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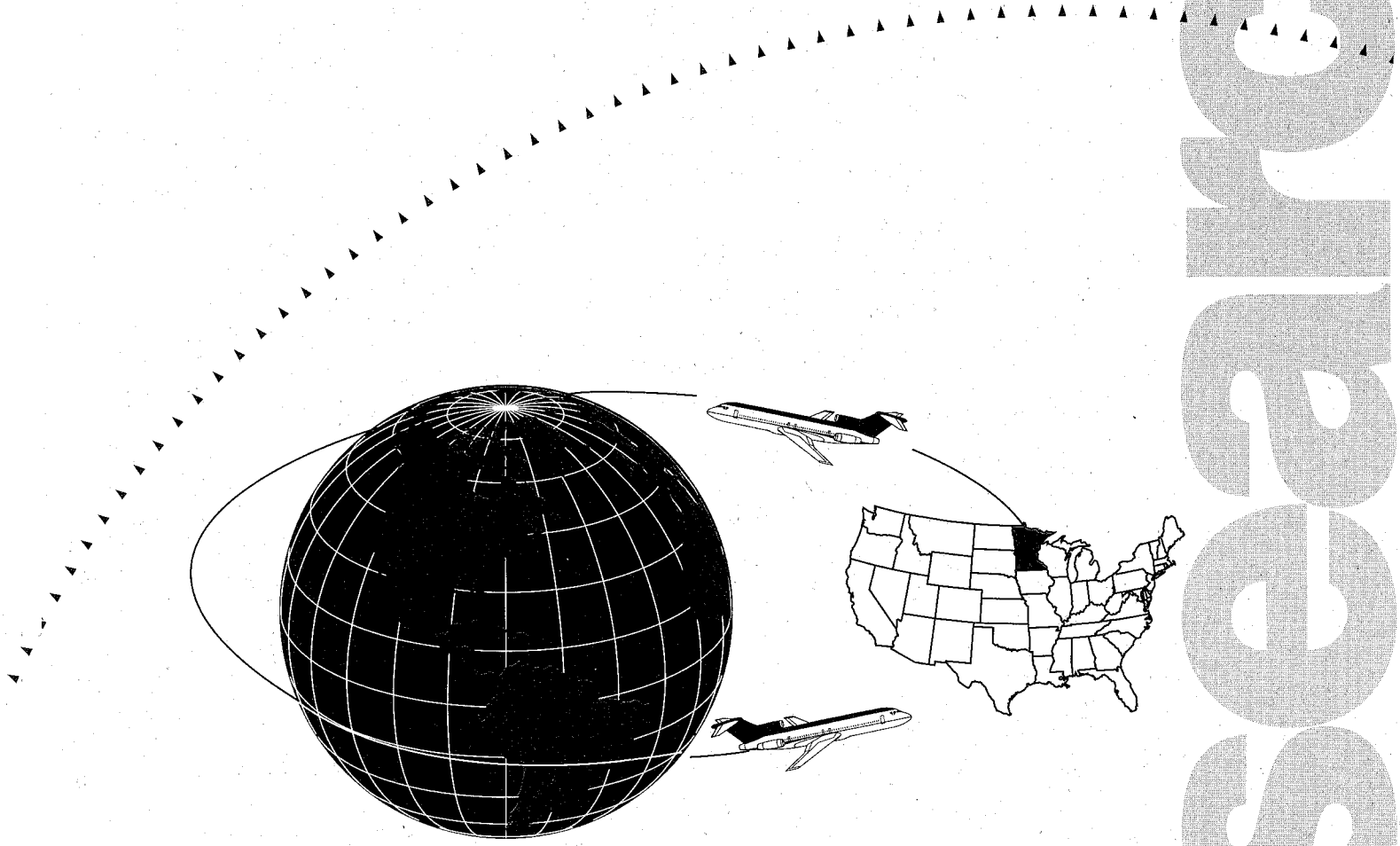

Overseas Air Cargo Service, Airborne Export-Producing Industries and U.S. Cities, 1980-1995

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This report presents results of an analysis of changes in the geographic patterns of U.S. markets for overseas cargo service between 1980 and the mid-1990s. The study determines which U.S. cities have and have not participated in the period's dramatic service expansion, and the ways in which their competitive positions have changed as a result.

The study identifies industries that rely heavily on air cargo service to facilitate export activities and examines their employment distributions among U.S. cities to demonstrate demand for overseas air cargo service. A classification of U.S. metropolitan regions based on the mismatches revealed improvement or decline in service supply and demand, as well as identifying cities with winning and losing records during the period. Case studies of Portland, Oregon; St. Louis; Washington-Baltimore; and Minneapolis--St. Paul indicate the influences of location, local economic conditions, airline networks, carrier health, and industry changes; and leadership on and off the airport.

Study results make clear the need for coordinated local and regional efforts to actively promote better air service for communities in the face of competition for limited service. Civic leaders must address those issues within their influence and develop long-range plans carefully attuned to concurrent airline industry and regulatory changes.

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EXECUTIVE SUMMARY

This geographical analysis of U.S. markets for overseas air cargo service provides concrete evidence of the increasing global ties that are becoming more important to a growing number of U.S. cities Specifically, it examines patterns of overseas air cargo service availability, or supply, and employment in airborne export-producing industry, to indicate overseas cargo service demand, among 64 U.S. metropolitan regions in 1980 and the mid-1990s

Overwhelming expansion occurred in the amount of all- and mixed-cargo service available between U.S. cities and overseas points, and is not surprising given the technological, industry, and regulatory changes of the period. Service documentation reveals a localized trend away from traditional gateway airports; more cities had a piece of the overseas air cargo service pie in 1995 than did in 1980—and the pie itself was larger. The nationwide scope and inclusion of all potential service gateways in the analysis is crucial to eliciting and demonstrating these trends.

This study determines which specific industries use and rely most heavily on air transportation for their export activities. Low-weight, high-value products associated with high-technology sectors prevail among airborne exports, but other categories with particular economic or physical perishability also appear. For example, specialized industrial machinery and fish are among the highest weight group, and the high percentage value category includes raw materials such as silver ore as well as biological and chemical substances.

Industry employment in these target industries at each metropolitan region serves as an indicator of airborne export production demand locations in 1980 and the mid-1990s. Taken separately, regional strengths of individual target industry groups are clear: Seattle and Los Angeles continued to have high concentrations of aircraft parts production and all sectors involving computers and electronics thrived at San Francisco during the study period. Equally clear, however, is the over 20 percent loss of jobs in the eight target industry sectors combined. Although the total weight and value of U.S. airborne exports more than doubled during the study period and the value of airborne exports accounted for nearly one-third of all U.S. exports by 1995, jobs in the sectors producing the exports most commonly shipped by air shrunk considerably. Traditional industrial centers in the Northeast, Chicago, and southern California

were hit hardest by job losses. As with supply, demand for air cargo service spread out from traditional centers during the period.

The study employs a matrix to summarize changes in rank of each metropolitan region according to the amount of cargo service available and the number of jobs in target industry groups. The resulting classification indicates that only four cities (Orlando, Atlanta, Philadelphia, and Portland) experienced improvements in their competitive positions relative to other metropolitan regions in terms of both service supply and demand. Conversely, a total of 22 cities among the 64 examined suffered declines in both their supply and demand ranks between 1980 and the mid-1990s. The high number is due in part to the inclusion of 33 places that had no nonstop overseas service in either year. The large number of cities without nonstop overseas service were included because they fell (1) among the 60 largest cities in the United States, or (2) within the FAA-designated large or medium hub community categories based on total aircraft activity. Since 1995, Phoenix has gained its first nonstop service to Europe, and a few other previously unserved metropolitan regions are likely to follow.

Three metropolitan regions stand out as opportunities for airborne export producers because of their gain in air service supply dominance without commensurate gains in target industry employment standing: Washington-Baltimore, Cincinnati, and Chicago. Twenty metropolitan regions enjoyed improvements in their standing according to service demand, but their ranks according to service availability slipped. The remaining metropolitan regions considered in the aggregate market analysis were stable in at least supply or demand; the New York City metropolitan region held its position as the top overseas cargo service gateway in the nation and the second-ranked city in terms of target industry employment (behind Los Angeles).

Portland, St. Louis, Washington-Baltimore, and Minneapolis-St. Paul serve as representative case studies cases from the four corners of the overseas service market classification matrix. These cases exemplify how local characteristics and broader airline industry trends can influence a metropolitan region's potential as an overseas cargo service gateway. It also shows that not all of the factors likely to shape local cargo market development are within the influence of local authorities. Cities with leaders who promote local strengths, undertake needed infrastructure improvements, and, most importantly, consider a long-term view of the metropolitan region's potential competitive advantage over its competitors seem to have the best

prognosis for improved air cargo service. But leaders must make the best of these opportunities, since they cannot change their city's geographic situation and are unlikely to be able to succeed in rearranging airline networks so that their communities are in the center. The varying successes of Portland and the other case study metropolitan regions emphasize the importance of farsighted local leadership to reasonable and appropriate market development.

Throughout this study, the theme of interurban competitiveness appears repeatedly. Air service is just one of the bases upon which U.S. (and even foreign) cities compete for economic activity today. Frequent comparisons between metropolitan regions, between markets, and among service providers and consumers reiterate this theme. The need for individual places to promote themselves today to attract and keep employers, air service, sports teams, and any number of other economic activities is at once a cause and effect of interurban competition. The study identifies the relative positions of U.S. cities based on overseas cargo service supply and demand indicators and also shows which cities are and are not keeping up with their own past standings. Not every city can be a major overseas air cargo service center; cities that understand their strengths and limitations and tailor their competitive advantage development schemes accordingly are those best poised to create and support a level of overseas cargo service appropriate for their local market.

The study provides documentation and analysis of nationwide and industry-wide trends that local practitioners can use to inform decisions involving long-range, strategic planning for their communities. Additionally, the results can inform and suggest new directions for academic research through its synthesis of economic and transportation geography and by offering concrete evidence of the connections between local and global economic activity.

Most importantly, however, the study's results make clear the need for coordinated local and regional efforts to actively promote better air service for communities in the face of competition for limited service. Civic leaders must address those issues within their influence and develop long-range plans carefully attuned to concurrent airline industry and regulatory changes. The airline industry is a dynamic, profit-driven business. Cities and regions that want to benefit from the service it provides must demonstrate viability as a market for new or expanded service.

CHAPTER ONE
INTRODUCTION

Service capacity and freight value on international air cargo routes to and from U.S. cities have increased dramatically since domestic airline industry deregulation in 1978. However, not all cities have participated equally in this expansion. Our research analyzes previously undocumented changes in the geographic pattern of overseas cargo service markets at U.S. cities between 1980 and the mid-1990s. We identify target industry groups that rely heavily on air cargo service to facilitate their export activities, and examine their employment distributions among U.S. metropolitan regions as an indicator of demand for overseas air cargo service. Further, we classify U.S. metropolitan regions based on the mismatches our findings reveal between improvement or decline in overseas air cargo service supply and demand. We use four brief case studies to demonstrate how local factors may affect the position of each U.S. city within the urban hierarchy defined by overseas air cargo service market characteristics.

MOVING BEYOND TRANSPORTATION

Secure, rapid transportation of goods around the world is largely taken for granted where it is available today, but not every U.S. city is well connected to the international air cargo network that makes this service possible. Industries that require access to air cargo service for their export activities exist in most major metropolitan areas. There is a mismatch, however, between overseas cargo service supply and demand: some cities have more service than they need, while others need more service than they have. Past research has investigated the air transportation networks or local economic conditions in isolation with only peripheral consideration of how these features are related.

Geographers, with their knowledge of the spatial dimensions of economic processes, are well equipped to move past analyses of the air transport networks themselves and draw connections to their roles in facilitating local economic activities and enabling access to international markets. However, few have looked beyond service and industry organization to make connections between international air cargo service and local economic performance. Some

researchers have discussed air transportation in general as a contributing factor to large-scale economic change. A few authors have documented the growing economic interdependence among distant nations, argued that access to national and international markets through transportation and telecommunications technology is crucial to global competitiveness, and peripherally cited air service as a factor helping to bring the world closer together [1,2]. One study is slightly more specific, claiming that the improved speed and reliability of all transportation service types (presumably but not explicitly including air) made possible the adoption of just-in-time manufacturing strategies that revolutionized production practices in the late 1980s [3].

Other approaches have focused on the varying availability of transportation services at different places and related the inconsistencies to economic patterns. The earliest attention to air transportation networks from geographers identified a hierarchy of domestic passenger service among U.S. cities and established it as an indicator of relative economic dominance among metropolitan areas [4]. Slightly later, an urban geographer defined the term "gateway city" and argued that such a city's monopoly on transportation access to other places is a main reason for that city's regional economic leadership [5]. Although the author gave little attention to air transportation, this 1971 study's observations are directly applicable to the "gateway city" phenomenon that is reinforced by today's hub-and-spoke systems borne of deregulated domestic and liberalized international air transportation systems. More recent studies have cited job and income growth and the pursuit of world-class status as reasons to seek improved international passenger service at the local level. However, these studies and the vast majority of airline industry deregulation analyses are oriented toward passenger rather than cargo service. [6,7,8,9].

International air cargo traffic and U.S. imports and exports have more than doubled since 1980. Annually, cargo traffic growth has outpaced that of passenger traffic during most years, yet little attention has been given to the cargo side of air transportation and the trade activities that it facilitates. Integrated all-cargo carriers like Federal Express (FedEx) and United Parcel Service (UPS) have spurred exceptional domestic industry growth, providing door-to-door service with which passenger airlines have difficulty competing on domestic, much less international, routes. With the rise of integrated and other all-cargo carriers in international service as well, cargo traffic can no longer be dismissed as a shadow of passenger flows.

How much international air cargo service U.S. cities have enjoyed since domestic deregulation in 1978 has been influenced by the differing agendas of four groups. Profit-maximizing airlines seek to operate combinations of routes that give the company the highest revenue for the least cost, regardless of the effects on places served or not served. Airport operators and local governments seek to improve the well-being and increase the prestige of the local community through additional service and the business revenues, jobs, and tax revenues it is perceived to provide. Consumers of cargo service want the quickest and most secure service possible at the lowest cost, regardless of where the cargo goes between origin and destination. Finally, federal policy makers seek to balance the wishes of their domestic constituents, plus those of foreign governments and airlines, to ensure a safe, strong international air service system.

International air cargo service, like major employers or professional sports teams, has become a competitive target for cities as a perceived local economic development tool. Together with international passenger service it has moved beyond solely a transportation access issue in the eyes of many policy makers. Memphis, Louisville and other cities that are hubs for cargo airlines have gained service disproportionately to the local growth of cargo-using industries. Other places, including Minneapolis-St. Paul, have enjoyed growth in cargo-using industries without commensurate service expansion. Through analysis of service supply and demand patterns over time, our study reveals which cities' shares of air cargo service have and have not been paralleled by their proportions of employment in selected airborne export-producing industries, and therefore where opportunities for carriers to improve service or for cities to attract more airborne export-producing employers may exist.

