis has demonstrated the feasibility of modeling air travel markets to assess the impacts of code sharing on U.S. and foreign producers and consumers. Keeping in mind the major limitations--namely, the static nature of the analysis and the assumptions that code sharing affects neither overall market sizes nor the amount of service—the results from the model estimated in this study could be used to assess the likely impacts of other code-sharing proposals.

Such an analysis would entail using the estimated model coefficients to project estimated market shares with and without code sharing in city-pair markets where applicants were proposing to offer code-sharing service. To carry out such an analysis, first it would be necessary to construct choice sets in the relevant markets. If one were willing to accept the lag in DB1A reporting, it might be feasible to obtain current flight offer information directly from CRS terminals rather than through the OAG. Then, the attributes (i.e., the values of the explanatory variables) associated with each choice would be developed. Relatively little effort would be required to produce the values for FIRSTPCT and the HUB variables since the underlying data on seating classes and hub airports have already been developed for the present analysis. However, a more significant effort would be required to develop the data on seat shares, fares, average time between departures and average elapsed time per flight, as these attributes are market-specific.

The basic approach to estimating market share and surplus effects would be the same as presented here. Specifically, one would first project a set of baseline market shares by combining the constructed choice sets and attributes with the estimated coefficients of the current model; these projected shares would represent the current "no code sharing" baseline. Then, a counterfactual scenario would have to be developed where specific alternatives in each market would be assumed to switch from regular service to code-sharing service. A new set of market shares then would be projected for this "code sharing" case. Just as in the present analysis, the "effects" of the proposed code-sharing alliance could be assessed by comparing the projected results under each scenario.

The work effort involved in such an analysis would depend importantly on the number of city-pair markets over which one wished to obtain predictions, which suggests that the method could be implemented more easily for smaller code-sharing proposals.

7.5 RECOMMENDATIONS FOR FURTHER RESEARCH

As noted above, the model estimates presented here could be used to assess the likely impacts of future code-sharing agreements. However, a primary limitation inherent in the present analysis, and one which would affect such future assessments, owes to the fact that international code sharing is a very recent phenomenon where carrier relationships may take time to develop. Thus, estimates based on 1994Q1 data likely reflect relatively immature relationships which may have changed significantly in the interim. The special reports provided by USAir and Northwest provide support for this view. Moreover, both of the major code-sharing alliances analyzed here may themselves be affected by the development of the United/Lufthansa agreement, which is just now beginning to take hold.

The changing and developing nature of the code-sharing environment suggests that DOT may want to consider updating the analysis presented here by re-estimating the model with more recent data. Prior to undertaking any such effort, however, it is strongly suggested that DOT consider the possibility of obtaining ticketing information from foreign carriers who fly to or from U.S. gateways. As noted in the analysis, important theoretical and computational compromises had to be made owing to the lack of available data on foreign carrier tickets. It is also important to note that there were significant learning curve effects associated with processing and handling the data inputs and estimating the carrier choice model. This suggests that future efforts could be accomplished more quickly and with fewer resources than used in this study.

CHAPTER 8: THE FUTURE OF CODE SHARING

8.1 INTRODUCTION

There are a number of factors which will affect code sharing in the future. These include the existing bilateral and regulatory regime and future developments in these areas. In addition, the likely future structure of the airline industry can be affected by code sharing and also could affect the need for carriers to code share in order to form transnational alliances. The policies of governments in other regions of the world also could affect the need for or the ability of U.S. carriers to enter into code-sharing agreements with foreign carriers.

This section of the report opens with a discussion of the likely future environment of the international airline industry and the broad factors which will affect code sharing. After that, the section identifies how the empirical analysis in Chapters 6 and 7 provides insights into the future structure of the airline industry. Finally, the potential policy goals of DOT towards code sharing are examined along with a discussion of the data that DOT should acquire to monitor code sharing.

8.2 FUTURE OUTLOOK FOR THE INTERNATIONAL AIRLINE INDUSTRY

8.2.1 Experience of the U.S. Airline Industry

The airline industry in the United States underwent dramatic restructuring after airline deregulation. In the first years, there was a flurry of entry by new carriers. This was followed by a period of consolidation when there were a number of airline mergers and some carriers exited the industry. Airlines increasingly turned to hub-and-spoke operations to exploit economies of density and scope. These systems generally featured increased frequency of service with smaller aircraft. The hub-and-spoke networks and increased competitive rivalry lead to a dramatic decline in interline service as airlines sought to serve passengers on one system from origin to destination.[1] Table 8-1 shows the proportion of flights which were direct, connected on the same carrier or were interline connections in 1979, 1984 and 1988. Direct flights decreased somewhat and interline connections decreased markedly, while online connections doubled over the period.

Table 8-1

PASSENGER SHARE OF DIRECT SERVICE, ONLINE, AND INTERLINE CONNECTIONS

Type of Service	Share in 1979	Share in 1984	Share in 1988
Direct	0.7	0.72	0.65
Online Connecting	0.16	0.22	0.32
Interline Connecting	0.14	0.06	0.03

Source: Bruekner and Spiller, "Economics of Traffic Density in the Deregulated Airline Industry," Journal of Law and Economics, October 1994, pg. 380.

Today the U.S. domestic airline industry is dominated by a small number of very large airlines. However, in recent years new entrant carriers have emerged, and a number of niche carriers, such as Southwest, have become important factors in the domestic airline market. Even with fewer carriers, there is substantial competition among the large U.S. airline networks. Although the industry has consolidated, there has been an increase in market-pair competition since deregulation. For example, as shown in Table 8-2 the average number of competitors in various groupings of the largest airline markets has increased over the 1978 to 1988 time period. Pricing discipline is exercised by the niche carriers and new entrants in many markets.

8.2.2 Outlook for the International Airline Industry

If the trend toward creating hub-and-spoke networks continues, the international airline industry will likely follow the same course as in the U.S. after deregulation. A number of factors are currently pushing for greater international

[1] Jan K. Bruekner and Pablo T. Spiller, "Economies of Traffic Density in the Deregulated Airline Industry," Journal of Law and Economics (October 1994) pp. 379-381.

consolidation into hubs and spokes. However, there are also factors that will serve to encourage smaller, niche airlines like those that have sprung up in the U.S.

Table 8-2

CONCENTRATION AT THE CITY-PAIR LEVEL (INVERSE OF HERFINDAHL INDEX)

Group	1978	1984	1988
Largest 100 markets	1.89	2.72	2.72
Largest 300 markets	1.86	2.36	2.42
Largest 500 markets	1.71	2.23	2.30

Source: Bruekner and Spiller, "Economics of Traffic Density in the Deregulated Airline Industry," Journal of Law and Economics, October 1994, pg. 383. Markets are ranked by 1988 O&D traffic.

Demand factors--If world income grows at a moderate 2.5-3.0 percent per year, in twenty years aggregate income will be 64-80 percent higher than today. Assuming that air transportation has a conservative income elasticity of demand of 1, there will be more than half again as much demand twenty years from now. The result is that many routes will become more densely traveled than they are now. At larger airports this will promote more point-to-point traffic because of the very high traffic densities. At the same time, smaller airports that are now spokes may become hubs for their local areas, as potential traffic density increases on routes that are not now served.

Supply factors--Higher costs for airlines will make it unprofitable to operate less densely traveled routes. The result will be a strengthening of hub-and-spoke networks. New technology that allows for larger aircraft will also tend to make hub-and-spoke networks more desirable. However, technology that reduces costs at lower levels of density will tend to promote point-to-point service.

Infrastructure--As airports become more congested, hub-and-spoke operations will become more difficult. Point-to-point routes will increase at larger airports, while less congested airports may become new hubs. In many parts of the world infrastructure availability is already a major problem. Carriers that wish to expand the reach of their networks may not be able to acquire the necessary airport facilities and landing slots. As a result, they will be forced to ally with other carriers who already have these scarce assets.

These factors taken together will serve to increase the use of hub-and-spoke networks in many areas, especially those where the airline industry is less developed, as in many international markets. On the other hand, in more developed markets, these factors may result in the emergence of more niche carriers flying point-to-point routes. The result will be that code sharing continues to have value because it can connect the hub networks of international carriers, but that these markets may become more contestable because of possible entry by the niche carriers.

The international airline market is less developed than the U.S. domestic market, but its growth has been very fast. The North America-Europe market is projected to grow faster than the U.S. domestic market, and the markets to the Middle East and Asia are growing at even greater rates. Table 8-3 shows traffic growth forecasts for a number of major markets. Much of the impetus for the many new airline alliances is the fast growth of international markets. In fact, as shown in Table 8-3, the FAA expects that international traffic of U.S. air carriers will grow at almost twice the rate of domestic traffic.

Table 8-3

FORECAST ANNUAL GROWTH RATE OF REVENUE PASSENGER MILES

	Forecast Growth Rate (%)		
Market	1995-2000	2000-2005	2005-2010
FAA:			
U.S. Carriers-Domestic	4.31	3.64	
U.S. Carriers-Int'l	8.05	6.30	
Boeing:			
N. America-Europe	5.28	4.59	4.43
Intra Latin America	5.32	5.06	4.80
N. America-Middle East	5.41	4.53	4.14
Intra Europe	5.60	4.83	4.45
Europe-Latin America	6.06	5.07	4.69
N. America-Latin Amer.	6.87	5.96	5.45
Asia-Middle East	7.66	7.55	6.59
Europe-Middle East	7.10	4.89	4.11
Asia-Europe	9.40	8.24	7.62
Intra Asia	9.69	8.18	7.63
N. America-Asia	9.81	8.08	7.30

Sources: U.S. Carriers: FAA Aviation Forecasts 1994-2005, pg. IX-13; World markets: Current Market Outlook, Boeing Commercial Airplane Group, 1994, Appendix A.

International markets are just now beginning to undergo the transformation to hub-and-spoke networks. Consolidation and cross-border ownership are taking place.

For example, British Airways acquired a domestic competitor, British Caledonian, while Air France secured additional domestic feed when it acquired Air Inter and eliminated an international competitor when it bought UTA. These mergers were approved under European Union competition rules because they strengthened European airlines in the face of competition from the U.S. mega-carriers.[2] Table 8-4 shows some airlines which hold significant interests in foreign carriers.[3] These investments are held by airlines seeking to expand the reach of their own networks. Some European airline alliances have been formed as carriers seek to position themselves to take advantage of the liberalization of airline services within the European Union.

As an example, British Airways has invested in Qantas and holds equity positions in other European carriers such as Deutsche BA and TAT. These arrangements involve code sharing as does its agreement with USAir. Iberia has invested in South American carriers. KLM has invested in and maintains an extensive relationship, including code sharing, with Northwest. Air France has invested in Sabena. Delta, Singapore and Swissair have exchanged equity investment in one another. These are but a few examples of carriers forming transnational alliances, many of which involve code sharing.

In addition to developments in the U.S. and Europe, which represent the majority of the world's airline markets, carriers elsewhere seem to believe that they must become part of a larger alliance to survive. The large U.S. mega-carriers--American, Delta and United--which combine strong domestic hub systems and large international route systems seem to have spurred other carriers to believe that a large network is essential for survival.

It appears that the restructuring of the world's airline industry has begun even under a restrictive regulatory regime for international airline services. While there have been many calls for a more liberal international airline regulatory regime, it does not appear that this will come about immediately or without a struggle. However, it is

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[2]Stephen Wheatcroft, Aviation and Tourism Policies: Balancing the Benefits, London: Routledge, 1994, p. 31.

[3]Not all carriers with investments in foreign carriers are shown. In addition, the table excludes domestic airlines owned by others and the ownership of some foreign carriers which does not represent a strategic alliance.

Table 8-4

INTERNATIONAL CROSS-OWNERSHIP OF AIRLINES

Owner	Airline	Share
Air Canada	Continental	0.196
Air France	Sabena	0.375
Alitalia	Malev	0.300
AMR Corp.	Canadian Airlines Int'l	0.330
British Airways	Deutsche BA	0.490
British Airways	Qantas	0.250
British Airways	TAT	0.499
British Airways	USAir	0.246
Cathay Pacific	Dragonair	0.430
Delta Airlines	Singapore Airlines	0.027
Delta Airlines	Swissair	0.045
Iberia	Aerolineas Argentinas	0.830
Iberia	Ladeco	0.375
Iberia	Viasa	0.450
KLM	Air UK	0.149
KLM	ALM Antillean	0.400
KLM	Northwest	0.250
SAS*	British Midland	0.349
Singapore Airlines	Delta Airlines	0.050
Singapore Airlines	Swissair	0.027
Swissair	Delta Airlines	0.046
Swissair	Singapore Airlines	0.006

*SAS held an investment in Continental which was written off as a result of Continental's bankruptcy.

Source: Air Transport World, July 1994, pp. 45-49.

apparent that airlines have found ways within the existing system to achieve economies of scope and density by forging alliances with other airlines. Code sharing has become an integral component of these alliances.

Much of the additional airline consolidation is likely to be overseas because the rest of the world is characterized by a large number of moderately sized airlines. These carriers will either have to develop a defensible niche operation by specializing in a particular type of service or serving a particular region of the world, or they will seek to become a part of larger airline alliances. Nationality (for bilaterals) and flag carriers (for sovereignty) are likely to continue to be important to some countries, so alliances may be formed where the participating carriers retain some separate identity.

The European Union's (EU's) recent airline liberalization allows nationals from one country to establish a carrier in any other EU country and provides virtually unlimited market access within the EU to EU carriers (cabotage is not available until 1997). Thus, bilaterals between EU countries have been largely supplanted by the formation of the EU aviation market. However, bilaterals between EU countries and non-EU countries will still present obstacles to carrier consolidation because of nationality requirements. This may be why carriers such as BA have formed affiliates in other countries so that they can benefit from a home country bilateral with a non-EU country. Code sharing is an important part of the BA arrangement with its affiliates, which operate as franchisees so that BA can brand the product as its own. Virgin Atlantic also has a number of similar arrangements with airlines from other EU countries.

Carriers are now seeking to establish brand-name identities for code-sharing service. British Airways is pursuing this strategy, along with a franchise concept linking together its partners in Europe. Northwest and KLM have developed their alliance to include a common Business Class product and have established identical on-board service. Delta is tying together its diverse code-sharing alliances and marketing them under a common theme. These trends are likely to continue and even expand as carriers try to further develop integrated systems. It is these and other coordination activities which are most likely to succeed in attracting additional traffic to the code-sharing alliance.

8.2.3 Prospects for Consolidation and Alliances in Asia

Thus far, there have been no broad-based code-sharing alliances with Asian carriers, similar in scale to USAir/BA or Northwest/KLM. However, there have been some moves in this direction. For example, Singapore Airlines has exchanged equity investment with both Delta Airlines and Swissair. Thai Airways International recently entered into discussions with Lufthansa for a broad code-sharing agreement and other types of cooperative activities. Because Thai is also setting up an agreement with United, this may represent the emergence of a globe-spanning alliance if it goes forward. It also has been reported that the Japanese government has changed its policy and will allow its carriers to enter into strategic alliances with foreign carriers.

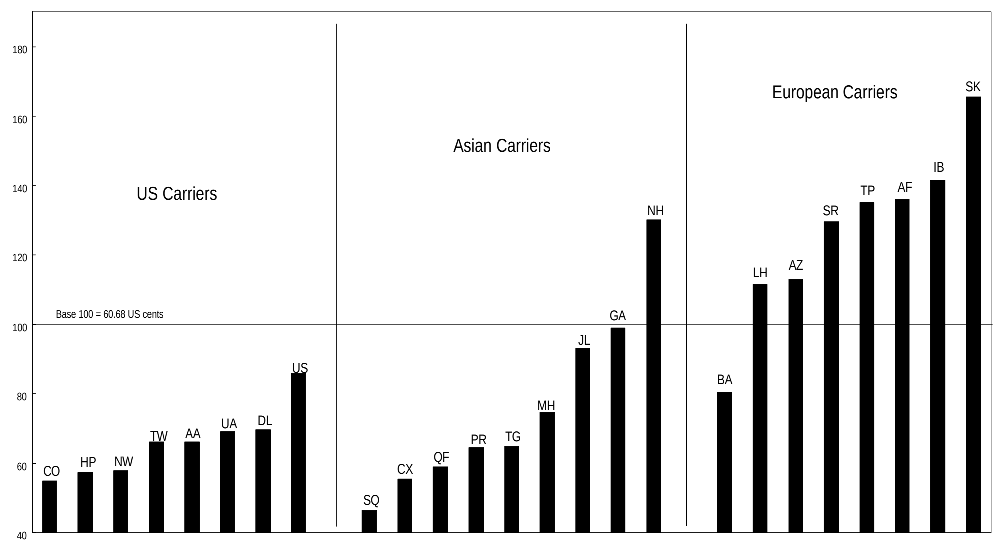
The Asian market has some interesting similarities to the European market. For example, Tokyo is strikingly similar to London. It has a congested airport where national carriers are protected by slot constraints. It makes a superb gateway because it is the area's largest city and economic hub and the first major city that aircraft flying from the U.S. reach.