Our research helps to fill several gaps in our understanding of the complex relationships between international air cargo service, exporting industries that use it, and the hierarchy of U.S. metropolitan regions that compete for both the service itself and service-consuming employers. It investigates, for the first time, the mismatch between geographic patterns of supply and demand for overseas air cargo service to and from U.S. cities. Our analysis also shows which industries rely most heavily on air cargo service to facilitate their trade activities, and which cities have achieved the best access to overseas markets.

These findings can inform local policy makers of international air cargo service's importance to the success of specific airborne export-producing industries locally, and to the

competitive advantage or disadvantage of their cities in the world economy. By identifying geographic patterns of growth in overseas cargo service, our results indicate to local leaders how their home cities compare among competing U.S. metropolitan regions. Linking these patterns to local employment change in selected industries can help focus initiatives on industries that produce high value, low weight, and/or time-sensitive goods, but are either not yet exporting their products or not using locally-originating overseas service for their export activities. These new insights into cargo service markets can also inform major investment decisions about the airport infrastructure needed to attract and sustain overseas air cargo service and related employers.

STUDY ORGANIZATION AND FINDINGS

This study identifies supply and demand characteristics of U.S. cities that are most likely to be the largest production and distribution centers for airborne exports. In all, 64 county-based metropolitan regions are examined, some of which are served by as many as three airports with international service while others have no international flights at all. Thresholds for consideration include the presence of either at least one "large" or "medium" air service community as defined by the Federal Aviation Administration (FAA), or one of the sixty largest U.S. cities according to population. (The FAA categorizes cities as large, medium, small, and non hub communities based on annual passenger traffic statistics. For a complete discussion of metropolitan region definitions and criteria for selection, please see Appendix A.) Cities without international air service are included in the domestic production analysis to enable identification of new markets based on potential overseas service demand.

Service supply and demand data are investigated for 1980 and the mid-1990s. The 1980s saw several waves of new, more liberal, bilateral agreements between the U.S. and its trading partners. Selection of 1980 as a starting point for the study captures a picture of the industry before the industry reorganization stimulated by these events was fully underway. The study utilizes the most recent data available at the time of investigation for both supply and demand analyses (1995 and 1994 figures, respectively). Study years allow before-and-after comparison of a roughly 15-year period; neither year represents any major airline industry peaks or valleys.

Service considered in this study departed from U.S. cities, terminated at non-U.S. destinations outside of Canada and Mexico, and made fewer than five stops en route. Airports

that are situated within U.S. territories and holdings but are outside the 50 states are omitted from the study altogether: affected jurisdictions include Puerto Rico, the U.S. Virgin Islands, Guam, and other islands in the Caribbean Sea and South Pacific. Although these island markets deserve investigation in their own right, the cargo traffic to and from them is not significant relative to the national total, and does not cleanly fit as either U.S. imports or exports.

Throughout this study, we use the term "overseas" rather than "international" to describe the service examined. Routes to Canadian and Mexican destinations are not considered in the study because the United States shares contiguous land borders with each. Alternative transportation modes are available between U.S., Canadian and Mexican cities, often with comparable total elapsed travel times. Again, cargo transportation between these three nations is worthy of study, but the topic merits a separate investigation that can devote appropriate attention to intermodal competition and North American Free Trade Agreement issues.

The study is divided into seven chapters. Chapter Two finishes the introductory portion of the study. In it we present background overviews of the language and measurement of the air cargo industry, the importance of air freight, what characteristics make an item appropriate for air rather than another transportation mode, who provides and uses international cargo service, and how the international system is governed. These sections provide crucial context for the empirical portion of the study that follows.

In Chapters Three through Five we document our nationwide analysis of service supply and demand and develop a classification based on changes in both local market characteristics over time. We use Chapter Six for analysis of metropolitan region case studies drawn from the major categories of the overseas cargo market classification. The following four research steps are commensurate with these four chapters:

- Documentation of advertised overseas air cargo service levels at the sixty largest U.S. cities and all FAA-designated large and medium airport facilities nationwide in 1980 and 1995 (71 airports in a 64 metropolitan region study area);
- Identification of the exports most often shipped by air (air-eligible) and examination of the geographic distribution of employment in these target export industries among the 64 metropolitan regions during 1980 and 1994;

- Classification of each metropolitan region according to growth or decline in its share of (a) service and (b) employment in the identified target industries; and
- Investigation of the specific features of four metropolitan regions representing matches and mismatches between service and local air-eligible export-producing industry employment changes between 1980 and the mid-1990s.

In Chapter Three we analyze changes in the overseas air cargo service network in terms of service proportions of all flights available at U.S. cities. We document the number of overseas destinations served and the type and quantity of service offered from airports within each of the 64 metropolitan regions in September 1980 and 1995. We use Official Airline Guides (OAG) data and make distinctions between nonstop and direct service, and service on all-cargo and combined passenger-cargo aircraft. We find that service within multiple-airport metropolitan regions shifted from the traditionally dominant gateway to less-congested facilities, and that these gateways also lost shares of the nationwide service to newly-served, smaller metropolitan regions. Overall, eleven new metropolitan regions gained at least one nonstop overseas flight each week while one (Bangor) lost its only overseas service. The number of metropolitan regions with nonstop overseas flights from at least one local airport rose from 19 to 29 between 1980 and 1995. In the final section of the chapter we demonstrate the shifting hierarchy of metropolitan regions as overseas service gateways using a map of proportion changes in total service supply among all U.S. cities over the period.

In Chapter Four we investigate the changing geographic pattern of employment in cargo-using industries. First, we use U.S. Census data on international export activities to identify industries that accounted for the highest values, largest weights, and largest proportional values of exports shipped by air during 1995. The eight industry groups revealed to be the most significant air cargo consumers include high-technology industries such as electronic components (superconductors), drugs, and medical instruments and supplies. The locations of these target industries serve as an indicator for service demand. We incorporate target industry employment in 1980 and 1994, extracted from establishment-based *County Business Patterns* data, to compile a map of potential air cargo service demand. By examining each metropolitan region's proportion of total target industry employment in both years, we isolate where improvement or decline in a

city's cargo market competitive advantage has occurred. Cities in the southern and western United States gained the largest shares, while traditional industrial giants like New York and Los Angeles did not fare well at all.

We bring together the service supply and demand characteristics documented in the two previous chapters in Chapter Five. This approach enables us to compile a simple classification of the 64 metropolitan regions according to their rank changes in service supply (scheduled nonstop overseas flights per week) and demand (employment in airborne export-producing target industries). Nine categories result: We divide the metropolitan regions among cells in a three-by-three matrix showing improvement, stability, or decline in rank based on service and employment. Because there were fewer metropolitan regions without any nonstop overseas service in 1995 than in 1980, the ranks of these cities fell dramatically and give an overly negative impression at first observation. Cities in the four corner cells (showing decline and/or improvement, but not stability in rank) form the groups from which we identify Portland, Oregon; St. Louis; Washington-Baltimore; and Minneapolis-St. Paul as case study metropolitan regions.

We briefly consider the local political, economic, and industry issues that influence service and employment in these four metropolitan regions in Chapter Six. Detailed investigation of service availability and cargo-using industries present in these cities illustrate the unique local factors that are significant to the international service-local economy relationships. Publicly-funded marketing initiatives, private industry development organizations, and community leaders in some metropolitan regions have mobilized to attract new overseas carriers and routes, while other places have not made improved service a priority. Case study examination provides the local insight necessary to more fully understand relationships identified in the aggregate analysis of overseas cargo service and cargo-using industries.

Chapter Seven summarizes the major findings and implications of this study. As our economy has become broader and more geographically flexible, so also have the supply and demand forces shaping local international air cargo service markets. Between 1980 and the mid-1990s, more U.S. cities gained direct links to the overseas air cargo service network. Likewise, employment in industries that produce air-eligible exports became more widely dispersed among a greater number of places. Our study reveals that the hierarchy of U.S. metropolitan regions competing for service and employers shifted away from traditionally dominant cities over this

period. It demonstrates where actual service and employment have grown or declined, but more importantly identifies cities whose competitive place among other metropolitan regions has fallen or risen. Employment rank gain without commensurate improvement in service position reveals potential markets for new service. Conversely, service position improvement without similar employment rank gain indicates potential opportunity for increased local airborne export production.

This study begins to address the air cargo industry's importance to international trade, and in doing so reveals large gaps that still remain. First, until we can determine where products exported by air from the United States actually are produced, we cannot understand how well our total export transportation processes work. Second, we have yet to identify important characteristics of individual air cargo markets: the geographic dimensions of international cargo catchment areas for various metropolitan regions, the amount and location of jobs related to production of exports, and the extent to which limitations in back-haul traffic constrain development in both the air and ground transportation networks. Third, we still know very little about the long-term success of local efforts to court improved service.

Our study's greatest contributions are to the furthering of our knowledge about overseas air cargo service access among U.S. cities, the export industries that rely on air transportation to reach overseas markets, and employment patterns among them. Findings from the national classification of metropolitan cargo markets are more revealing for what they tell us about individual places rather than the nationwide picture. The study's documentation of service, trade, and employment data, and this first attempt to bring the information together in a meaningful overseas cargo market analysis, can provide a new launching point for research on the relationships between local economic processes and international transportation systems that link them to the world economy.

CHAPTER TWO
INDUSTRY CONTEXT

The air cargo business is a mystery to most people who are not directly involved in its activities or reliant upon its services. As travel times have shortened and increased in reliability, one often becomes aware of the complicated distribution systems that move people and goods around the world only when something goes wrong. In this chapter we provide background on the small but expanding part of the modern transportation business that moves goods by air. We introduce basic terminology and measurement strategies used by industry experts, discuss the role of air freight in today's economic system, and explain characteristics that render some goods more appropriate for transport by air than others. Next, we identify the major participants in business, from service providers to consumers. Finally, we give a brief overview of the regulatory environment that shapes the international cargo industry. The chapter serves as a backdrop for the empirical supply and demand analyses that follow.

INDUSTRY TERMINOLOGY AND MEASUREMENT

Air *cargo* generally refers to all items carried in a plane for hire that are not passengers or their baggage. It includes, but is broader than, air *freight*—all air cargo except airmail (Figure 2.1). The United States Postal Service (USPS) buys space on aircraft by volume from air carriers for the purpose of carrying mail. Between 1984 and 1993, U.S. carriers earned an average of 1.6 percent of their annual revenues (close to $1 billion in 1993) from airmail contracts, with very little deviation from year to year [10]. Revenue earned from envelope delivery handled by services other than the USPS is not considered in the airmail total; for example, revenue from Federal Express (FedEx) and United Parcel Service (UPS) express letter shipments accrues under the air freight category because it is a private service. Although annual airmail revenue makes up a small proportion of total airline earnings, it is a stable source of income in an otherwise volatile industry.

Unlike those from airmail, revenues from air *freight* fluctuate greatly depending on the demand for an ever-changing menu of services offered by carriers and the activities of economic

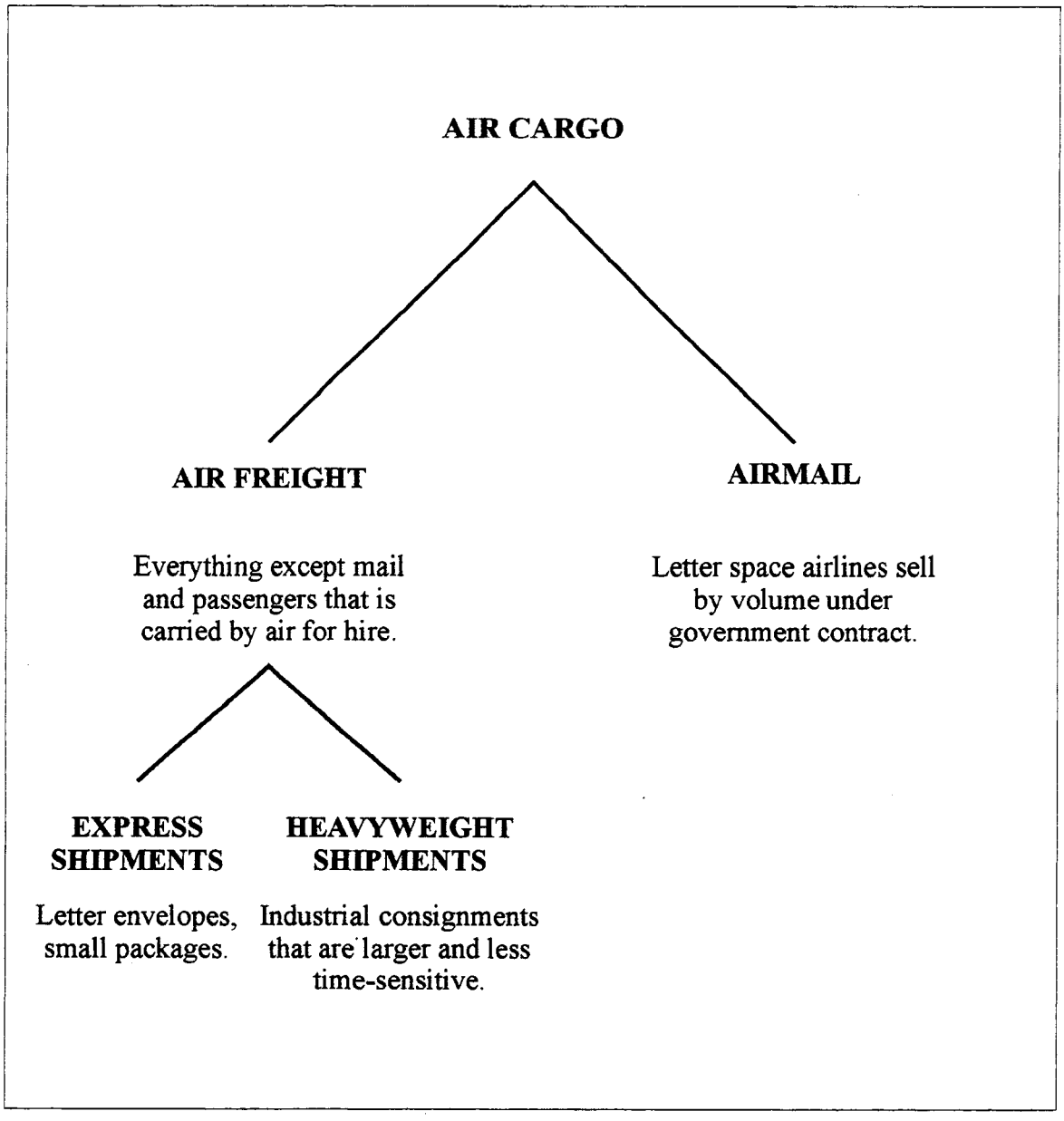


Figure 2.1. Components of Air Cargo. Air cargo includes both freight and mail. Although mail contracts are a steady source of income for air carriers (particularly on international routes), airports and airlines alike have greater opportunities to influence and profit from the amount of air freight they carry than the amount of mail. SOURCE: Clancy, B., D. Hoppin, and W. Liddicoat. (1995). "Overview of the air cargo industry." In *Air Cargo Compendium.* Washington: Airports Council International.

sectors unrelated to the airline industry. They also consistently make up a greater proportion of total air carrier revenues than airmail; even at its lowest point in ten years, air freight activities accounted for more than four percent of total revenues ($1.6 billion in 1985 dollars). Between 1984 and 1993, an average of 8.3 percent of carrier revenues came from their freight services (peaking at $5 billion in 1993) [10]. Since reaching its highest proportion of total revenues reached in 1988 at 11.6 percent, air freight has gained increasing attention as a profit-making opportunity for air carriers of all types.