As with Europe, some U.S. carriers already have extensive service to Asia including fifth freedom rights. They will not want to give up long-haul flying to Asian carriers. On the other hand, the U.S. airlines without Asian service may be especially interested in code sharing with an Asian partner as a means to access traffic in this rapidly growing market.

8.2.4 U.S. Airline Competitive Prospects

In the face of these major changes in the international environment, U.S. carriers have strong competitive positions and are attractive as members of global carrier alliances. Figure 8-1 shows a comparison of U.S. carrier costs with those of European and Asian carriers. Only BA, among the European carriers, has unit costs approaching those of U.S. carriers. (KLM did not file financial data with ICAO and is not included in the comparison.) It is expected that other European carriers will attempt to reduce their costs, but the U.S. has a significant lead time advantage in this area owing to the early (relative to the rest of the world) deregulation of the U.S. airlines. The U.S. does not have a clear cost advantage over Asian airlines, however.

Figure 8-1: Operating Costs per Available Tonne-Kilometer



Source: Civil Aviation Statistics of the World, ICAO (1992). All figures for 1992 except 1991 for GA, MH, LH, SR, and IB. (KL did not report.)
Note: Costs are not stage length adjusted.

It can be expected that, over time, the transnational alliances will try to shift flying to the lower cost airlines within the group. This should reduce the overall costs of the network and will serve to make the alliance more competitive with other alliances. Once the first alliance begins to take this step, others will face competitive pressures to follow suit. (Undoubtedly, there will be barriers in some countries to making the shift, including agreements with labor, national employment policies, and so forth.) The shift to lower cost airlines should work to the advantage of U.S. carriers and to U.S. factors of production such as airline labor. Long-haul routes connecting the alliances are the most likely areas for this because they can be flown by the carrier at either endpoint.[4] In the case of alliances between U.S. and Asian carriers, there does not appear to be a clear cost advantage favoring flying by U.S. carriers. However, Japan is a notable exception to this.

It is likely that international airline consolidation will take place whether or not U.S. carriers participate. In fact, as noted above, it is already taking place. Therefore, U.S. carriers will have to compete in an environment where there will be large airline alliances, and with the existing broad-based alliances involving some U.S. carriers, the question facing DOT is not whether U.S. carriers should participate, but rather whether any limitations should be placed on their participation.

8.2.5 Airline Network Types

[4]The recent code-sharing agreement between Continental and Alitalia has Continental flying the Newark-Rome route under a wet lease to Alitalia. This provides benefits to the U.S. carrier and its employees. It is also likely to represent an overall cost reduction for the alliance.

Airlines are taking a number of approaches to position themselves for global competition. It useful to describe the types of carrier organizations which have come into existence. These include the following, among others:

- **Classic Interline**--A carrier depends on feed at both ends of international gateway services. Commercial arrangements are governed by standard IATA prorates, with the possibility of preferential prorates in the most important markets to the carriers. An example of this would be how Japan Airlines and Air India interact at gateways in Japan and India.

- **Integrated Carrier Online**--A carrier relies on its own network and brand, and connects a large number of foreign gateways to its hub(s). Such a carrier may oppose code sharing, especially on a broad scale, preferring to obtain additional authority to expand its own network. It will enter into ad hoc code sharing to obtain access in thin markets, to establish a market presence, or if direct access is not bilaterally or commercially feasible. This resembles the position taken by American Airlines.

- **Integrated Carrier Online Plus**--A carrier maintains an integrated online system but enters into code-sharing and other alliances to fill in gaps in its own network. It may elect to code share when it cannot obtain authority to provide online service or when it is not economic to operate online service. The carrier seeks to expand its network without a major investment in foreign carriers. An example of a carrier employing this strategy is Delta.

- **Bridged System Carrier**--An integrated carrier establishes a linkage with another integrated carrier to join together two existing airline networks covering different regions of the world. The carriers seek to provide the attributes of online service including single check-in for passengers, exchange of frequent flyer credits, coordinated schedules, and so forth. These cooperative agreements may be exclusive in the markets covered by the alliance, but these agreements do not involve equity investments. The two carriers may compete in some markets. Either partner may be free to enter into agreements with other carriers in markets not covered by the agreement. One example of this type agreement is that between United and Lufthansa.

- **Integrated Transnational System**--Two carriers enter into an agreement to act as single carrier in certain markets. This type of arrangement may require approval by one or both carriers' regulatory authorities, and may encounter resistance from other countries' regulatory authorities. This type of arrangement requires a long-term commitment by the participating carriers and is likely to be accompanied by equity investment by one or both carriers in the other. An example of this type of arrangement is that between KLM and Northwest.

The trend clearly is for many U.S. and foreign carriers to use alliances as a means to become a bridged system carrier or to achieve an integrated transnational system. In addition to the above, there are carriers such as Southwest which are pursuing a specific market niche which is not based on cooperation with other airlines. It may well be that other U.S. and foreign carriers pursue niche markets as an alternative to an alliance with another carrier.

8.3 IMPLICATIONS OF CODE-SHARING BENEFITS FOR LIKELY INDUSTRY STRUCTURE

The quantitative analysis in Chapters 6 and 7 show that code sharing can have large positive effects on the share of the market captured by the participating carriers. Therefore, it is likely that U.S. carriers will continue to seek code-sharing alliances with foreign carriers to maintain or improve their competitive position in international markets. Code sharing is also likely to become more widespread geographically. As a result, the international airline industry will increasingly become characterized by competition among integrated transnational airline systems. As happened in the U.S. domestic airline market after deregulation, this increased consolidation can be accompanied by increased competition. Notwithstanding this overall trend, there also is likely to be a place for niche carriers that specialize in serving specific regions or types of traffic.

The analysis also shows that code-sharing alliances produce substantial consumer benefits. They arise from the coordination activities undertaken by the code-sharing partners to make their service offers more closely resemble online service. As more and more carriers enter into code-sharing alliances, the market share benefits of individual code-sharing alliances are likely to diminish. However, consumers will be afforded a higher level of service overall. In the longer term, this will result in increased choices being available to consumers that will be provided by integrated transnational airline systems competing intensely with one another.

8.4 EFFECTS OF CODE SHARING ON SERVICE PATTERNS

Code-sharing alliances may have important effects on the level of service available at various airports. Airports that are hubs of carriers in an alliance are likely to see more service, while those that are not will likely see no change or perhaps a slight fall in service. These changes can affect the geographical distribution of code-sharing traffic.

When carriers form a code-sharing alliance, they have an incentive to align their service offerings with one another. By concentrating service at one-another's hubs, two airlines can maximize the number of code-sharing flights that they can offer. Most of the major airline alliances have resulted in new or increased services between the code-sharing airlines' hubs. KLM and Northwest began flights from Amsterdam to Northwest's hubs in Minneapolis and Detroit to take advantage of their alliance, and they increased service to Northwest's smaller hub in Boston. They have now announced plans to begin service from Amsterdam to Memphis, another Northwest hub. Delta and Swissair launched Cincinnati-Zurich service as part of their alliance, and BA recently announced that it would add a second daily flight into USAir's Philadelphia hub.

Such new flight offerings exploit the advantages of international networks described in Chapter 2. By connecting their hubs in the U.S. and abroad, the airlines in an alliance can achieve economies of scope and density. Economies of scope come from the ability to offer service to large numbers of city-pair markets including many double-connect markets. Economies of density may be achieved because of the greater traffic on the long-haul route between the hubs and perhaps on some of the spoke routes as well. For example, the Delta / Swissair alliance apparently increased Cincinnati-Zurich traffic sufficiently that it became economical to offer non-stop service in this market.