The distinction between air cargo and air freight is important. Total airmail tonnage carried has been growing steadily, but the amount of total enplaned *cargo* has exploded—more than doubling between 1984 and 1989 alone [11]. Air freight is also of special interest because actions of individual airports or airlines may alter the map of freight flows, although similar actions are unlikely to change airmail traffic patterns. Demand for airmail is not as sensitive to other economic factors as that for air freight, and airmail tonnage generally makes up less than one-third of the total cargo enplaned by U.S. carriers system-wide [12].

Government agencies, airlines, airports, and trade associations each record data on limited aspects of air cargo for their own purposes. Publicly available data include traffic, capacity, revenue, or some combination of these, but all are confined to general, aggregate figures. Information on all-cargo aircraft landings and takeoffs (operations) track one sector of the industry without considering the vast amount of freight and mail carried in passenger aircraft (especially on international wide-body flights). Those collecting operations data are more concerned with facility capacity and usage than with the contents, value, and destination of what is being shipped.

An example of one motivation for and usage of air cargo data explains the limitations of its utility in addressing the question of what is being carried from where to where, and why. The Federal Aviation Administration (FAA) Office of Airport Planning and Programming tracks total aircraft weight of all the all-cargo airplanes landing at U.S. airports each year as a criterion for grant distribution. They are not interested in the cargo industry per se; the goal is to measure the need for infrastructure investment based on wear and tear from usage by heavy aircraft. Mapping all-cargo aircraft weight reflects the distribution of airport usage by all-cargo equipment, but does

not distinguish between foreign or domestic traffic and fails to account for mixed-use aircraft cargo (Figure 2.2). It tells only part of a complicated story.

To better understand the total cargo traffic picture, industry analysts often consider enplaned tons of cargo at a given airport or across an entire system. Capacity measures are also useful, especially for comparison with what is actually shipped. Total revenue from cargo traffic provides an aggregate assessment of how the cargo side of the business is doing relative to the passenger side in addition to measuring business performance and determining profits. Revenue-ton-miles (or kilometers) indicate earnings per unit distance of each ton carried, and allow airlines to determine which sections of their system are the most lucrative. Each U.S. carrier must file such information with the U.S. Department of Transportation, but disclosure is often limited for competitive reasons and individual airlines are understandably protective of their own profitability analyses.

While the public and private sectors alike keep track of many aspects of airline service itself, they give less attention to *what* is shipped. U.S. airlines know that over 90 percent of their freight traffic comes from forwarders rather than shippers, and until lately have been content to let the forwarders worry about the nature of that traffic. A 1995 Northwest Cargo advertisement sums up the traditional U.S. carrier approach: "We won't ask why, just where and when." Integrated carriers like FedEx, UPS, and DHL work directly with shippers, but until lately have not aggressively sought larger, industrial-sized shipments.

In part because of this lack of interest and in part due to the lack of government regulation in the cargo industry since the late 1970s, no standardized, detailed information on domestic shipments is available. There is no international air waybill documentation source either. The only systematic information on the "what" and "where" of international air cargo shipments must be derived from combinations of other sources. Thus, tracking the complete paths of air freight for which contents are known into and out of the country is extremely difficult.

THE IMPORTANCE OF AIR FREIGHT

Why does air freight, and particularly international air freight, warrant attention? First, direct and indirect local economic benefits arise from air cargo service just as they do from passenger service. Employment earnings, tax revenues and business revenues from service

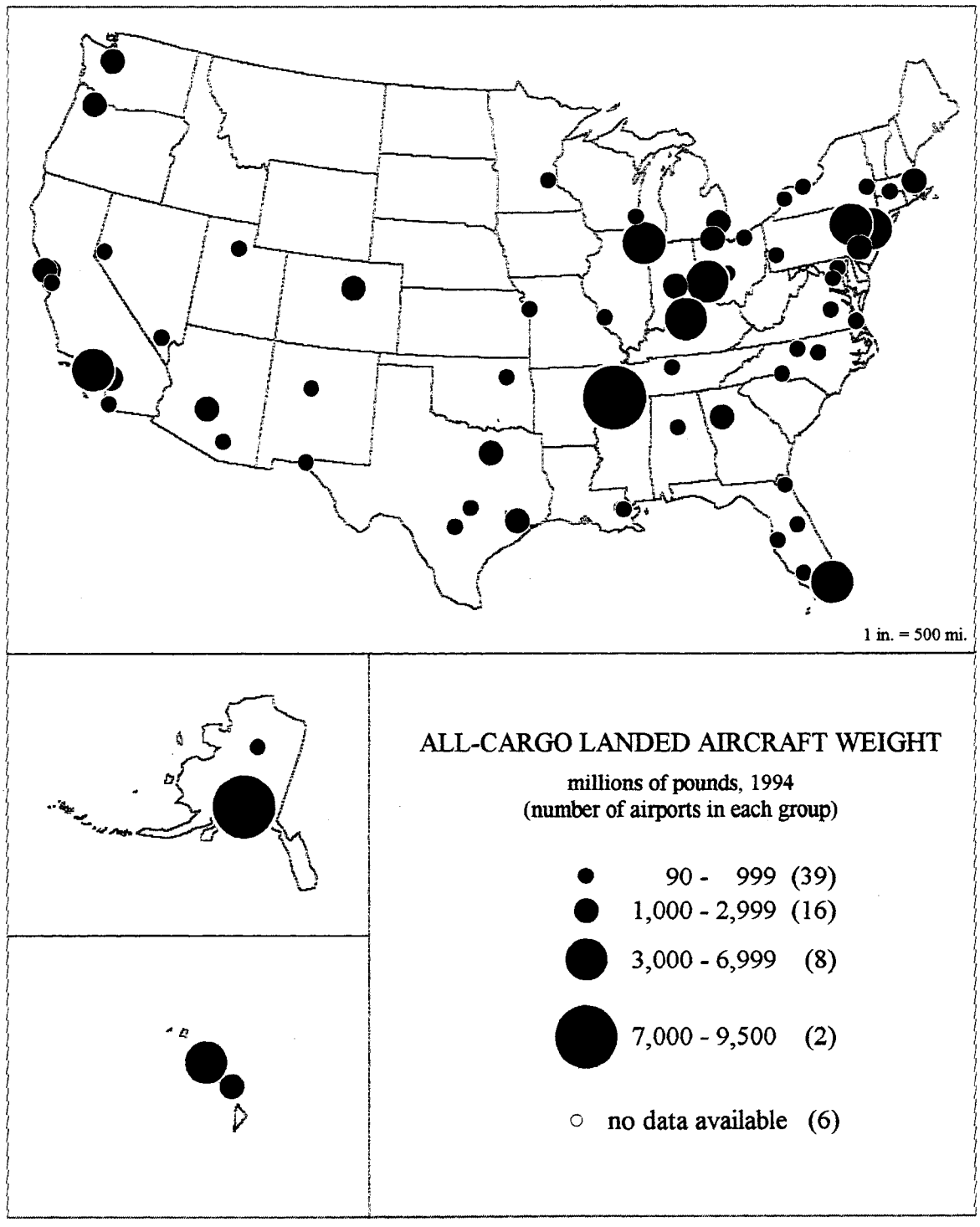


Figure 2.2. All-Cargo Aircraft Activity Distribution, 1994. The FAA's Office of Airport Planning and Programming uses the total landed weight of all-cargo aircraft (regardless of origin) to determine funding. All-cargo airline hubs and major international traffic gateways dominate the map because data for passenger aircraft are excluded. Those of the 71 airports among the 64 metropolitan regions in the study that had over 1 million tons of total landed aircraft weight in 1994 are shown. SOURCE: Federal Aviation Administration. (1995). *Airport Activity Statistics of Certificated Route Air Carriers* (Report F-C10). Washington: Federal Aviation Administration.

provision are at least partially cycled back into the local economy. These additions to the economy in turn support other business activities, such as forwarding and brokerage operations, that yield further earnings and revenues [13]. Similar ripple effects arise from the business activities of cargo customers themselves (airports regularly commission or engage in their own economic impact studies detailing these effects) [14].

One clear but often undocumented benefit of international cargo service is its role in getting locally-produced goods to markets abroad. Air has become an increasingly vital mode in facilitating U.S. trade. Although air cargo regularly accounts for less than one percent of U.S. exports by weight, goods shipped by air now make up close to one-third of total U.S. export value. (See Chapter 4 for a discussion of air transportation's importance to U.S. export activities.) Shipping by air allows U.S. producers to expand markets of traditionally non-air-eligible goods, and extend the reach of U.S. economic interaction around the world. Not only do the airline industry and other transportation providers related to air shipments benefit from a strong market for air freight, the producers and consumers where the service is available also benefit.

The air cargo industry is irrevocably entwined with many other industries because it is a producer service: its customers are other businesses rather than private consumers. Demand for air freight service is derived from other economic activities—the production and consumption of goods and services unrelated to the airline industry itself. As geographic patterns of production and consumption shift, the transportation and communication modes used to connect places change as well [15]. Availability of air transportation for the shipment of both intermediate and finished products is an important factor in globalization processes.

Local economic benefits arising from air cargo industry activities are multiplied where there is not only service, but also carrier headquarters and/or distribution center functions. These cities gain more employment and revenue benefits because of the home-based activities, and therefore depend more on industry health than so-called "spoke" or "non-hub" cities. If FedEx or Northwest Airlines suffers due to downturns in the industry, the economies of Memphis and Minneapolis-St. Paul will suffer as well. A firm within a profitable industry is likely to be an asset to the home community. U.S. passenger carriers generally earn about ten percent of their revenue from cargo [16]. As a whole, the airline industry enjoyed its third profitable year in a row in 1996

[17]. Cities eager to share in the industry upswing seek increased air freight service and compete for service providers as they would for any other major employer.

Finally, the air cargo industry's competitive structure is dynamic, and these industry developments directly influence service levels at many cities. After deregulation, integrated carriers gained dominance in the domestic industry through scale-induced cost reductions, service improvements, and competitive advantage over many carrier and forwarder combinations. Will history repeat itself in international freight markets? Concerned that the worldwide integrated service of FedEx, UPS and DHL will have a similar competitive advantage over passenger airlines internationally, passenger carriers are looking to forwarders, motor carriers, and foreign shipping agents with whom to cooperate. Vertical alliances with other service providers are crucial for air carriers to build worldwide air-ground networks that can compete with single-company integrated services [18]. As different types of carriers vie for overseas traffic, nonstop service between some city pairs will be sacrificed for global hub-and-spoke systems.

THE NATURE OF AIR-ELIGIBLE GOODS

Determining what types of goods and products are appropriate for air carriage on overseas routes is based on alternative modes available, time constraints on delivery, and how much time-reliable delivery will add or detract from the value of the shipment. When shippers seek to move goods internationally, four factors traditionally influence their modal choice: cost, speed, reliability, and security (Table 2.1) [12]. No mode can provide all of these benefits equally, so a decision must be made as to which service type provides the most desirable complement of characteristics for each shipment.

Air transportation has traditionally been synonymous with short shipment times, reliable service, low rates of pilferage and damage, and enormous costs. Alternatively, water transportation costs less to operate but is slow, often less predictable, and prone to poor security (especially with non-containerized shipments) because waterborne freight is exposed to more unsupervised situations over a longer period of time than air freight. The geographic reach of water transport is more limited by physical features, too: without transferring vessels or modes, origins and destinations for waterborne shipments are limited to coastal ports or inland waterways

Table 2.1. Traditional Tradeoffs between Factors Influencing Modal Choice for Overseas Shipments.

In terms of...		*Which mode is better?*	
Traditional Factor	**Method of Measurement**	**Air**	**Water**
COST	Dollars of explicit transportation cost.		X
SPEED	Door-to-door time between shipper and receiver.	X	
RELIABILITY	On-time arrival performance at receiver.	X	
SECURITY	Rates of loss, damage, and theft.	X	

that can accommodate ocean-going ships. Air has the advantage of enabling shipment delivery and pickup much closer to the actual locations of each shipper and recipient.

Today, time of delivery can sharply affect the value of a shipment. Three key time-related concepts drive the advantage of air freight transportation over other modes. First and foremost is the issue of perishability. Perishability is not just the physical degradation of a product such as fruit or flowers over time, it is also the economic utility of an item (Figure 2.3). A shipment of cherries to Japan will be useless if it arrives too late—the contents will have spoiled. Equally useless is the shipment of Mother's Day greeting cards that arrives in late May—after the annual holiday. Some goods, such as long-stemmed roses in February, are affected by both economic and physical perishability. Roses that arrive in time for Valentine's Day sales bring much higher market prices than those that are delivered on February 18th. Because markets are time-sensitive, higher prices may more than cover the differential cost of premium transportation services that guarantee speedy delivery.

The second time-centered issue is the reliability of a delivery time estimate. Air transportation's definite delivery times allow shippers to shorten their production cycles, enabling them to reduce warehousing and storage costs. The longer a shipment is in storage or transit, the less time that the investment is working for the company. Also, the significance of time increases with the value or capital intensity of a good—in effect, the company is paying interest on the product until it pays for itself. Electronics, precision instruments, and specialized industrial machines are examples of such high-value shipments. Minimizing logistics costs is especially crucial for such items.

Third is the issue of demand predictability. Depending on the demand flow, shippers may not know what they will need to deliver until the last minute. If the consignee, or receiver, is inflexible and places delivery orders that need immediate fulfillment, air is the necessary option. This is true in the case of a machine part that is crucial to preventing production line stoppage, or emergency medical equipment. Also, fickle markets require shorter times between when orders are placed and shipments received. For example, which new toy will be the most popular for holiday gift-giving may not be known until evidenced by early sales; a manufacturer wants to get the right amount of the right product into the stores in time for holiday shopping to avoid

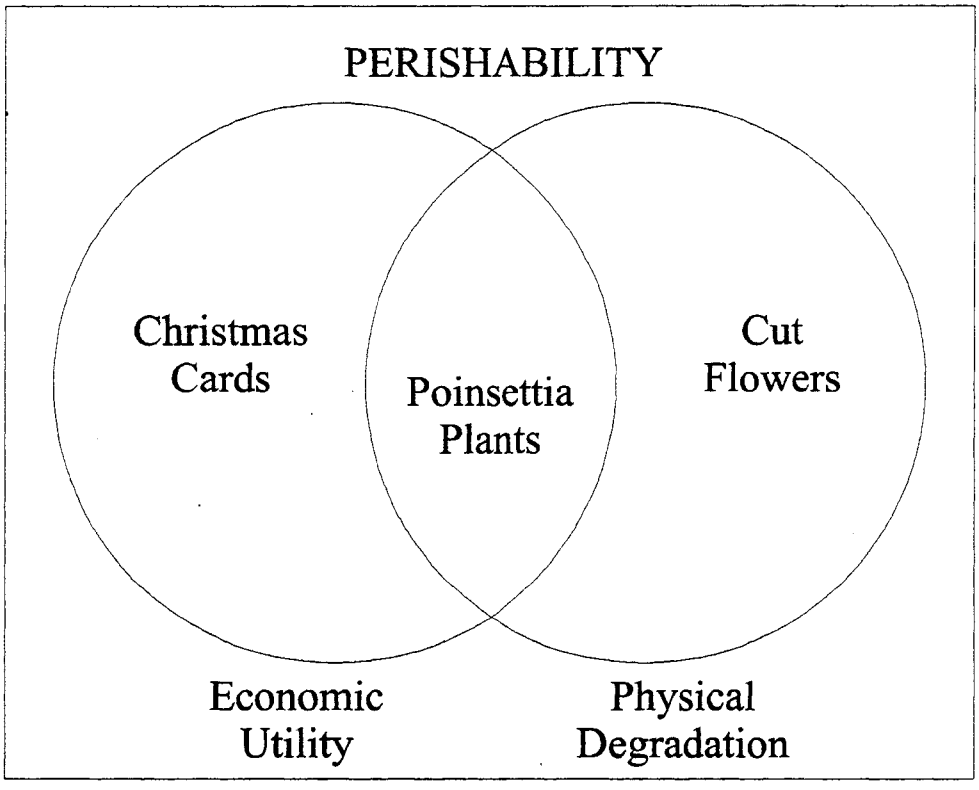


Figure 2.3. Economic and Physical Perishability of Freight. Christmas cards, poinsettia plants, and cut flowers are three examples of goods that are potentially air-eligible. Christmas cards bring in very little money in January, and cut flowers run the risk of spoiling if they do not reach the point of sale in a timely manner. Poinsettia plants are perishable for both economic utility and physical degradation reasons.

foregone sales or overstocking of an unpopular items. Air is particularly useful for these time-sensitive, last-minute orders.