The effects of international networks on long-haul service in non-hub-to-hub markets is less clear. As an example, consider KLM's flights from Amsterdam to Houston. Houston is not a Northwest hub, so the flights to that city are not integral to the alliance. Passengers who wished to travel beyond Houston might find it easier to travel beyond Minneapolis using the better connections with Northwest. This could result in lower densities on the Houston route and perhaps a reduction in service. On the other hand, general economic growth will tend to increase traffic on all routes, including Houston-Amsterdam. These effects may well balance one another.

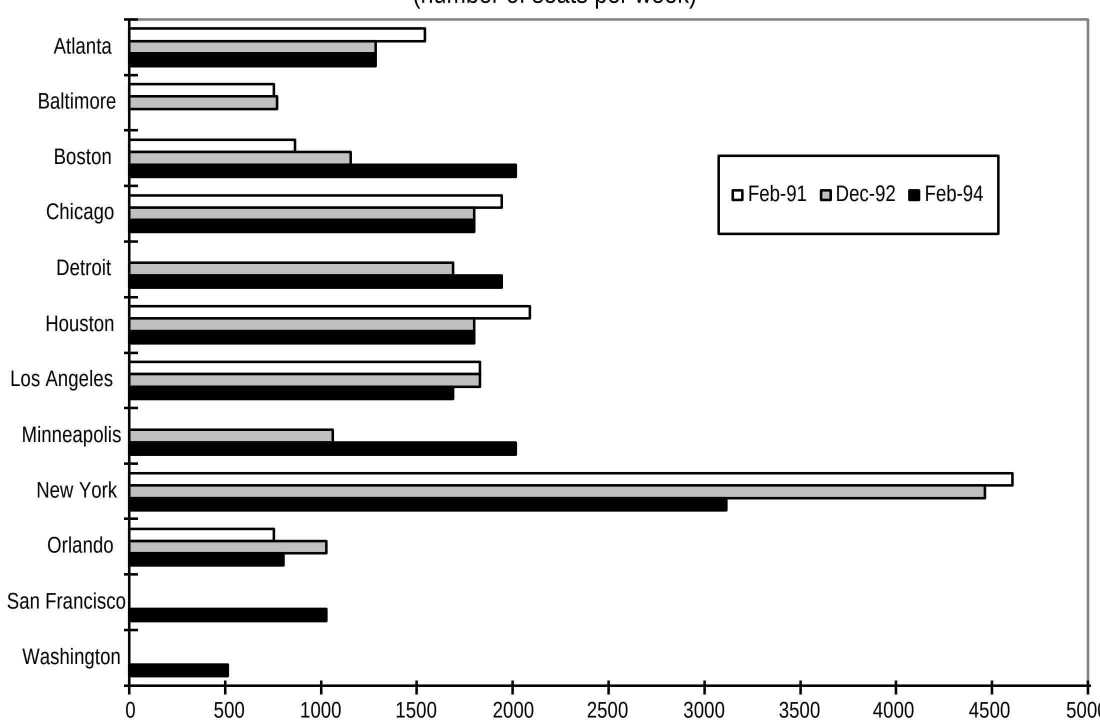
Service has in fact remained constant on most KLM routes between Amsterdam and U.S. cities that are not Northwest hubs. Figure 8-2 below shows that the number of seats offered per week between Amsterdam and Atlanta, Chicago, Houston, Los Angeles, and Orlando has stayed about the same since 1991. In 1991 no seats at all were offered to Minneapolis and Detroit, while these had become major destinations by 1994. Service on Northwest from Boston to Amsterdam doubled at the same time. There were reductions in service at New York and Baltimore, but these were largely offset by new service to San Francisco and Washington. In short, most new growth in the Amsterdam-U.S. market is taking place at Northwest hubs, but service is not significantly changing elsewhere.

The effects of code-sharing agreements are specific to the carriers involved and the existing service pattern. For example, some Delta alliances have not resulted in any new service at all, while as noted above Northwest and KLM have made considerable changes. In the future it is likely that more new service will open up between U.S. airlines' hubs and their partners' hubs overseas. Non-hub-to-hub international service could remain unchanged.

Figure 8-2

FLIGHTS FROM U.S. GATEWAYS TO AMSTERDAM ON KLM/NORTHWEST

(number of seats per week)



Source: International OAG

8.5 POTENTIAL DOT POLICY OBJECTIVES AND CONSTRAINTS

The consolidation of international airlines requires careful policy-making by DOT. DOT has considered a number of possible goals for its policies in light of the new organization of the airline industry. Among these goals are preserving and increasing access of U.S. carriers to foreign markets, preserving competition on both the international and the domestic fronts, and obtaining liberalized bilaterals or at least liberal code-sharing agreements. Achievement of these objectives will likely be constrained by the regulatory environment for international airline services.

8.5.1 Access

It is in the U.S. interest to have its carriers participate in international networks because they are evolving elsewhere, and it is likely that many alliances will take place whether or not U.S. carriers participate in them. U.S. carriers join alliances in an attempt to expand their networks. Many U.S. carriers have seen it in their own business interest to forge an alliance with a foreign carrier or carriers for this reason. Therefore, an important consideration is whether U.S. government policy will be to encourage or restrict its carriers from increasing the size of their networks through alliances with foreign carriers. (In the domestic airline market, this would be decided on the basis of antitrust considerations.)

If U.S. carriers are to increase the size of their networks, they must have access to foreign markets. At present there are often access problems, as the controversy surrounding the Delta / Virgin alliance clearly illustrates. One important DOT policy goal is that U.S. airlines have access to foreign points both directly and indirectly (via code sharing) beyond the initial foreign gateway, just as foreign carriers receive varying degrees of interior U.S. access depending on the U.S. grant of code-sharing rights and the U.S. partner chosen.

8.5.2 Competition

Another DOT objective is preserving competition, both in the international market and domestically. Much of the international consolidation and alliance-building parallels (albeit on a larger scale) the steps taken by U.S. airlines to forge alliances with regional carriers in the post-deregulation era. These too were pointed at increasing the size and scope of the carriers' networks. We would expect to see some of the large integrated U.S. carriers seek to lead a transnational network, while other U.S. carriers may be part of a transnational network involving a large foreign carrier. The important point is that this restructuring is taking place within the constraints of the existing regulatory system. If one looks at the experience of U.S. domestic airline deregulation, it appears that competition can be maintained with a smaller number of larger airline networks. Robust inter-network competition should be a force to assure that the economies of consolidation are passed forward to consumers.

The fact that competition can be maintained or increased with a small number of networks means that if industry consolidation occurs, it need not be anti-competitive. Furthermore, the building of large international networks could in some cases increase domestic competition by strengthening carriers that otherwise might exit markets. The increased competition that can occur because of international code sharing should be beneficial to the U.S.

8.5.3 International Regulatory Framework

The existing bilateral regime colors discussions of specific code-sharing agreements between U.S. and foreign carriers. Inevitably, in the absence of an agreement permitting code sharing, the U.S. proponents of a specific code-sharing arrangement will point to the benefits they receive from participation in it. Meanwhile, opponents will argue that the U.S. will not receive sufficient benefits in the foreign market in return for the increased access to the large U.S. market that the foreign airline partner will secure.

Many air services are based on the interlining system where carriers exchange traffic at gateway cities for distribution within a country or a region. For example, a European carrier flying to the U.S. will hand over traffic to a U.S. carrier destined for interior U.S. points at a U.S. or foreign gateway city. On the other hand, many U.S. carriers carry traffic to a U.S. or foreign gateway and turn it over to a foreign carrier. The interline system is based on standard IATA agreements to prorate revenues between carriers, and there are limited incentives to prefer one foreign carrier for interlining over another.

Among the questions that apply not only to the types of airline networks that exist today, but also to how the international airlines industry is evolving, are the following:

- To what extent can carriers rely on already approved bilateral authority as a basis for combined operations including code sharing?
- To what extent can the bilateral system address the emergence of new forms of cooperation among carriers, including joint ventures, foreign investment, and so forth?
- To what extent do transnational airline networks raise market access issues for carriers who can not or do not choose to enter into such an alliance?
- How does the traditional national balance of benefits analysis apply in a code-sharing agreement between airlines from different countries?
- Does the emergence of transnational airline alliances require a refocus of competition analysis from one of examining a group of carriers within a country (or a market area such as the European Union) to one of

examining the effects of competing airline networks, each of which could involve carriers from a number of countries?

It is important to recognize that carrier decisions to code share arise, in part, from the restrictions imposed by the bilateral system and national ownership laws. While continued pressure for liberalization is expected, it is likely that these restrictions will continue to affect the development of integrated airline networks. Some countries will be reluctant to go along with increased liberalization until their carriers are better positioned to compete in such an environment.

The U.S. has been a leader in promoting a less restrictive environment for international airline competition. This may be due, in part, to the large consumer benefits obtained from domestic airline deregulation and an attempt to achieve similar benefits in international airline markets. In addition, U.S. carriers are efficient relative to foreign carriers, and would likely be advantaged by a more liberal environment for international airline competition. However the U.S. domestic airline market is unparalleled in size and access to it may be highly attractive to foreign airlines. On the other hand, international airline markets are growing at a faster rate than the U.S. domestic market. In determining whether to enter into code-sharing agreements, a relevant consideration is whether increased access to more rapidly growing markets is a sufficient return for allowing foreign carriers to increase their access to the U.S.

The establishment of global airline networks, even through code sharing, requires broad and flexible route authority. U.S. carriers need to be able to operate between international gateways by way of any point and beyond to any point at the discretion of airline management. Carriers should be allowed to do so with direct service using their own equipment or indirectly through arrangements with other carriers. This will require that the U.S. expand the number of liberal air service agreements with other countries. Even where more liberal agreements cannot be obtained in the near term, code sharing may be a means of increasing access by U.S. carriers. As noted below, the DOT does recognize that concerns are raised when code sharing is proposed by a carrier from a country with a restrictive regulatory regime.

8.6 U.S. INTERNATIONAL AVIATION POLICY STATEMENT

DOT issued a policy statement on international aviation on November 1, 1994.[5] This reiterated U.S. goals for safe, affordable, convenient and efficient air service for consumers. It also restated the U.S. reliance on the marketplace to determine the variety, quality and price of air service. It also noted that this approach would work best to:

- Expand the international aviation market;
- Increase airlines' opportunities to expand their operations;
- Increase productivity and high-quality job opportunities within the aviation industry; and
- Promote aerospace exports and general economic growth.

The policy statement also noted that international airline service is growing rapidly and that the distribution of U.S. international service is changing. For example, U.S. airlines' international revenues are now greater in the Pacific than in the Atlantic, and international traffic from the U.S. to Latin America is growing rapidly.

The policy statement indicated the code sharing and other forms of cooperation can provide cost-effective ways for carriers to enter new markets, expand their operations and obtain additional traffic to flow over their existing networks. In addition, code sharing can benefit consumers by providing additional service options and enhancing competition in international markets. It also noted that code sharing could enhance competition in the U.S. domestic market, as U.S. carriers compete to carry passengers on the domestic segments of international trips. The policy statement did conclude, however, that the U.S. also will monitor code-sharing agreements and other areas to assure that they do not harm U.S. interests. For example, when airlines request authority to serve restricted bilateral markets that is not provided for under an international agreement, the U.S. will consider these requests on a case-by-case basis to determine:

- Whether approval will benefit consumers and improve access to the international air transportation system;

[5] U.S. International Aviation Policy Statement, issued by U.S. Department of Transportation (Docket No. 49844), November 1, 1994.

- The effects of the proposed transaction on the U.S. airline industry and its employees; and

- The potential for the transaction to eliminate operating and market restrictions and promote further market liberalization.

In the case of extra-bilateral code sharing, the policy statement notes that the DOT will give greater value to those proposals where U.S. carriers provide long-haul flying. This is consistent with the results of the empirical analysis conducted for this study.

As noted in Chapter 7, it is possible to use the carrier choice model developed during this project to evaluate existing code-sharing agreements to better understand their economic impacts on U.S. and foreign airlines and consumers. In addition, the model also provides a means to examine proposed code-sharing agreements. However, we recommend that the DOT consider requiring ticket sample data from foreign carriers equivalent to that filed by U.S. carriers in Data Bank 1A in order to fully understand the economic effects of code sharing on airlines and consumers. Such data should cover all foreign carrier traffic to and from the U.S. In addition, foreign carriers which have approved code-sharing agreements with U.S. carriers also should be required to file special reports (as U.S. carriers with code-sharing agreements do) which identify the carrier code under which tickets were sold.

APPENDIX A

DISCRETE CHOICE MODELS: THEORETICAL FOUNDATIONS AND STATISTICAL ESTIMATION

A.1 THEORETICAL OVERVIEW

Discrete choice models have been used in numerous econometric studies since the mid-1970s. Such models, also called "qualitative response" models, are relevant for situations where a decision-maker must make a choice between two or more "discrete" options, e.g., whether or not to purchase a new car, which candidate to vote for, whether to enter the labor force, etc. In the context of an econometric analysis, one is interested in relating the decision to a set of explanatory variables. For example, in the context of transport demand, a "mode choice" model might be specified so that the decision to choose a particular transport mode can be projected based on physical and economic attributes of the available modes (e.g., access and transit times, fares or freight charges, departure frequencies) as well as characteristics of the relevant population or commodity under consideration (e.g., incomes and trip purpose in the case of passenger demand, commodity value in the case of freight demand).

The standard discrete choice model is a behavioral model that can be interpreted as applying at the level of the individual decision-maker; it considers an individual who must choose among a predetermined set of alternatives and generates predictions of the probability that the individual will choose each of the available alternatives. Across all individuals in the relevant population, such predictions can lead to estimates of the overall market share for each alternative.[1]

[1] There is a large literature dealing with both theoretical and empirical aspects of discrete choice modeling. McFadden (1974a, 1981) has provided most of the theoretical foundation as it relates to consumer behavior; some of the many empirical applications relating to transport demand include McFadden (1974b), Levin (1981) and Morrison and Winston (1985). Important survey reviews include McFadden (1976), Amemiya (1981) and Winston (1985).

It is convenient to group discrete choice models into two broad categories — binomial and multinomial. The former considers choices made between exactly two alternatives; the latter allows for more than two alternatives. For estimation purposes, it also matters whether the data to be analyzed are "individual" or "grouped." Individual data consist of observations on the actual response for each member of the sample, e.g., Person #1 chose to ride the bus, Person #2 chose private auto, etc. On the other hand, individuals may be aggregated into groups based on observed characteristics, and one observes only the proportions of each group that chose each alternative, e.g., 20% of Group #1 chose the bus, 40% chose private auto, and so on for each group.

A.2 BINOMIAL MODELS

To focus ideas, consider first the following choice model: a respondent must choose whether to fly on Airline A or Airline B. A ticket survey is undertaken and the responses are coded as y=1 if the ticket indicates Airline A and y=0 if it indicates Airline B; this coding is strictly for convenience. Suppose we believe that a set of factors such as age, education, income, etc. determine the value of y; these factors are gathered into a vector **x**. For the moment, we will ignore attributes of the choice itself (e.g., fare, travel time). In this case, we can write:

$$\begin{aligned} Prob[y=1] &= F(\boldsymbol{x},\mathbf{\hat{a}}) \\ Prob[y=0] &= 1-F(\boldsymbol{x},\mathbf{\hat{a}}) \end{aligned} \qquad (1)$$

where **â** is an unknown parameter vector to be estimated and F is some (as yet unspecified) function. Thus, the parameters in **â** reflect the impact of changes in **x** on the <u>probability</u> of choosing Airline A or B. Note that the expected value of y is:

$$\begin{aligned} E[y] &= 0\left[1-F(\boldsymbol{x}\mathbf{\hat{a}})\right] + 1\left[F(\boldsymbol{x}\mathbf{\hat{a}})\right] \\ &= F(\boldsymbol{x}\mathbf{\hat{a}}) \end{aligned} \qquad (2)$$

One possibility for estimation would be to employ a linear regression by specifying:

$$F(\boldsymbol{x},\mathbf{\hat{a}}) = \boldsymbol{x}\mathbf{\hat{a}} \ , \qquad (3)$$

leading to:

$$y = \boldsymbol{x}\mathbf{\hat{a}} + \mathring{a} \ , \qquad (4)$$

where å is an unknown random disturbance term. This could be estimated using the ordinary least squares (OLS) technique.