Shippers today send seasonal goods halfway around the world in dedicated freighters, opening new markets for both purchases and sales. Traditional high-value goods are making way for some surprising items in cargo compartments, with garments a particularly striking example. The Limited, a retail clothing chain, now uses a chartered freighter for its major season rather than traditional modes so that it can ensure offering the most popular styles to its customers. The combination of low labor costs in East Asia, enhanced demand predictability for Western markets enabled by short air delivery times, and the improved cost-effectiveness of distributing throughout the U.S. market via truck from an off-airport center in Columbus make this practice a worthwhile investment [12].

In addition to temporal issues, physical characteristics influence the suitability of air transportation for overseas shipping needs. Constraints on air eligibility include size, temperature, and weight. Even these barriers to air transportation's usage are diminishing, though. Aircraft are larger and more commonly used only for freight. Freight holds can be pressurized and temperature-controlled to allow carriage of live animals, flowers, or refrigerated items. Technological developments have made freight pallets and other containers lighter, stronger, and easier to use. Better packaging materials soften the journey for delicate items without sacrificing as much space. In all, physical issues no longer pose problems for the majority of air shipments.

Finally, geography can influence a shipment's air eligibility if its destination is cost-prohibitive or even impossible to reach. Although air sometimes provides the only access to isolated destinations due to ground transportation limitations, harsh terrain can also make even air landings impossible with heavily-laden aircraft in some instances. More common site-specific constraints include security issues, customs delays, or a lack of back-haul traffic; these can make offering profitable service to some markets impossible.

AIR CARGO SERVICE PROVIDERS AND CONSUMERS

Between any two locations, air freight carriage itself is but one link in a total transportation service. Getting a shipment from point A to point B requires more than a single mode of transport (unless, of course, A and B are airports themselves). Because aircraft do not

serve shippers and consignees at their doorsteps, intermediate transportation services are necessary to and from the nearest origin and destination airport facilities. These services are coordinated by the logistics or traffic management department of the shipping organization, a forwarder, or an integrated carrier. Likewise, the airborne portion of the shipment's journey may be operated by one of several types of air carriers. This section describes the major service provider groups that participate in the provision of freight transportation service that involve international air journeys, beginning with air carriers themselves.

Carrier Types

Two major types of carriers operate aircraft in conjunction with their international air freight services: all-cargo carriers and passenger carriers (sometimes called combination or mixed-cargo carriers because most sell passenger aircraft belly space for cargo transport). All-cargo carriers include integrated carriers, integrated forwarders, and dedicated cargo carriers. Integrated carriers manage the shipment, track it door to door, and provide all necessary transport services between origin and destination. FedEx was the earliest company to offer integrated door-to-door service in the early 1970s by adding and coordinating motor carriage with its already thriving air cargo business. Conversely, UPS began as a door-to-door truck service that expanded to include aircraft operations in the 1980s. These carriers, along with DHL, have created and now dominate the enormous U.S. express package service industry and are expanding their market share of larger domestic shipments as well as their integrated international services.

Integrated forwarders such as Emery Worldwide, Burlington Air Express, and Airborne Express operate their own aircraft, but also contract with other carriers for space. Often, they do not operate their own aircraft on international routes, but instead purchase space on other airlines' widebody flights. Like integrated carriers, integrated forwarders have real-time tracking capabilities for shipments across their air and ground transportation system through the use of high-tech "smart" packaging and labeling systems. Both integrated carriers and forwarders may use allied local operators for ground delivery in foreign countries, but generally their alliances are stronger than partnerships between traditional forwarders and the motor/air carriers with whom they contract. Dedicated cargo airlines with international service are relatively small in number; Nippon Cargo (Japan) and Cargolux (Luxembourg) are examples. These carriers sell their space

either directly to shippers or to integrated or traditional forwarders who arrange their own ground delivery and pick-up.

Passenger carriers that handle international cargo can be categorized according to the types of aircraft they operate and space they make available for cargo traffic. Some passenger airlines operate freighters (all-cargo aircraft) on international routes, but the vast majority use only belly space in their passenger airplanes. Northwest Airlines was the only U.S. passenger carrier to operate freighters on international routes during the 1980s and early 1990s. The other major U.S. passenger carriers focused on their passenger operations as they sought to position themselves in the post-domestic deregulation industry. The belly space available in widebody passenger and combination (or "combi") aircraft provided enough capacity to satisfy the carriers' perceived cargo demand. Foreign combination carriers include Lufthansa (Germany) and British Airways. Overseas passenger flights with cargo service from U.S. airports outnumbered all-cargo flights by about six to one in both 1980 and 1995, indicating that passenger flights remained the mainstay of overseas air cargo service (Figure 2.4) [19,20].

Capacity distinctions between "narrow" and "wide" body aircraft are also significant: a narrow-body Boeing 707 freighter holds only as much cargo as the belly space available in a Boeing 747 configured for maximum passenger seating. Narrow-body aircraft also require stricter limits on the dimensions of the containers they can accommodate due to door size, compartment dimensions, and engine power. Appendix B lists major aircraft in commercial service today according to their widebody or narrow body designation. Narrow-body service remained an important component of the total overseas cargo service from U.S. cities between 1980 and 1995, especially for markets in the Caribbean basin, Central America, and South America because of their proximity to the mainland United States The proportion of mixed-cargo narrow-body service increased from 4 percent to 17 percent of total overseas flights with cargo service during the period, reflecting the increase in short-haul passenger traffic to leisure markets.

The all-cargo narrow-body service proportion remained constant during the period, but the actual number of this type of flight more than doubled [19,20]. The continued significance of this type of service can be attributed to two major factors: (1) a strengthening of trade ties in the region, and (2) the purchase of used narrow-body aircraft by emerging foreign flag carriers in Central and South America. These developments have been reinforced by a continued

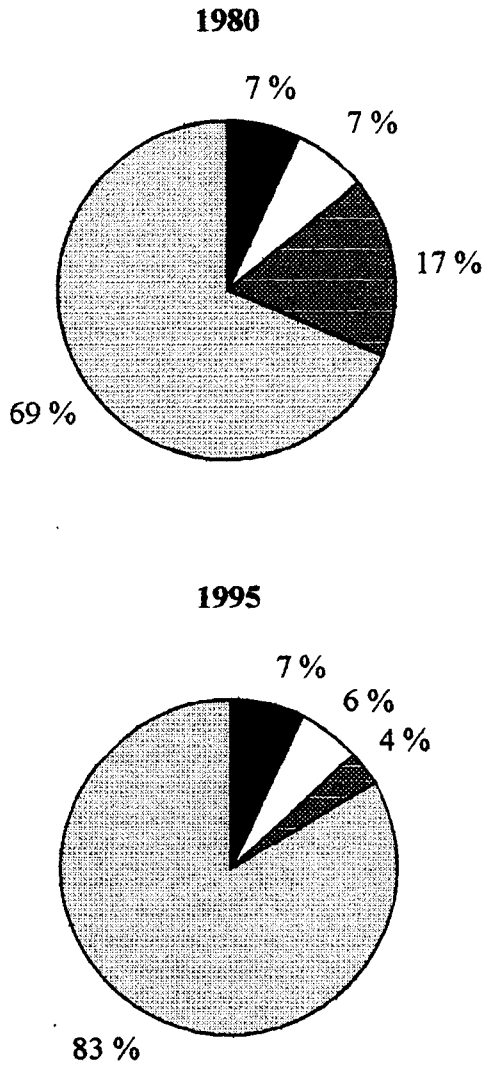


Figure 2.4. Aircraft Type and Configuration Combinations on Overseas Routes from U.S. Airports, September, 1980 and 1995. Widebody mixed-cargo service accounted for the majority of all weekly scheduled cargo service in both years. Narrow-body aircraft were used on a greater proportion of all-cargo flights in 1995 than in 1980, but on a much smaller proportion of mixed-cargo routes. SOURCES: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; and Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file compiled by BACK Information Services). Oak Brook, IL: Reed Travel Group.

concentration of service within the region at Miami International Airport (MIA). Over 96 percent of MIA's nonstop overseas departures in 1995 used narrow-body aircraft, making it an anomaly among U.S. international airports. The Miami case is just one example of carrier network organization that is relevant to this study.

Carrier Networks

Most U.S. carriers use one or more cities as their major distribution point(s) (hubs) for air and/or ground traffic. Passenger carrier hub locations for domestic traffic are driven by large population centers (both for passenger volumes and airline work force availability), and geographic proximity between other major markets (Figure 2.5). Thus, many passenger carriers have hubs in the middle of the U.S. rather than on the geographic periphery. It is logical to operate cargo hub operations at airports where congestion from passenger activity does not drive up airport facility space costs and complicate operations. Cargo carriers are concentrated where access to ground transportation access is good.

Cincinnati, Dayton, Indianapolis, Louisville, and Memphis are all planted firmly at the center of the U.S. interstate highway system, are well situated in the geographic center of the continental United States, and are not faced with excessive competition for airport resources from passenger carriers. Anchorage, on the other hand, provides an excellent distribution point for international traffic. FedEx and other international carriers use the airports at Anchorage and Fairbanks as consolidation points for traffic between Asia, North America, Europe, and even Latin America.

Major U.S. international freight gateways include several cargo and passenger carrier hubs, but also reflect traditional port locations. Gateway traffic, in this case, is measured by freight (not cargo) weight on all scheduled and nonscheduled commercial flights operated by U.S. carriers (Figure 2.6) [22]. Data include tonnage on all aircraft that are large enough to seat at least 60 passengers, if so configured. The gateway distribution for international traffic emphasizes the geographic periphery of the entire United States, with two in Alaska and one at Honolulu, Hawaii. Miami was the busiest freight gateway in 1994; New York's Kennedy Airport and Newark combined to account for just under twenty percent of all U.S. international freight counted in this data set.

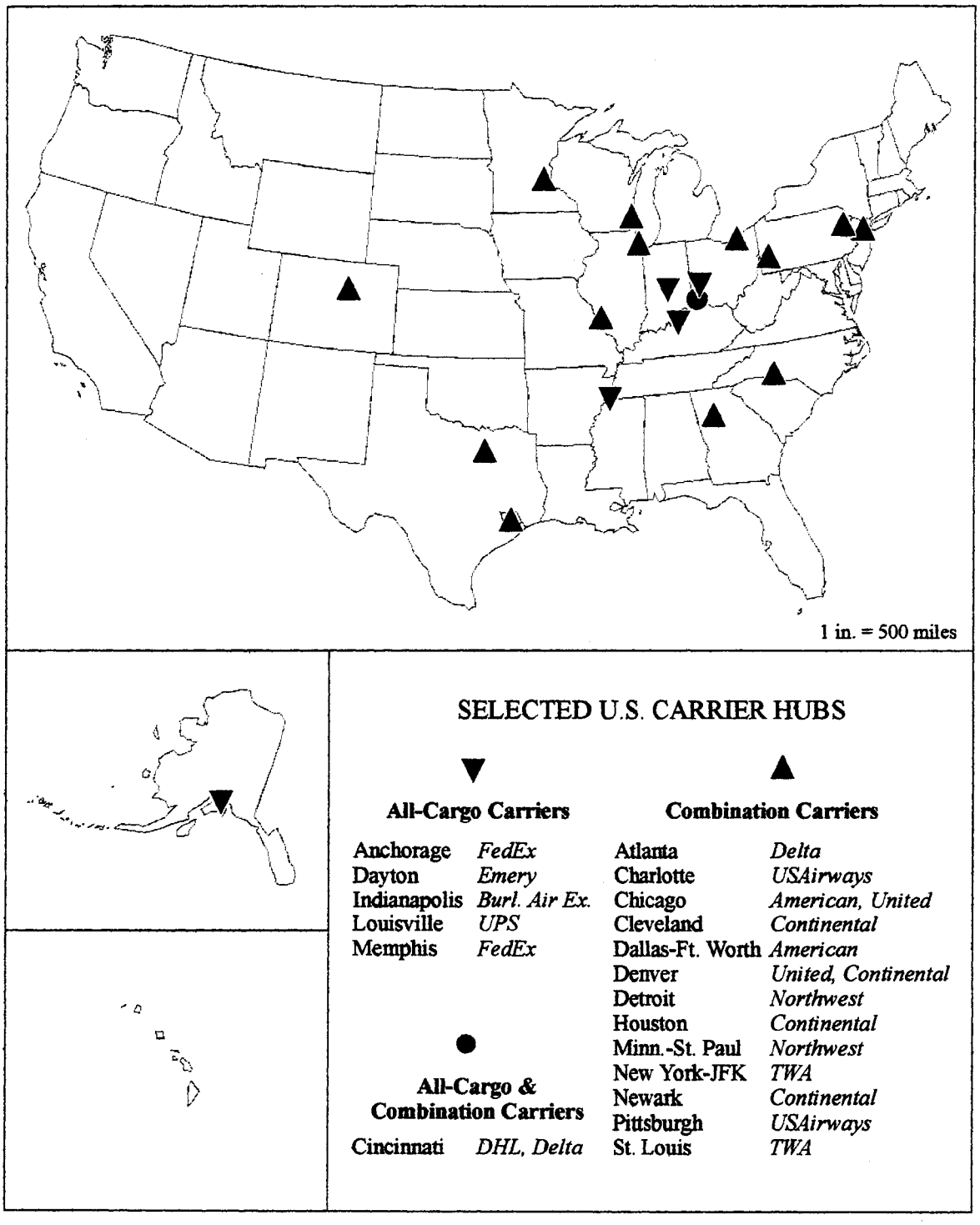


Figure 2.5. U.S. Cargo and Combination Carrier Hubs. Passenger hubs are distributed throughout the middle of the country and along the East Coast; cargo carriers concentrate their service in the geographic center of the United States near major junctions in the interstate highway system.