However, there are problems with this formulation. First, the error term is heteroskedastic (i.e., its variance is not constant). This is not a serious complication because we could straightforwardly apply a generalized least squares (GLS) estimator that accounts for the heteroskedasticity. A more serious problem is that some of the predicted values of y may lie outside the [0,1] interval. Because the predicted y values are properly interpreted as probabilities, this means that we may end up with nonsense predictions. Moreover, the corresponding variances will be negative in such situations.

A preferable alternative is to choose any continuous cumulative distribution function for F(**x**,**â**), which by definition will be restricted to the [0,1] interval. In practice, either the normal distribution or the logistic distribution has been employed. With the normal distribution, we have:

$$F(\boldsymbol{x},\hat{\mathbf{a}}) \;=\; \ddot{O}(\boldsymbol{x}\hat{\mathbf{a}}) \tag{5}$$

leading to a "probit" model defined by:

$$Prob[y=1] \;=\; \int_{-\infty}^{\boldsymbol{x}\hat{\mathbf{a}}} \ddot{o}(z)\; dz \tag{6}$$

With the logistic distribution, we have:

$$F(\boldsymbol{x},\hat{\mathbf{a}}) \;=\; \ddot{E}(\boldsymbol{x}\hat{\mathbf{a}}) \tag{7}$$

leading to a "logit" model defined by:

$$Prob[y=1] \;=\; \frac{e^{\boldsymbol{x}\hat{\mathbf{a}}}}{1+e^{x\hat{a}}} \tag{8}$$

In practice, it typically does not make much difference which specification is used. In general, the logistic distribution is quite similar to the normal, except that it is somewhat heavier in the tails. Therefore, the binomial logit model tends to give larger probabilities to y=0 when **xâ** is very small and smaller probabilities to y=1 when **xâ** is very large.

A-3 MULTINOMIAL MODELS

Now consider the case where decision-makers choose among more than two alternatives; specifically, assume there are exactly J different alternatives available. Let the probability that the j^{th} alternative is chosen be p_j. Define the outcome vector $\mathbf{y} = (y_1,...,y_J)$, where y_j is one if alternative j is chosen and zero otherwise; then the probability of **y** is $p(\mathbf{y}) = p_1^{y_1} p_2^{y_2} \cdots p_J^{y_J}$. For N individuals (or groups), the likelihood function is proportional to the multinomial form given by:

$$p(\boldsymbol{y_1},...,\boldsymbol{y_N}) = \prod_{i=1}^{N} p_1^{y_{i1}} p_2^{y_{i2}} \cdots p_J^{y_{iJ}} \tag{9}$$

where y_{ij} is one if individual i chooses alternative j and zero otherwise.

In order to relate the probabilities to observed data, it is now useful to distinguish between alternative-specific attributes and individual characteristics. The latter, such as age and income, are gathered into a vector $\mathbf{s}_i$; alternative-specific attributes, such as transit time and price, are identified in $\mathbf{z}_{ij}$, which allows for the possibility that the values of these attributes may be different for different individuals. Following the standard "random utility" approach (McFadden, 1974a), the utility of alternative j for individual i is assumed to be linear in parameters and is given by:

$$V_{ij} = \boldsymbol{x_{ij}}\hat{\mathbf{a}} + u_{ij} = \boldsymbol{W_{ij}} + u_{ij} \tag{10}$$

where $\mathbf{x}_{ij}$ now represents a vector of functions of the $\mathbf{z}_{ij}$ and $\mathbf{s}_i$, **â** is an unknown parameter vector, u_{ij} is a random variable that measures the effects of unobserved attributes, individual taste variations, etc., and $\mathbf{W}_{ij} = \mathbf{x}_{ij}\hat{\mathbf{a}}$ represents "mean utility" in the population.

Individuals are assumed to maximize utility, so that the probability that individual i will choose alternative j is given by:

$$\begin{aligned} p_{ij} &= prob\left[\boldsymbol{V_{ij}} \geq \boldsymbol{V_{ik}},\ all\ k \neq j\right] \\ &= prob\left[u_{ik} \leq \boldsymbol{W_{ij}} - \boldsymbol{W_{ik}} + u_{ij},\ all\ k \neq j\right] \end{aligned} \tag{11}$$

This probability becomes well-defined once we choose a joint distribution for the u's. Suppressing the i subscripts and letting $f(u_1, u_2, \ldots, u_J)$ represent the corresponding joint density function, we can write:

$$p_j = \int_{-\infty}^{\infty} \int_{-\infty}^{\boldsymbol{W_j} - \boldsymbol{W_1} + u_j} \cdots \int_{-\infty}^{\boldsymbol{W_j} - \boldsymbol{W_J} + u_j} f(\cdot)\, du_J \cdots du_1\, du_j \tag{12}$$

Subject to specification of the error terms, Equation (12) can be substituted into Equation (9) and estimated via standard maximum likelihood techniques.

This model can be implemented by sampling the population under consideration; each i is an individual taken to represent a larger group who are identical with respect to the attribute vectors $\mathbf{z}_{ij}$ (j = 1,...,J) and measured consumer characteristics $\mathbf{s}_i$. The probability p_{ij} calculated from (11) therefore can be interpreted as the predicted fraction of individuals from this group who will choose alternative j.

In searching for an analytically tractable multivariate distribution for the random variables in Equation (12), it is helpful to rewrite (11) in differenced form as:

$$p_j = prob\left[u_k - u_j \le \boldsymbol{W_j} - \boldsymbol{W_k},\ all\ k \neq j\right] \tag{13}$$

With this formulation of the selection probabilities, the number of integrals that must be evaluated is reduced by one. Even so, it would be very difficult to base such a model on the normal distribution with more than, say, three or four choice alternatives. Instead, distributions that are closed under subtraction or that result in convenient distributions under subtraction would be good candidates for the joint density of the u's. Moreover, considerable convenience will be obtained if the **u**'s are independently distributed. (There is a cost, however; this is discussed later.)

A-4 THE LOGIT SPECIFICATION

McFadden (1974a, 1976) has considered the implications of treating the u's as independently and identically distributed random variables with Type I extreme value density functions (Johnson and Kotz, 1970).[2] The corresponding cumulative distribution functions take the form:

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[2]Some authors have referred to the Type I extreme value distribution defined by Johnson and Kotz as the Weibull distribution, although Johnson and Kotz are careful to distinguish between the two; see their discussion (pp. 272-273) for details.

$$prob\left[u_j \leq \ddot{a}\right] = \exp[-\exp(-\ddot{a})] \qquad (14)$$

The difference between any two random variables with this distribution yields a random variable that has the logistic distribution (Johnson and Kotz, 1970), and this gives rise to the "conditional logit" model. McFadden (1974a) has shown that the assumption that the errors in the random utility specification (11) have independent extreme value distributions leads to a logit model in which the choice probability of the k^{th} alternative is given by:

$$p_k = \frac{\exp(\boldsymbol{x_k}\hat{\mathbf{a}})}{\sum_j \exp(\boldsymbol{x_j}\hat{\mathbf{a}})} \qquad (15)$$

This formulation is convenient computationally because the probabilities are expressed in closed form. Moreover, McFadden shows that the log likelihood function corresponding to Equation (9) is globally concave when the probabilities are given by (15); consequently, consistent maximum likelihood estimates of the parameter vector $\hat{\mathbf{a}}$ may be obtained using any convergent nonlinear optimization technique. All significance tests under maximum likelihood estimation are asymptotic.

A-5 THE INDEPENDENCE OF IRRELEVANT ALTERNATIVES ASSUMPTION

The conventional logit model has a restrictive property — the assumption of "independence of irrelevant alternatives" (IIA) — which makes it impossible to take into account the effects of similarities among alternatives. If the alternatives are sufficiently distinct from one another (in terms of their physical/economic attributes), this may not be an important limitation; but if a subset of the alternatives are closer substitutes for each other relative to other alternatives in the choice set, the logit model may yield unreliable results.

The IIA property of the logit model can be expressed formally by considering the effect on the odds of choosing, say, Alternative 1 over Alternative 2 when the number of available alternatives is increased from J to J^*. When J alternatives are available, the odds of choosing Alternative 1 over Alternative 2 are:

$$\frac{p_{i1}}{p_{i2}} = \frac{\exp(\boldsymbol{x_{i1}}\hat{\mathbf{a}}) \;/\; \sum_{j=1}\exp(\boldsymbol{x_{ij}}\hat{\mathbf{a}})}{\exp(\boldsymbol{x_{i2}}\hat{\mathbf{a}}) \;/\; \sum_{j=1}\exp(\boldsymbol{x_{ij}}\hat{\mathbf{a}})} = \frac{\exp(\boldsymbol{x_{i1}}\hat{\mathbf{a}})}{\exp(\boldsymbol{x_{i2}}\hat{\mathbf{a}})} \qquad (16)$$

When J^* alternatives are available the odds remain the same since the denominators (now summations up to J^*) still cancel out. Therefore, the odds of choosing any given alternative over any other one are independent of the presence or absence of a third alternative. This can be a serious restriction when some alternatives are closer substitutes than others.

As an example, consider McFadden's "red bus/blue bus" problem: Suppose commuters initially have the choice of driving or taking a red bus to work and that 2/3 of them choose to drive and 1/3 prefer to take the bus. Then a third alternative, a blue bus identical in all respects to the red bus except for color, becomes available. We would still expect 2/3 of the commuters to drive and the remaining 1/3 to split their choices among the bus alternatives according to their color preference. In the logit model, however, the 2:1 odds of choosing driving over the red bus must remain constant, so that the new logit probabilities would be (assuming commuters are evenly split regarding color preference) 1/2 for the driving alternative and 1/4 for each of the bus alternatives. This result is counterintuitive and shows the weakness of the IIA assumption when two or more alternatives are close substitutes. Note that any random utility model where the cross-alternative errors are assumed to be independent will be unable to take account of similarities among alternatives.

In the present case, there is no practical solution to this problem; rather, one must simply assume that the IIA assumption is reasonable because there are no reliable market data available for pure foreign carrier alternatives.

A-6 INTERPRETATION OF MODEL COEFFICIENTS

It is important to recognize that the parameters of the logit model, like those of any nonlinear regression model, are not the marginal effects one is accustomed to evaluating. In other words, the coefficients do <u>not</u> indicate the effect of a unit change in the corresponding exaplanatory variable values on the probability of choosing any given alternative. Rather, the marginal effects are given by:

$$\begin{aligned}\frac{\partial E[y]}{\partial \boldsymbol{x}} &= \frac{dF(\boldsymbol{x}\hat{\mathbf{a}})}{d(\boldsymbol{x}\hat{\mathbf{a}})}\hat{\mathbf{a}} \\ &= f(\boldsymbol{x}\hat{\mathbf{a}})\hat{\mathbf{a}}\end{aligned} \tag{17}$$

where f(·) is the density function corresponding to F(·). In practice, the scale factor $f(\mathbf{x}\hat{\mathbf{a}})$ would typically be evaluated at the means of the regressors, so that the impacts are proportional (but not equal) to $\hat{\mathbf{a}}$. For the logit model, this becomes:

$$\frac{\partial E[y]}{\partial \boldsymbol{x}} = \ddot{E}(\boldsymbol{x}\hat{\mathbf{a}})(1-\ddot{E}(\boldsymbol{x}\hat{\mathbf{a}}))\hat{\mathbf{a}} \qquad (18)$$

Clearly, these marginal effects vary with values of **x**.

A-7 MEASURING CHANGES IN CONSUMER WELFARE

An important feature of the modeling approach outlined here is that the "value" of alternative-specific attributes can be calculated in a straightforward way. For example, one is often interested in estimating the impact on a traveller's welfare of a change in a given transport mode's attributes.

In particular, when the **z** vector in the utility specification includes price, one can calculate a "shadow price" for each non-price attribute that can be interpreted as the dollar value of a unit of that attribute. The shadow price of attribute $\mathbf{z}_j$ is the change in price that has the same effect on utility as a unit change in the level of the attribute, i.e., the shadow price of $\mathbf{z}_j$ equals the marginal rate of substitution between the price attribute and $\mathbf{z}_j$. Given the linear specification in Equation (10), a consistent estimate of this shadow price can be calculated by dividing $\mathbf{z}_j$'s estimated coefficient by the estimated price coefficient.

A more formal measure is available using the notion of a compensating variation (CV).[3] In particular, Small and Rosen (1981) show that the compensating variation pertaining to a change in the price or other attribute of alternative j can be calculated by using the formula:

$$CV = -\frac{1}{\ddot{e}} \int_{W_j}^{W_j^f} p_j(\boldsymbol{W_1}, \dots, \boldsymbol{W_J})\, d\boldsymbol{W_j} \qquad (19)$$

where ë is the marginal utility of income, W_j^0 is the mean utility associated with alternative j before the change, W_j^f is this same utility evaluated after the change, and p_j is the probability of choosing alternative j as defined in Equation (12). Equation (19)

[3]For a given change in price or some other attribute, the compensating variation is defined as the amount of income that must be given to a consumer to make him just as well off after the change as before.

shows that the difference in utility between the initial and final points is multiplied by the negative of the inverse of the marginal utility of income (i.e., the dollar value of each unit of marginal utility) to yield a dollar value of the change in utility.[4] Note that if price is included as an explanatory variable in the model being estimated, then a direct estimate of ë is given by the negative of the estimated price coefficient.

As noted in Chapter 6, however, the model estimated here produced an implied value of time (computed by taking the ratio TIME_FLT / FARE) that was unrealistically high. Given this result, surplus measures based on the value of the FARE coefficient are not likely to be reliable. In its place, we use an external estimate of the value of time ($42 per hour for air travellers) to compute a corresponding value of the marginal utility of income relevant for our sample.

For the logit model, Equation (19) can be expressed in closed form as:

$$CV = -\frac{1}{ë}\left[\ln \sum_j \exp \boldsymbol{W_j^f} - \ln \sum_j \exp \boldsymbol{W_j^0}\right] \qquad (20)$$

This formula is easily modified to take account of simultaneous attribute changes.

[4]The formula in (19) is strictly correct only if the marginal utility of income, ë, is constant and income effects are zero. In the present context, an additional important assumption is that the market share changes for code-share alternatives in the counterfactual cases that result when switching seat shares from code-share categories to non-code-share categories actually reflect changes in consumer utility.

APPENDIX B
CODE SHARE SAMPLE MARKETS

BA/USAIR CODE-SHARING SAMPLE MARKETS

ORIGIN	DESTINATION	USED IN MODEL ESTIMATION
NASHVILLE, TENN.	LONDON, ENGLAND	X
LONDON, ENGLAND	CHARLESTON, S.C.	X
CLEVELAND, OHIO	LONDON, ENGLAND	X
LONDON, ENGLAND	CHARLOTTE, N.C.	X
COLUMBUS, OHIO	LONDON, ENGLAND	X
CINCINNATI, OHIO	LONDON, ENGLAND	X
DAYTON, OHIO	LONDON, ENGLAND	X
LONDON, ENGLAND	GREENSBORO/WIN-SALEM, N.C.	X
INDIANAPOLIS, INDIANA	LONDON, ENGLAND	X
LONDON, ENGLAND	LAS VEGAS, NEVADA	X
LAS VEGAS, NEVADA	LONDON, ENGLAND	X
KANSAS CITY, MISSOURI	LONDON, ENGLAND	X
MILWAUKEE, WISC.	LONDON, ENGLAND	X
LONDON, ENGLAND	MYRTLE BEACH, S.C.	X
PHOENIX, ARIZONA	LONDON, ENGLAND	X
RALEIGH/DURHAM, N.C.	LONDON, ENGLAND	X
RICHMOND/WMBG., VA.	LONDON, ENGLAND	X
ROCHESTER, N.Y.	LONDON, ENGLAND	X
SAN DIEGO, CALIFORNIA	LONDON, ENGLAND	X
ST. LOUIS, MISSOURI	LONDON, ENGLAND	X
SYRACUSE, N.Y.	LONDON, ENGLAND	X
LONDON, ENGLAND	SYRACUSE, N.Y.	X