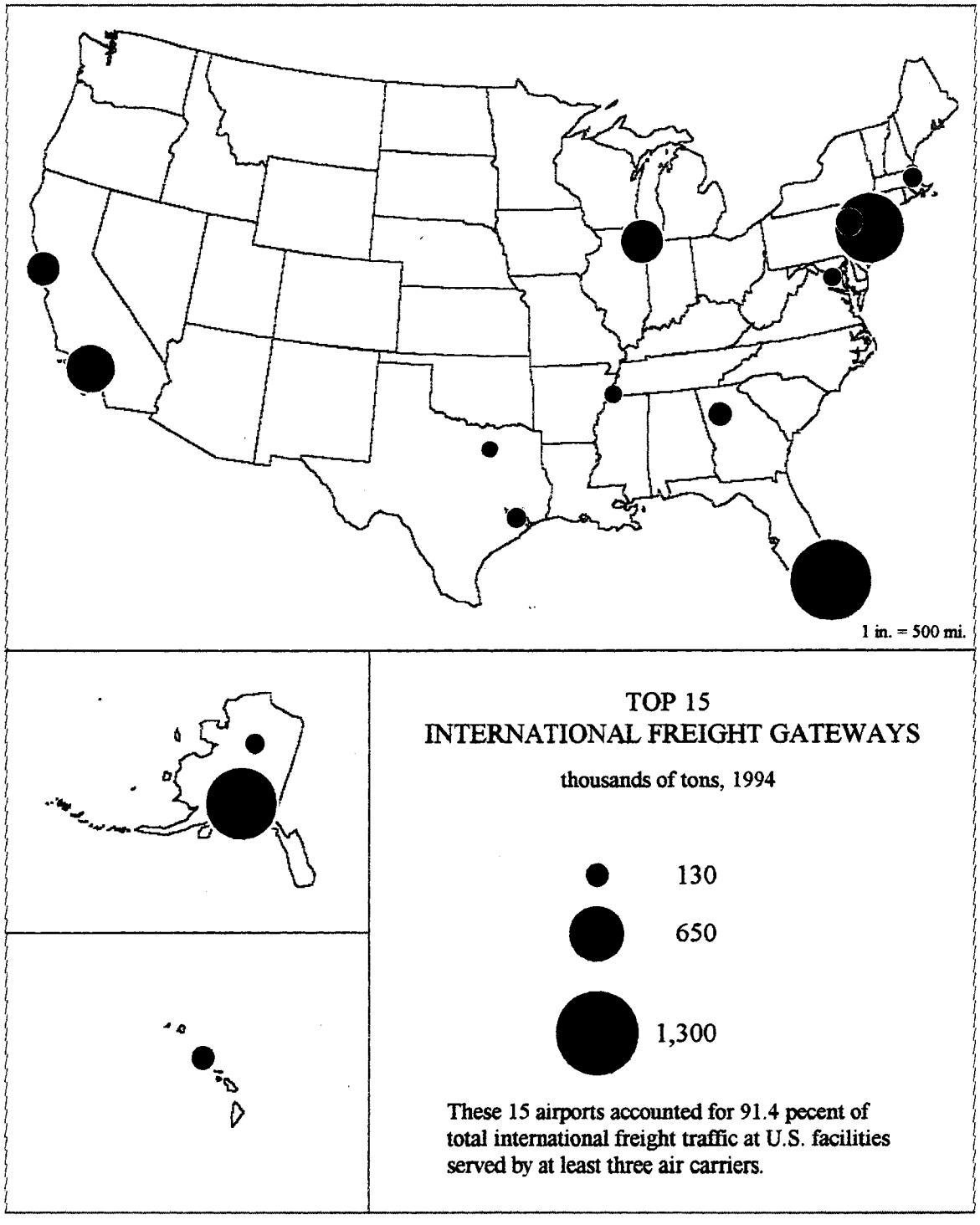


Figure 2.6. Major U.S. International Freight Traffic Gateways, 1994. Fifteen U.S. airports with the most international traffic (by weight, thousands of tons enplaned). SOURCE: Bureau of Transportation Statistics. (1995). *U.S. International Air Passenger and Freight Statistics Calendar Year 1994, Vol. 2, No. 24.* Washington: U.S. Department of Transportation.

Those cities with the most international freight traffic are homes to some of the nation's busiest airports. Freight capacity for growth at these sites is therefore less than at other airports with developing international freight markets, and at airports where there is less competition with passenger traffic for facility resources. International freight traffic growth at the fifteen busiest gateways between 1993 and 1994 reflects where there is room for expansion. New York's JFK, MIA, and Los Angeles International Airport (LAX) experienced increases, but theirs were of a much smaller magnitude than Anchorage, Washington's Dulles International Airport (IAD), Atlanta, and (most markedly) Memphis. Memphis' drastic traffic expansion is attributable to growth in FedEx international flights and the addition of nonstop service to Amsterdam by Northwest; between 1993 and 1994, enplaned freight rose by 58 percent, from 49 to 77 thousand tons.

Although FedEx and UPS top the world airline industry in terms of airborne freight traffic during 1995, the rest of the top (Lufthansa, Japan Air Lines, and Korean Air Lines) are foreign carriers. In all, the top 15 carriers handled nearly 60 percent of the traffic by volume around the world. Four U.S. passenger carriers (American, United, Northwest, and Delta), three European passenger carriers (Air France, KLM-Royal Dutch Airlines, and British Airways), one Asian passenger carrier (Singapore Airlines), and two U.S. integrated forwarders (Emery and Airborne Express) complete the list [12]. The overwhelming strength of the U.S. domestic cargo market explains the strong representation of U.S. carriers.

As mentioned above, U.S. passenger carriers generally have not emphasized cargo sales to the same extent as passenger sales. Foreign carriers have gained shares on nearly all routes to and from the United States in the past twenty years [22]. Cargo traffic growth outpaced that of passenger traffic in the early 1990s, drawing new attention to the cargo side of the business from U.S. carriers. United Airlines has launched new all-cargo service to Asia since 1995, and nontraditional international cargo flight operations are a booming business. Atlas, Polar, Challenge, and Sun Country are just a few of the U.S. companies either investing in and then leasing widebody freighters to be operated by passenger airlines, or providing and operating their own aircraft for hire by other companies (the latter is termed a "wet lease") [23]. With the rise in the availability of widebody passenger aircraft for conversion into all-cargo freighters for

immediate service, the outlook for overall worldwide capacity expansion in the coming years appears strong.

It is, however, unlikely that growth will continue with similar momentum. Since late 1995, U.S. carriers have watched cargo profits slow or even decline. Some analysts are concerned about over-capacity on previously high-profit routes—just as the integrated carriers continue to expand their global networks, refine their operations in foreign countries, and gain worldwide market share [24]. Northwest Airlines, however, blames its own slowed profits on a *lack* of capacity during the quarters in question: two of the airline's eight freighters were simultaneously out of operation for scheduled maintenance, drastically cutting the space available on Northwest flights. Additionally, passenger load factors during the same period broke new records—Northwest's Pacific routes topped 80 percent, and its system-wide load factor reached 75 percent. (Load factors indicate passenger capacity usage: revenue seat miles flown divided by revenue seat miles available; load factors of 70 percent are considered commendable, especially system-wide. An increase in the number of passenger seats filled, however, limits the amount of cargo that can be loaded onto an aircraft because of operating constraints. As long as passenger seats bring higher yields than cargo, passengers will remain a priority for combination carriers [25].

Forwarders

In the simplest terms, freight forwarders perform tasks for freight that are commensurate with those performed by travel agents for passengers. Freight, however, requires considerably more attention during its travels. Air freight shipments necessitate ground transportation at both ends of the journey. Border crossings require documentation for customs clearance, too. Whereas passengers can manage transfers between ground and air transportation, aircraft changes en route, and any customs or inspections barriers that may arise, freight is not similarly capable. Freight forwarders make logistical arrangements for a shipment between the shipper (usually the forwarder's client) and the consignee. They manage all transportation and handling services needed, including filing all documentation for import/export on behalf of the shipper if needed.

Forwarders work directly with the motor and air carriers that provide the actual transport of a shipment, coordinating the modes so that movement is as smooth as possible between origin

and destination. They are often caught between the role of service provider and consumer; forwarders purchase service from air carriers, add the value of their ability to arrange and manage the shipment, and sell the total service to shippers. In the past, this service orientation and attention to detail has differentiated forwarder service from the limited airport-to-airport service offered directly by air carriers. The forwarder and carrier combinations, however, face growing competition on international routes from integrated carriers [18]. Increasingly, shippers have come to expect service that is reliable not just in terms of the number of days from initial delivery, but even in terms of the number of hours. Such precision is difficult to muster when working with multiple handlers—each additional carrier, broker, or agent involved in the trip between shipper and consignee complicates the operation and provides additional opportunity for error. Just as passenger carriers have scrambled to build worldwide networks with foreign air carrier alliances, carriers that handle cargo now seek similar partners to build door-to-door service alliances with their own integrated data management and product track systems [26].

The day of the forwarder is by no means past. Carriers are not eager to take on traditional duties of the forwarder, from front-end marketing to ground transportation management in the most remote places. Forwarders also specialize in larger shipments than those previously sought by integrated carriers, and often have long-term relationships with their clients and carriers. Certain forwarders specialize in either a specific world region or a particular type of good—other market niches from which integrated carriers are likely to shy away. Integrated carriers work, in part because of the volume of traffic they push through their systems; when faced with shippers and consignees around the world that have highly specialized needs, that system is not as effective. As long as shippers require more types of and flexibility in transportation services than any one provider or loosely-unified group of providers can handle, there is room for integrated carriers, forwarders, and air carriers.

Shippers

A shipper is the sender of freight. Shippers can be any party that seeks to move something without accompanying the shipment. A company may have its own transportation/traffic management or logistics department to manage goods movement and storage, or it may contract with an outside supplier (a forwarder or integrated carrier) for these services. Shippers rarely

care what transportation mode is employed, as long as cost, speed, reliability, and security needs are met. UPS takes advantage of this attitude in its domestic markets by moving much of its "Next Day Air" business by truck. Large shippers often engage multiple forwarders to manage the various types and destinations of shipments required by their business activities.

THE REGULATORY ENVIRONMENT

Two aspects of airline regulation are significant in relation to this study: domestic deregulation and liberalization of international agreements [13]. First, the impacts of U.S. domestic deregulation cannot be ignored. Under federal control through the late 1970s, major carriers were mandated to obtain government approval to operate any service within the United States. Regional carriers (those who used smaller aircraft than the majors) were subject to less rigorous rules. FedEx maintained its status as a regional carrier, but used a regulatory loophole to legally fly multiple small aircraft on the identical routes simultaneously to meet capacity needs.

The end of domestic regulation allowed airlines to determine their own networks based on route profitability; by the 1990s, most carriers had adopted hub-and-spoke systems. Network consolidation at a few major passenger or cargo distribution centers for domestic service also yielded useful behind- and beyond-gateway feeder traffic for international routes. These direct results of domestic deregulation prompted domestic industry consolidation and restructuring, providing incentives for U.S. carriers to seek the regulatory leeway on international routes that would allow them to align their domestic systems with international routes.

Second, the U.S. strategies for bilateral agreements with individual foreign countries have matured in the past two decades. New "Open Skies" agreements reached with The Netherlands, Belgium, and other small countries in Europe, Asia, and Latin America have provided U.S. and foreign carriers much more flexibility in route selection, service frequency, and capacity. Even where this type of agreement has not been successfully negotiated (as with the United Kingdom), restrictions on cooperation between carriers from the two nations have diminished considerably. The United States remains the dominant player in any country-by-country negotiation situation because of its large, lucrative domestic market and multiple major carriers, as opposed to a single, often government-supported flag carrier. However, the potential strengthening of economic cooperating unions in Europe, Asia, and elsewhere is already weakening the U.S. position.

Overall, the regulatory framework governing service to and from the United States today is more flexible than ever. The desire to form global hub-and-spoke systems similar to but broader than the new domestic networks continues to make alliances with foreign carriers attractive to U.S. carriers as they seek to expand their worldwide reach. With distribution concentrations at domestic hubs, U.S. airlines have used the more liberal international route rights to establish service at nontraditional gateways. Smaller markets such as Portland, Detroit, Cleveland, and Memphis are among those that have benefited from new route rights for U.S. carriers and their foreign counterparts. Individual U.S. cities are now encouraged to petition national governments for new international service in conjunction with the foreign destination city and any airline willing to serve the route, giving cities new regulatory backing to strengthen their standing in the international service network.

In summary, this chapter brings together basic overviews of how the air cargo industry is organized and measured, why it matters, what is shipped by air, who provides and uses such service, and what regulatory issues influence service and industry organization. The air cargo industry and the services it provides are relatively unknown to those who are not regularly engaged in its activities; however, it is a dynamic business that is growing increasingly important in supporting trade activities. The context provided in this chapter informs the empirical analyses of nationwide service supply and demand in the following chapters.

CHAPTER THREE

AIR CARGO SERVICE SUPPLY: DIFFERENTIAL ACCESS FROM U.S. CITIES

A logical first step toward understanding the nature and distribution of U.S. markets for overseas air cargo service is to examine where and how service has been available in the past. The dilemma of any transportation service is the impossibility of knowing how successful it will be before the service is actually offered to potential customers. Knowledge of successful past operations provides a cornerstone for overcoming this challenge. In this chapter we explain how 1980 and 1995 data on destinations served and flight frequencies from U.S. airports reflect two trends: (1) overall overseas service expansion, and (2) diffusion and re-concentration of service among the network of U.S. overseas cargo service origins. We use several series of maps to reveal different aspects of these trends.

DATA SOURCES

The best industry-wide source of detailed cargo service information available is not maintained by government agencies or individual airports. The Official Airline Guides (OAG) comprise a series of marketing tools used by airlines to advertise their scheduled service. Reed Travel Group, an Illinois-based company, has sold several packages of air service information based on specific world regions or international routes for over sixty years. Among the company's growing line of paper and electronic transportation schedule products is a guide to scheduled cargo service around the world [19]. The OAG *Worldwide Edition Air Cargo Guide* (or OAG *Cargo Guide*) includes all advertised, scheduled cargo service available anywhere in the world. Service listed does not include nonscheduled service such as charter, seasonal, or otherwise irregular service. The OAG incorporates service offered by airlines that publicly advertise their flight schedules and/or make their schedules available to the OAG publishers, and are licensed by all governments involved to operate regular service.

The monthly OAG *Cargo Guide* indicates, among other things, the type of aircraft configuration used for each flight. There are three categories of service based on which parts of an aircraft are devoted to marketable cargo space:

- All-cargo (indicated as "AC" in OAG publications): aircraft configured as "freighters," with no passenger space on board at all beyond that needed for service personnel;
- Belly-cargo (indicated as "BC"): aircraft configured to carry cargo only in the aircraft belly below the main deck (the main deck is devoted entirely to space for passengers); and
- Pallet cargo (indicated as "PC"): combination or "combi" aircraft configured to hold a mix of the largest standard cargo pallets (96 x 125 inches) AND passenger seating on the main deck, in addition to belly cargo space.