NORTHWEST/KLM CODE-SHARING SAMPLE MARKETS

ORIGIN	DESTINATION	USED IN MODEL ESTIMATION
ATLANTA, GEORGIA	AMSTERDAM, NETHERLANDS	X
AMSTERDAM, NETHERLANDS	ATLANTA, GEORGIA	
BOSTON, MASS.	AMSTERDAM, NETHERLANDS	
AMSTERDAM, NETHERLANDS	CLEVELAND, OHIO	X
CINCINNATI, OHIO	AMSTERDAM, NETHERLANDS	X
DETROIT, MICHIGAN	AMSTERDAM, NETHERLANDS	X
AMSTERDAM, NETHERLANDS	GRAND RAPIDS, MICHIGAN	X
WASHINGTON, DC	AMSTERDAM, NETHERLANDS	X
NEW YORK, NEW YORK	AMSTERDAM, NETHERLANDS	X
LAS VEGAS, NEVADA	AMSTERDAM, NETHERLANDS	X
LOS ANGELES, CALIFORNIA	AMSTERDAM, NETHERLANDS	X
MINNEAPOLIS/ST PAUL, MINN.	AMSTERDAM, NETHERLANDS	X
CHICAGO, ILLINOIS	AMSTERDAM, NETHERLANDS	X
AMSTERDAM, NETHERLANDS	PORTLAND, OREGON	X
AMSTERDAM, NETHERLANDS	PHOENIX, ARIZONA	X
AMSTERDAM, NETHERLANDS	PITTSBURGH, PA.	X
SAN DIEGO, CALIFORNIA	AMSTERDAM, NETHERLANDS	X
AMSTERDAM, NETHERLANDS	SAN DIEGO, CALIFORNIA	X
SAN FRANCISCO, CA.	AMSTERDAM, NETHERLANDS	X
BOSTON, MASS.	STOCKLOHM, SWEDEN	X
STOCKLOHM, SWEDEN	MINNEAPOLIS/ST PAUL, MINN.	X
BOSTON, MASS.	BUDAPEST, HUNGARY	X
COPENHAGEN, DENMARK	BOSTON, MASS.	X
GENEVA, SWITZERLAND	BOSTON, MASS.	X
HAMBURG, GERMANY	BOSTON, MASS.	X
BOSTON, MASS.	LUXEMBOURG, LUXEMBOURG	
LUXEMBOURG, LUXEMBOURG	BOSTON, MASS.	
BOSTON, MASS.	MUNICH, GERMANY	X
BRUSSELS, BELGIUM	MINNEAPOLIS/ST PAUL, MINN.	X
FRANKFURT, GERMANY	DETROIT, MICHIGAN	X
OSLO, NORWAY	MINNEAPOLIS/ST PAUL, MINN.	X
FRANKFURT, GERMANY	MINNEAPOLIS/ST PAUL, MINN.	X
MINNEAPOLIS/ST PAUL, MINN.	GENEVA, SWITZERLAND	X
HAMBURG, GERMANY	MINNEAPOLIS/ST PAUL, MINN.	
MINNEAPOLIS/ST PAUL, MINN.	MUNICH, GERMANY	X
VIENNA, AUSTRIA	MINNEAPOLIS/ST PAUL, MINN.	X
ZURICH, SWITZERLAND	MINNEAPOLIS/ST PAUL, MINN.	X

OTHER CODE-SHARING SAMPLE MARKETS

ORIGIN	DESTINATION	USED IN MODEL ESTIMATION
NEW YORK, NEW YORK	STOCKLOHM, SWEDEN	X
CHICAGO, ILLINOIS	STOCKLOHM, SWEDEN	
BRUSSELS, BELGIUM	ATLANTA, GEORGIA	
ATLANTA, GEORGIA	BRUSSELS, BELGIUM	X
LOS ANGELES, CALIFORNIA	BRISBANE QLD., AUSTRALIA	
SYDNEY N.S.W., AUSTRALIA	BOSTON, MASS.	X
NEW YORK, NEW YORK	BRUSSELS, BELGIUM	X
CHICAGO, ILLINOIS	BRUSSELS, BELGIUM	X
NEW YORK, NEW YORK	BUDAPEST, HUNGARY	
LOS ANGELES, CALIFORNIA	BUDAPEST, HUNGARY	X
CINCINNATI, OHIO	ZURICH, SWITZERLAND	
SAN FRANCISCO, CA.	DUBAI-INT., U.A. EMIRATES	
NEW YORK, NEW YORK	MANILA, PHILIPPINES	X
MOSCOW, RUSSIA	NEW YORK, NEW YORK	
SYDNEY N.S.W., AUSTRALIA	NEW YORK, NEW YORK	X
ZURICH, SWITZERLAND	NEW YORK, NEW YORK	X
KAHULUI, MAUI, HAWAII	TOKYO, JAPAN	

NON-CODE-SHARING SAMPLE MARKETS

ORIGIN	DESTINATION	USED IN MODEL ESTIMATION
AUSTIN, TEXAS	AMSTERDAM, NETHERLANDS	X
ROCHESTER, N.Y.	AMSTERDAM, NETHERLANDS	X
FRANKFURT, GERMANY	BOSTON, MASS.	X
GLASGOW, SCOTLAND UK	BOSTON, MASS.	X
TEL AVIV, ISRAEL	BOSTON, MASS.	X
LOS ANGELES, CALIFORNIA	BRUSSELS, BELGIUM	X
MIAMI, FLORIDA	BRUSSELS, BELGIUM	X
BUFFALO, NEW YORK	MANCHESTER, ENGLAND (UK)	
MANCHESTER, ENGLAND (UK)	BUFFALO, NEW YORK	
MINNEAPOLIS/ST PAUL, MINN.	CAIRO, EGYPT	
CHARLOTTE, N.C.	LONDON, ENGLAND	
COPENHAGEN, DENMARK	LOS ANGELES, CALIFORNIA	
LOS ANGELES, CALIFORNIA	COPENHAGEN, DENMARK	
GLASGOW, SCOTLAND UK	DENVER, COLORADO	
LONDON, ENGLAND	DENVER, COLORADO	X
MANCHESTER, ENGLAND (UK)	DENVER, COLORADO	X
DENVER, COLORADO	MANCHESTER, ENGLAND (UK)	X
SEATTLE/TACOMA, WASHINGTON	OSLO, NORWAY	
PHILADELPHIA/WILM'TON, PA	ROME, ITALY	X
WASHINGTON, DC	FRANKFURT, GERMANY	X
FRANKFURT, GERMANY	WASHINGTON, DC	X
ROCHESTER, N.Y.	FRANKFURT, GERMANY	X
ST. LOUIS, MISSOURI	FRANKFURT, GERMANY	X
MIAMI, FLORIDA	GLASGOW, SCOTLAND UK	
GLASGOW, SCOTLAND UK	MIAMI, FLORIDA	X
SAN FRANCISCO, CA.	HONG KONG, HONG KONG	X
WASHINGTON, DC	GLASGOW, SCOTLAND UK	
GLASGOW, SCOTLAND UK	WASHINGTON, DC	X
LONDON, ENGLAND	WASHINGTON, DC	X
WASHINGTON, DC	LONDON, ENGLAND	X
LONDON, ENGLAND	HOUSTON, TEXAS	X
LONDON, ENGLAND	ITHACA, NEW YORK	
MANILA, PHILIPPINES	NEW YORK, NEW YORK	X
TAIPEI, TAIWAN	NEW YORK, NEW YORK	X
LONDON, ENGLAND	LEXINGTON, KENTUCKY	
LEXINGTON, KENTUCKY	LONDON, ENGLAND	
MINNEAPOLIS/ST PAUL, MINN.	LONDON, ENGLAND	X
SAN JUAN, PUERTO RICO	LONDON, ENGLAND	X
SAN DIEGO, CALIFORNIA	MANCHESTER, ENGLAND (UK)	X
ST. LOUIS, MISSOURI	MANCHESTER, ENGLAND (UK)	X
SYDNEY N.S.W., AUSTRALIA	SAN FRANCISCO, CA.	X

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