Widebody freighters have the greatest capacity and flexibility for handling cargo containers; a 747 freighter's main deck can hold oversized cargo as well as a vast array of containers, from pallets and conventional closed containers to air-ground intermodal containers (8 feet wide, 8 feet high, and 10, 20, 30, or 40 feet in length) [19]. Combi airplanes are obviously more restricted than dedicated all-cargo aircraft, but can accommodate the largest standard pallet and closed container sizes. Aircraft configured for the exclusive carriage of passengers on the main deck cannot accommodate these large containers, and run the risk of cargo off-loading due to weight constraints resulting from the weight needs of passengers and their baggage.

For the purposes of this study, we aggregate "BC" and "PC" service to form the "mixed-cargo" service category, as opposed to "all-cargo" service. Narrow-body and widebody aircraft are included together within these categories in the nationwide analysis despite their vast capacity differences; specific references are made to the breakdown between these types of aircraft where relevant in particular markets. (Appendix B lists aircraft "widebody" and "narrow-body" designations based on how they are marketed within the OAG Cargo Guide.)

We use two one-month time slices of advertised, scheduled routes to reflect 1980 and 1995 service levels. Carriers alter their service schedules at least seasonally if not more often based on market cycles and maintenance needs. We use September as the base month from which to calculate weekly flight frequencies because it is the height of neither the peak nor the off-peak seasons. Because some carriers make the transition from peak to off-peak schedules during this month, complications arose in determining a consistent frequency. Mixed-cargo service, particularly, is subject to seasonal changes in passenger service demand. If a scheduled route operated at all during the month of September in either year, it is included at least as a single

weekly flight. Where service by a particular carrier operated during the entire month of September, 1995 but at different rates, the last week in September served as the control period.

We documented by hand from the print form of the OAG *Cargo Guide* all September, 1995 overseas flights with fewer than five stops departing from U.S. airports. A total of 39 airports served as origins for such service during the month. Flights operated by multiple carriers as part of code-sharing agreements are listed separately under each carrier in the OAG *Cargo Guide*; we noted these operations in our initial recording of route data, but omitted the duplicate records of service in the final calculations in order to reflect actual service levels at each airport.

Back issues of the OAG *Cargo Guide* are not kept on hand by most industry subscribers, and libraries only subscribe to the passenger service publications. We obtained an electronic file of OAG data on all September, 1980 routes operating from U.S. origin airports to non-U.S. destinations from BACK Information Services, Inc. [20]. (BACK Information Services, a division of BACK Associates, uses master data tapes of the OAG database purchased directly from the Reed Travel Group to prepare specialized packages based on client needs. It is one of several firms engaged in aviation data services, reflecting the strong market for such information.) The file includes origin, destination, carrier and flight number, arrival and departure times, aircraft type, number of stops, and the total frequency of each flight during the month. Using the widebody/narrow-body categories defined in the September, 1995 OAG *Cargo Guide* (Appendix B), we re-coded the aircraft used as narrow- or widebody equipment and their configurations as all-cargo or mixed-cargo service. We also plotted the daily service schedule based on the month's total and the frequency of calendar days of the week that fell during September, 1980, to calculate weekly flight frequencies for comparison with those from September, 1995. Because only monthly flight frequencies were available for 1980, a standard method for converting these totals to weekly frequencies was necessary. Appendix C summarizes this process.

Although code-shared service was not widespread in 1980, Pan Am and a few foreign carriers did operate shared flights to and from the United States. To correct for duplicate listings of the same flight by different carriers, we combed the records for precisely matching frequencies, departure times, and arrival times for each city-pair and assumed that identical entries indicated shared service. We eliminated the appropriate number of double-counted flights from the

aggregate file accordingly. Once these adjustments were made, the computer-generated and manually-encoded data files from 1980 and 1995, respectively, were comparable.

OVERALL OVERSEAS SERVICE EXPANSION

In this section we examine the changes in geographic patterns of overseas cargo service between 1980 and 1995 revealed from OAG cargo service schedules. In general, the access of most individual airports to some form of overseas service grew dramatically over the fifteen year period. Overall access improvements are clear from the growth in destinations served with direct service and the number of weekly nonstop flights to the rest of the world. (Appendix D provides a detailed table of the overseas service discussed in this chapter.)

Destinations Served

In 1980, a total of 132 overseas airport destinations had direct mixed- or all-cargo service from at least one U.S. airport. (Each overseas airport is included once in the national total of destinations served, although many foreign airports are served from multiple U.S. origins.) That total had reached 172 by 1995—an increase of nearly one-third [19,20]. U.S. exporters, therefore, gained direct access to forty new points of entry into foreign economies. New York's John F. Kennedy (JFK) International Airport alone had direct service to 94 overseas points in 1980 and 104 in 1995. Appendix E lists U.S. airports and airport codes relevant to this study. Foreign cities that have historically been important destinations for direct service from the United States gained new U.S. origins as well (Table 3.1).

Most of the 26 U.S. airports with overseas service in 1980 line the mainland coast (Figure 3.1). Cities in the Northeast stand out: a cluster of airports in the Mid-Atlantic and New England areas enjoyed especially strong service. Available service at a string of cities from Miami to Houston reflects that region's orientation toward Latin American destinations, while Seattle, San Francisco, and Los Angeles had the only significant service in the western half of the continental United States. Chicago, with 27 overseas destinations, was the dominant interior airport in 1980.

A map of the same information from 1995 includes more than 17 additional U.S. airports (Figure 3.2). The most obvious feature of this map is the more geographically widespread access to direct overseas service destinations than previously. From each major gateway indicated on the

Table 3.1. Growth in U.S. Origin Airports with Direct Mixed-Cargo and/or All-Cargo Service to Selected Major Overseas Destinations, 1980 & 1995

Overseas Destination	**1980**	**1995**
	Number of U.S. origin airports with service to each.	
Amsterdam, The Netherlands	11	18
Frankfurt, Germany	11	21
London, United Kingdom		
Heathrow (LHR)	*13*	*11*
Gatwick (LGW)	*11*	*17*
Paris, France		
Orly (ORY)	*3*	*10*
Charles de Gaulle (CDG)	*9*	*15*
Sao Paulo, Brazil		
Viracopos (VCP)	*2*	*1*
Guarulhos (GRU)	-	*9*
Seoul, Republic of Korea	9	12
Tokyo, Japan *Narita (NRT)*	9	18

SOURCES: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services.). Oak Brook, IL: Reed Travel Group.

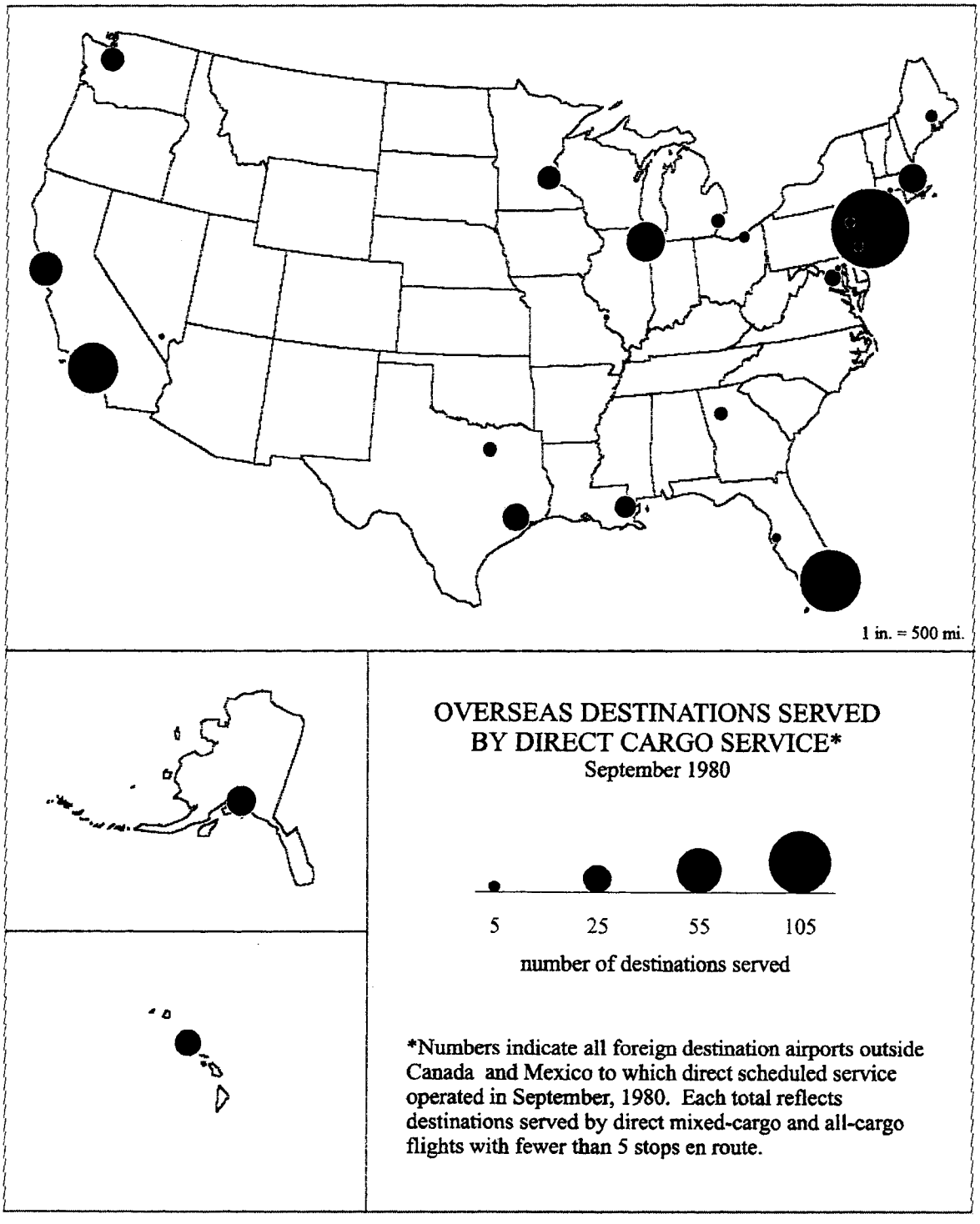


Figure 3.1. Overseas Destinations Served by Direct Cargo Service, September, 1980. SOURCE: Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services). Oak Brook, IL: Reed Travel Group.

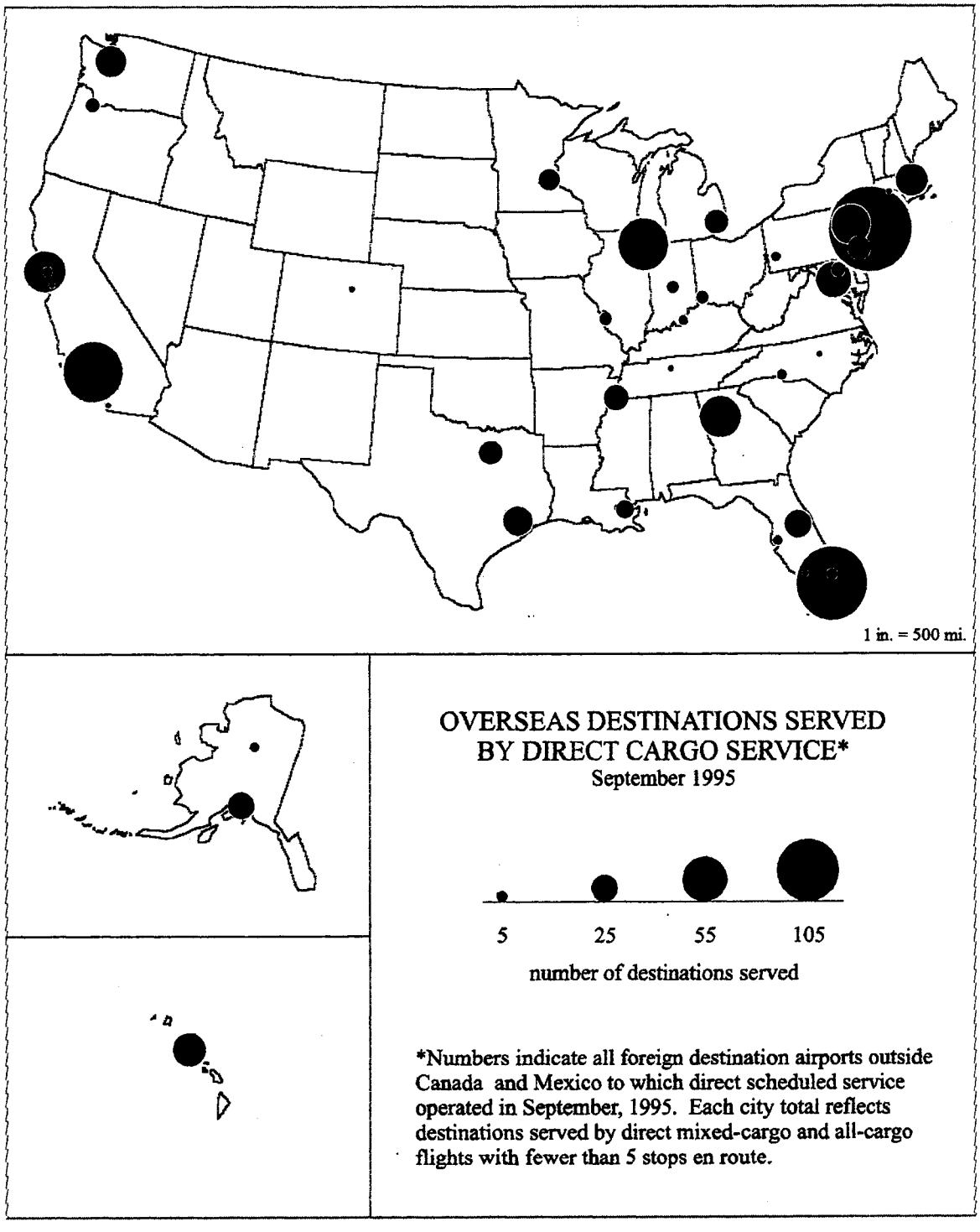


Figure 3.2. Overseas Destinations Served by Direct Cargo Service, September, 1995. SOURCE: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide*. Oak Brook, IL: Reed Travel Group.

1980 map, service seems to have spread outward. The increase to 43 U.S. airports with nonstop overseas service in September, 1995 marked a more than 50 percent jump in the number of gateways over the study period. The 1980 pattern filled in considerably—only the western half of the interior continental United States remained sparsely covered. Service from Las Vegas, barely noticeable on the 1980 map, disappeared completely by 1995. In the meantime, new service from Denver appeared and the number of destinations served from Dallas and Houston remained consistent.

Service from the Northeastern U.S. continued to dominate in 1995 with the greatest concentration of access to multiple overseas destinations, but New York's JFK faced stronger competition from Newark International, Philadelphia, and Washington, DC's Dulles International Airport. Farther south, new access to overseas destinations developed from Raleigh-Durham and Charlotte in North Carolina, and Atlanta's standing improved as well. Tennessee saw the introduction of new service from not only Memphis, but also Nashville between 1980 and 1995. In the Midwest, new service points emerged throughout Ohio, Indiana, and Kentucky and new overseas destinations were added in Detroit, Chicago, and St. Louis. Also of interest is the growth in the number of Florida cities with overseas service: Orlando's service improvement is especially striking.

Looking at the total number of overseas destinations to which U.S. airports have direct service indicates an important aspect of the scope of access U.S. businesses have to multiple international markets. The growth that was shared among nearly all airports with service and where the first direct overseas service began between 1980 and 1995 indicate the rising importance of international access among smaller, and previously less internationally-oriented, metropolitan economies. These trends were mirrored among major overseas destinations as well: the airports with the largest concentrations of service from multiple U.S. cities gained more U.S. origins, while many overseas destinations gained their first direct cargo service from U.S. points. Analysis of nonstop flight frequency distributions in 1980 and 1995 further attests to these patterns.

Weekly Flight Frequencies

Examining the distribution of total frequencies of service to all overseas destinations each week provides further insight into U.S. metropolitan regions' access to overseas cargo service as

well as the nature of service at each airport. Mapping direct service renders an overall access picture for U.S. cities of all sizes. Direct flights considered in this study include those with fewer than five stops en route between origin and destination and operated with the same flight number.

Graduated symbols effectively demonstrate variation in aggregate direct flights from airports across the U.S. (Figures 3.3 and 3.4). Circle sizes are scaled to reflect the number of flight departures for all overseas destinations within a single week. Shading reveals the proportion of all direct overseas departures from that city that are all-cargo rather than mixed-cargo in nature. The total frequency figures for each type of service are based on *opportunities to reach* each foreign destination, and do not indicate *actual* aircraft departures. Double-counting of actual airport activity is inherent in this approach, but the method is useful because the aggregate figures accurately reveal relative access strengths and weaknesses among individual airports.

An example illustrates the counting procedure used to determine total flight frequencies for each U.S. airport. The OAG *Air Cargo Guide* data are organized by origin and destination, or city-pair, because the information is intended to help potential airline customers determine their route options when planning a trip or a shipment. Each flight with multiple stops, as most overseas service is, is listed several times within the data set according to the number of origin and destination pairs served along the route.

Pan American Airways (Pan Am) operated Flight 005 daily in September, 1980. This flight was a passenger flight, but it was operated with a "74L"—a Boeing 747 aircraft configured to carry cargo containers of some kind on the main deck as well as in the aircraft belly. Flight 005 originated in New York's John F. Kennedy International Airport (JFK) and stopped in San Francisco (SFO) and Hong Kong before arriving at its ultimate destination: Singapore. JFK's direct, mixed-cargo flight frequency total of 722 weekly departures in 1980 includes 14 attributable to Flight 005: 7 departures (with one stop) to Hong Kong, and 7 departures (with two stops) to Singapore each week. Likewise, SFO's 1980 direct flight frequency of 144 weekly overseas departures includes 14 attributable to Flight 005 as well: 7 to Hong Kong (nonstop), and 7 to Singapore (with one stop) each week. Of course, only one aircraft actually departed each day from each city, but counting the flight for both destinations more accurately reflects the level of foreign access enjoyed by JFK, SFO, and the metropolitan areas they serve.

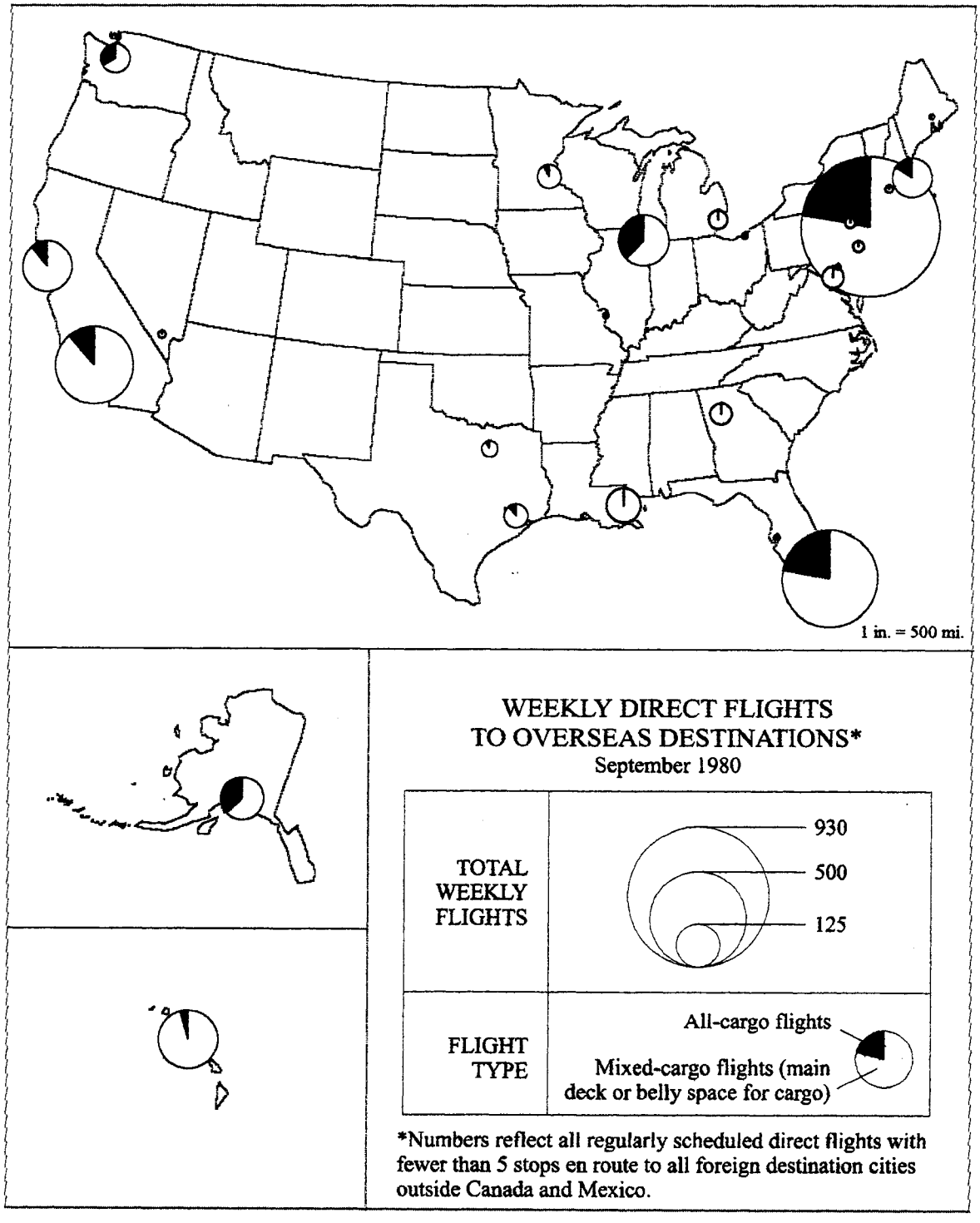


Figure 3.3. Direct All-Cargo and Mixed-Cargo Overseas Flight Frequencies from U.S. Airports, September, 1980. "Flight Frequency" refers to the number of weekly opportunities to reach each foreign destination from the indicated U.S. airport. Multiple-stop flights are counted for each overseas destination reached with fewer than five interim stops. SOURCE: Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services). Oak Brook, IL: Reed Travel Group.

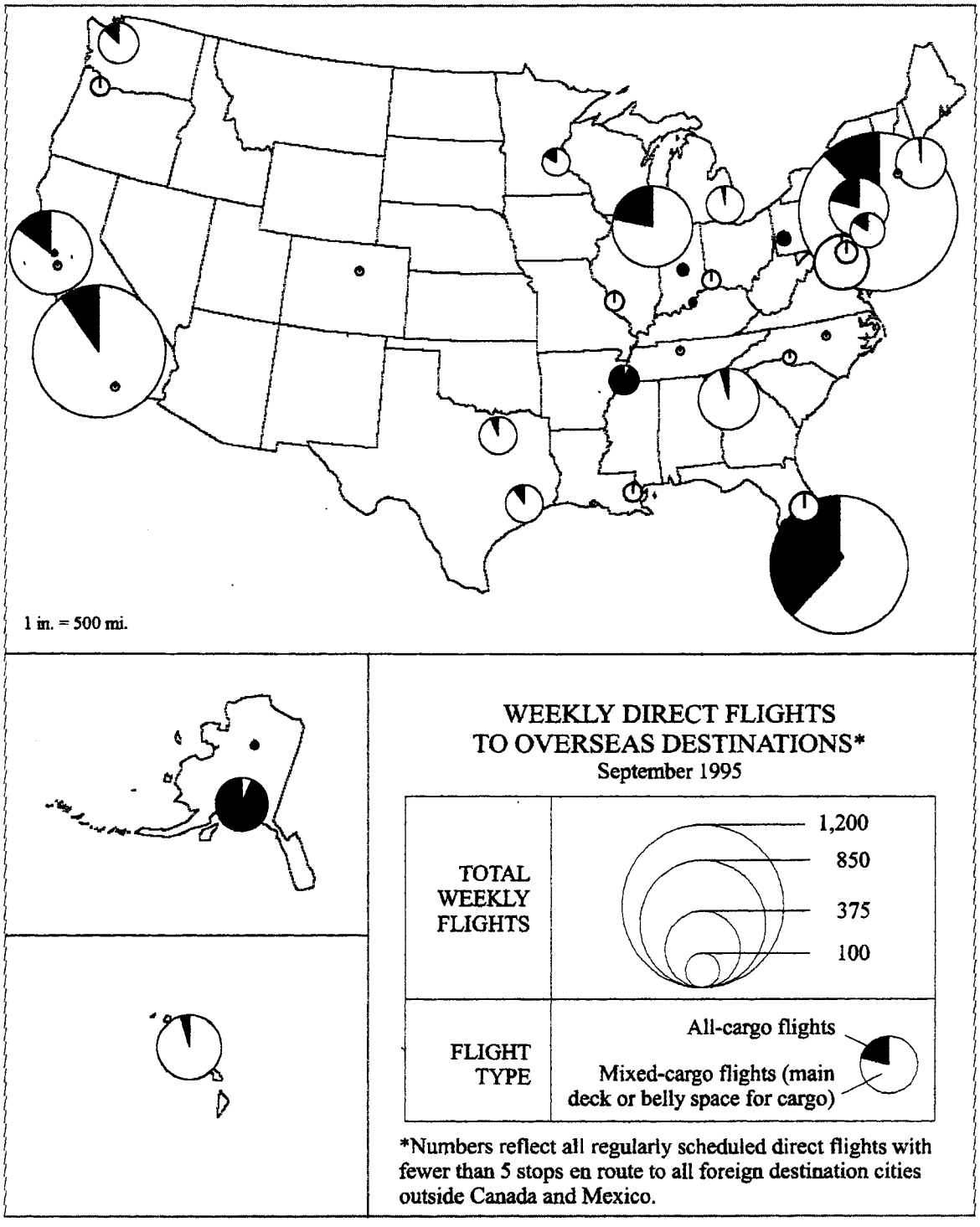


Figure 3.4. Direct All-Cargo and Mixed-Cargo Overseas Flight Frequencies from U.S. Airports, September, 1995. "Flight Frequency" refers to the number of weekly opportunities to reach each foreign destination from the indicated U.S. airport. Multiple-stop flights are counted for each overseas destination reached with fewer than five interim stops. SOURCE: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide*. Oak Brook, IL: Reed Travel Group.

All-cargo service schedules are often even more complicated than those of mixed-cargo flights. Cargo is less sensitive to the number of stops made en route, and air carriers seek to maximize the markets served with each aircraft operation. Also, flight times are not compressed into convenient or comfortable flying schedules for people, but actually capitalize on covering great distances during times when people are not interested in using airports.

Flying Tiger's September, 1980, Flight 075 exemplifies all-cargo route structures that remain typical today. The flight operated once a week. It originated at JFK and had a final destination of Hong Kong, with stops (in this order) at (1) Seattle, (2) Anchorage, (3) Tokyo, (4) Taipei, and (5) Singapore. Flying Tiger's goal was to schedule the route such that it was geographically logical to allow cost-effective aircraft operation, had enough stops to maximize capacity usage throughout the route, and covered all distances quickly enough to be marketable as a time-sensitive transportation service. Of the three U.S. cities included in the route, Anchorage had the best access, followed by Seattle and New York. Flight 075 counts as a frequency of 4 direct overseas destinations with a flight frequency of "1" each from Seattle and Anchorage, and 3 direct destinations (fewer than five stops) from New York, again with a frequency for each destination of "1" per overseas airport. Lower flight frequency totals reflect relatively lower access to overseas destinations commensurate with higher numbers of interim stops.

In 1980, JFK, Miami, and Los Angeles were the dominant direct service gateways according to this method of measuring overseas service access. Chicago, Anchorage, Boston, San Francisco, and Honolulu were also strong, followed by New Orleans, Seattle, Minneapolis, Houston, and Washington. Mixed-cargo service dominated all-cargo service without exception. Honolulu, New Orleans, Atlanta, and all of the New England and Mid-Atlantic airports other than New York and Boston had little to no dedicated cargo service to overseas destinations at all.

All-cargo service represented more than one-fourth of overseas direct flights at only Chicago, Anchorage, and Seattle in 1980. However, all-cargo flight frequencies were actually much higher at New York and Miami than at these facilities (the proportion was low because of the enormous volume of mixed-cargo traffic at Miami and JFK). Geographic and exogenous economic factors shaped the distribution of the relatively small all-cargo overseas service system among U.S. cities in 1980—the all-cargo industry had not yet re-engineered route networks around service consolidation centers.

Amounts of direct overseas cargo service from U.S. airports had exploded by 1995 in most cases (Figure 3.4). The difference between 1980 and 1995 is even more remarkable in terms of the numbers of weekly departures for all destinations than it was relative to the total number of overseas airports served (Figures 3.1 and 3.2). Although JFK and Los Angeles remained the dominant gateways for direct service, service from neighboring airports flourished. In the Northeast, for example, although New York's LaGuardia Airport lost its only overseas service, Newark's weekly flight frequencies grew from 11 mixed-cargo departures a week in 1980 to 149 in 1995, with the introduction of 42 all-cargo departures each week during the period as well. In addition, service at Philadelphia, Washington's Dulles International Airport (IAD), and Baltimore-Washington International (BWI) more than doubled, while Boston showed modest increases.

The proportion of all-cargo rather than mixed-cargo service at Chicago's O'Hare International Airport (ORD) slipped between 1980 and 1995, although the total service from ORD more than doubled during the period. The slower relative growth in all-cargo service can be explained by the assortment of newly available overseas all-cargo service that emerged from several points in the country's midsection—Louisville, Indianapolis, Pittsburgh, and Memphis, for example. UPS, Emery, Federal Express, and DHL all developed their major sorting facilities in the region, and these facilities help to feed overseas service.

Anchorage, no longer a necessary stopover for passenger traffic between continents in the Northern Hemisphere, flourished as a transit point for cargo traffic between North America, Asia, and Europe. Fairbanks began to reap similar service benefits during the study period. At both Anchorage and Miami, flag carriers of many countries capitalize on the large volume of cargo capacity arriving from and departing for numerous global destinations to fill their own planes.

Direct overseas service expanded dramatically at traditional gateways, overflowed to U.S. airports that previously did not have any overseas service, and reorganized around all-cargo sorting centers between 1980 and 1995. Tallying direct flight frequencies without regard for double-counting multiple-stop flights provides an overall indication of relative access among U.S. airports, but distorts actual service levels. Examining *nonstop* frequencies, however, alleviates this distortion and confirms these service trends (Figures 3.5 and 3.6).

Circle scale and shading in Figures 3.5 and 3.6 (nonstop service) are consistent with those used in Figures 3.2 and 3.3 (direct service) to facilitate comparison among service types and

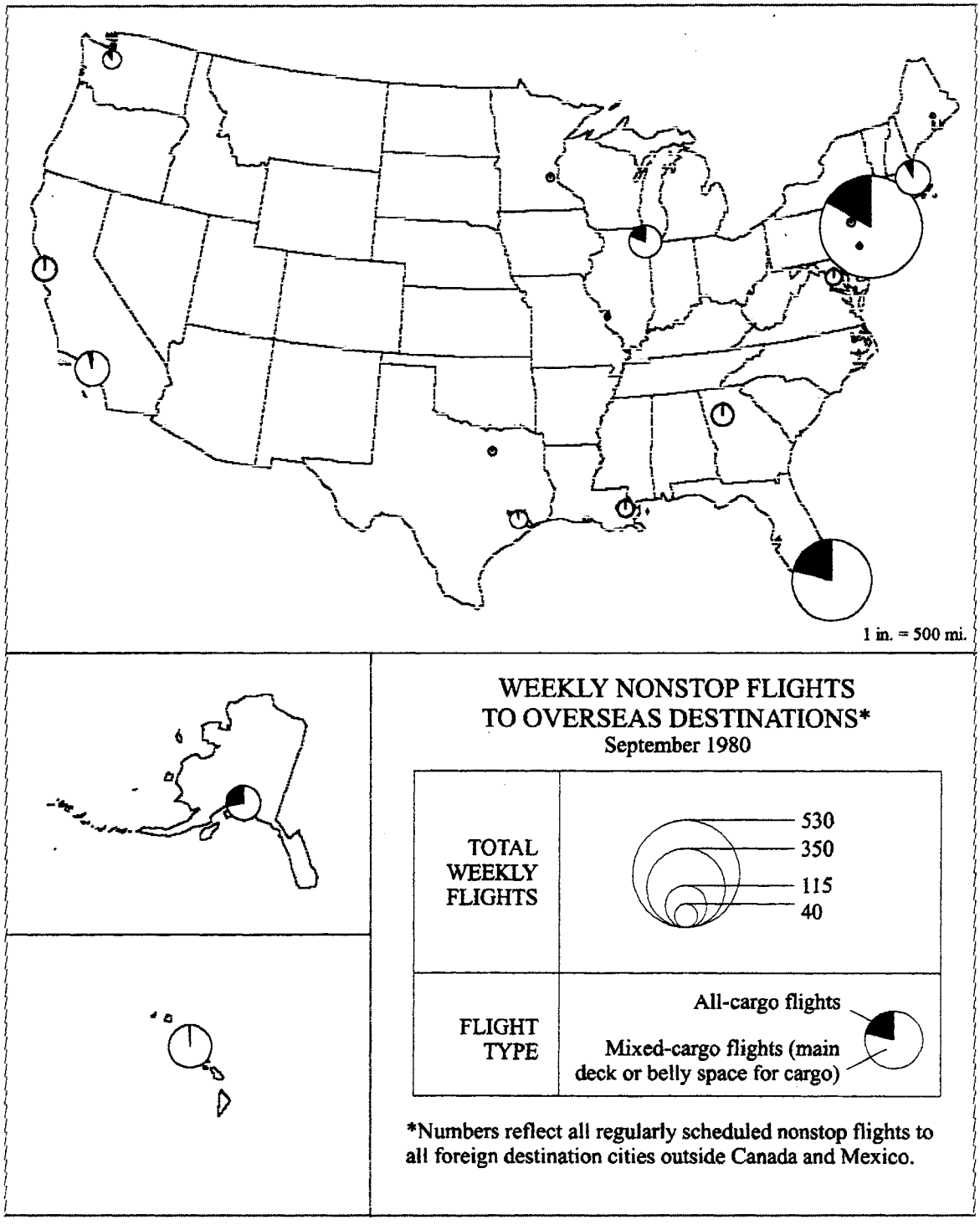


Figure 3.5. Nonstop All-Cargo and Mixed-Cargo Overseas Flight Frequencies from U.S. Airports, September, 1980. "Flight Frequency" refers to actual aircraft departures for nonstop overseas destinations (double-counting is eliminated). SOURCE: Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services). Oak Brook, IL: Reed Travel Group.

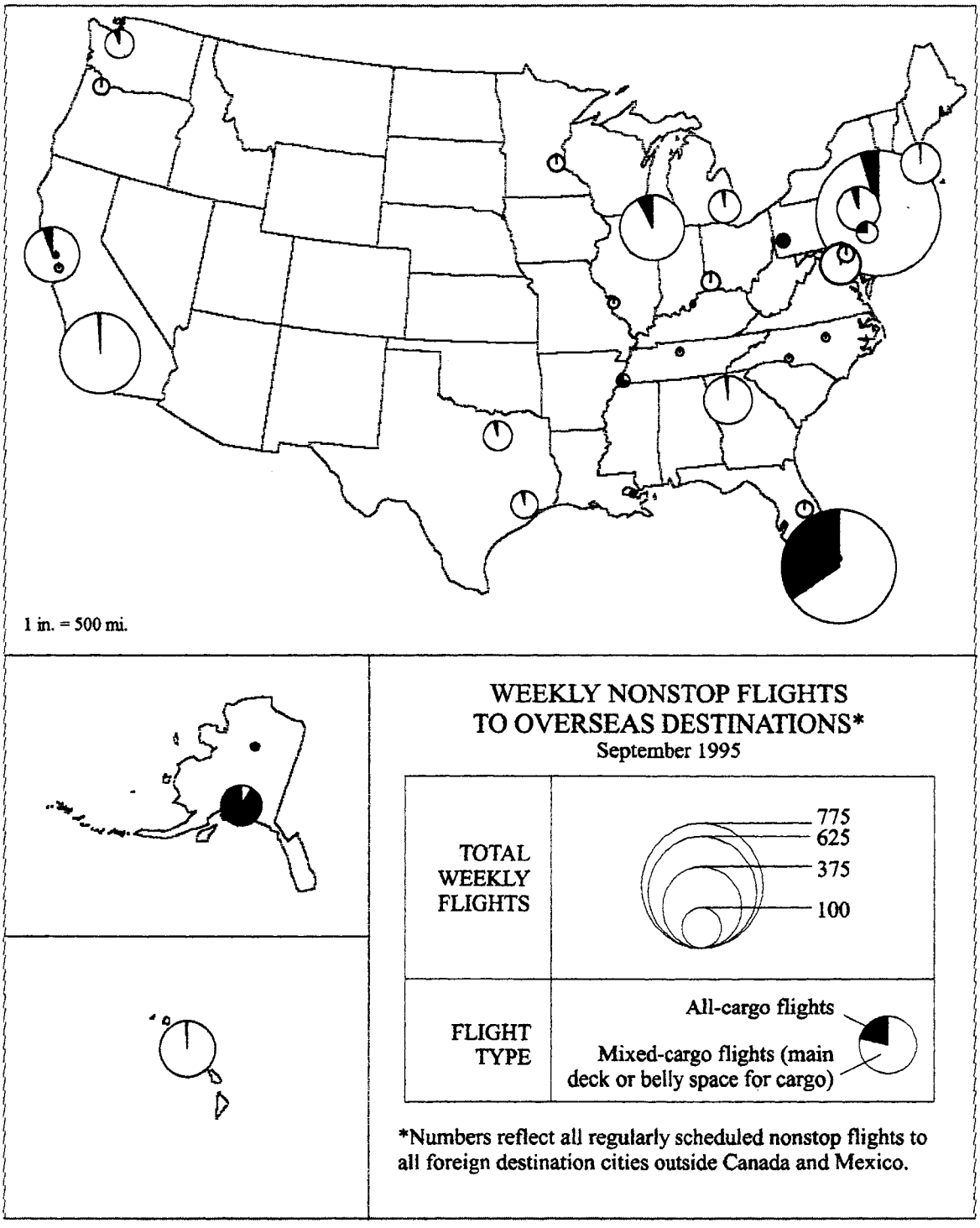


Figure 3.6. Nonstop All-Cargo and Mixed-Cargo Overseas Flight Frequencies from U.S. Airports, September, 1995. "Flight Frequency" refers to actual aircraft departures for nonstop overseas destinations (double-counting is eliminated). SOURCE: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide*. Oak Brook, IL: Reed Travel Group.

years. Because most international routes have multiple stops, it is logical that the frequencies of nonstop all-cargo and mixed-cargo flights were much lower than direct flight frequencies in both 1980 and 1995. The pattern of gateways is similar in both cases, but minor variations existed. JFK and Miami, for example, dominated the national nonstop distribution in 1980, but Anchorage was more significant as a nonstop flight gateway than any West Coast city.

Nonstop flight frequencies confirm Anchorage's importance as a service stop for both nonstop mixed- and all-cargo routes in 1980 Honolulu's strength is partially attributable to service stops as well, but as Hawaii's largest airport, Honolulu generates significant tourist traffic in its own right (unlike Anchorage, whose home population size and tourist traffic draw are much smaller). Another facility that served as a minor technical stop for overseas traffic was Bangor, Maine: Bangor's airport was formerly a U.S. Air Force base and therefore has the capacity to handle large aircraft. An added benefit of Bangor as a technical stop is its lack of congestion relative to other airports in the northeastern United States. Again, technical stops were no longer necessary on many long routes due to improved aircraft technology, so smaller cities on the geographic periphery of U.S. territory lost a service edge.

In 1980, interior mainland cities lacked significant nonstop overseas service other than from Chicago. Only one daily nonstop mixed-cargo flight each from Minneapolis and Dallas to London augmented Chicago's 54 weekly nonstop mixed-cargo and 13 all-cargo flights from the region. These two daily London flights, in addition to nonstop service from Atlanta, were early indications of the trend towards overseas service concentrations at interior or non-traditional airports where airline headquarters (and, later, their domestic hubs) are located.

Atlanta was home to both Eastern and Delta in 1980, and although Eastern was mainly a domestic airline, its traffic into the airport fed the 32 weekly nonstop overseas departures. Of these flights, five each week went to Bermuda, while the remainder served Brussels, Frankfurt, or London. Even in 1980, Atlanta was successful at attracting service from a number of foreign carriers in addition to Delta's international service: Lufthansa (the German flag carrier), Sabena (Belgium) and British Caledonian (U.K.) together provided over one-third of the nonstop overseas flights. Sabena operated two of its four weekly nonstop flights to Brussels with combi aircraft, providing the only non-belly cargo space available on Atlanta's overseas routes. The

region served by Atlanta, therefore, seems more significant for its passenger market than its cargo service demand.

Houston and New Orleans had similar total flight frequencies in 1980, but very different service profiles. In addition to nonstop narrow-body service to Bolivia (all-cargo) and Venezuela (mixed-cargo), a total of four carriers offered nonstop widebody mixed-cargo service to three European airports as well (Paris, London, and Amsterdam). Only two carriers, Air Toulouse International and TACA International, offered narrow-body mixed-cargo service from New Orleans to six destinations in Central America: Belize City (16 flights/week), Guatemala City (2), La Ceiba (Honduras—single weekly flight), and San Salvador (El Salvador—single weekly flight). Travel time between New Orleans and Belize City is under 2 ½ hours, as opposed to roughly nine hours of flight from Houston to European destinations. Although both cities are clearly oriented towards Latin America, Houston's wider service scope indicates a relatively higher level of direct economic interaction with more (and more distant) destinations than New Orleans.

Over 200 new nonstop overseas flights a week had begun to operate from U.S. airports by September, 1995 (Figure 3.6). Geographic patterns of total nonstop flight frequencies reinforce the two overall service trends noted for direct routes: widespread growth in all service and dispersion of overseas routes among a greater number of U.S. airports. In the Northeast, Florida, and California, the spreading of nonstop flights to airports surrounding the traditional gateways is especially striking. Even though nonstop service is not as plentiful as direct overseas flights from the nation's interior, the same dispersion of service throughout the Midwest is evident with nonstop flight frequencies.

The all-cargo nonstop service network changed between 1980 and 1995 as in the case of direct all-cargo service, but some patterns remained the same. The movement of all-cargo traffic through Miami continued to accelerate: nonstop overseas all-cargo departures nearly tripled from 74 in 1980. Although most of the all-cargo flights operating at Miami use smaller, narrow-body aircraft, total tonnage of international freight handled at Miami (1.2 million tons) surpassed even Anchorage and New York (966 and 889 thousand tons respectively) [21]. Thirty-three airlines offered nonstop all-cargo service from Miami to 35 destinations in September, 1995, indicating the airport's significance as a regional and global transit point.

Chicago remained an important all-cargo service gateway for the Midwest. Although the all-cargo service proportion of total nonstop departures declined during the study period, nonstop all-cargo flight frequencies actually increased by half of their 1980 level. Some of the overseas service from Memphis and Louisville (Federal Express and UPS hubs) in 1995 operated without additional gateway stops, reinforcing the importance of the sort centers at these cities. Although Memphis and Anchorage had at least a few nonstop mixed-cargo flights each week in addition to their all-cargo service, only all-cargo routes served Louisville and Fairbanks.

In this section we have analyzed overall service expansion from points in the U.S. using direct destinations served and flight frequencies for direct and nonstop routes. The total numbers of direct and nonstop overseas flights grew dramatically between 1980 and 1995 at most traditional gateways, and many airports gained new overseas service of one kind or another. The all-cargo service network more than doubled in size as major carriers focused routes on new sorting centers in the middle of the country in addition to utilizing global transit points like Anchorage and Miami. Within this widening web of overseas cargo service, each U.S. airport's share of national access to foreign markets is defining a dynamic new hierarchy of metropolitan regions as modern gateways to the world economy.

SHIFTS IN SERVICE HIERARCHIES

The previous section's documentation of aggregate flight information from U.S. airports reveals drastic growth in total overseas service between 1980 and 1995. Examining indices rather than totals, however, allows closer investigation of shifts in dominance among U.S. airports. Maps in this section employ graduated circle techniques again, but the symbols reflect each airport's *proportion* of *all weekly flights* departing from U.S. airports for overseas destinations. By removing the raw growth dimension from the data, each airport's relative importance as a point of entry and exit for air cargo (and, presumably, airborne trade) can be visualized more effectively (Figure 3.7).

We define each airport's service index as its percentage of all departing nonstop scheduled flights to overseas airports from the U.S. (Appendix D lists all-cargo and mixed-cargo service indices for each U.S. airport considered in this study.) An example illustrates the method used to obtain indices for each airport. In the final week of September, 1980, a total of 213 nonstop,

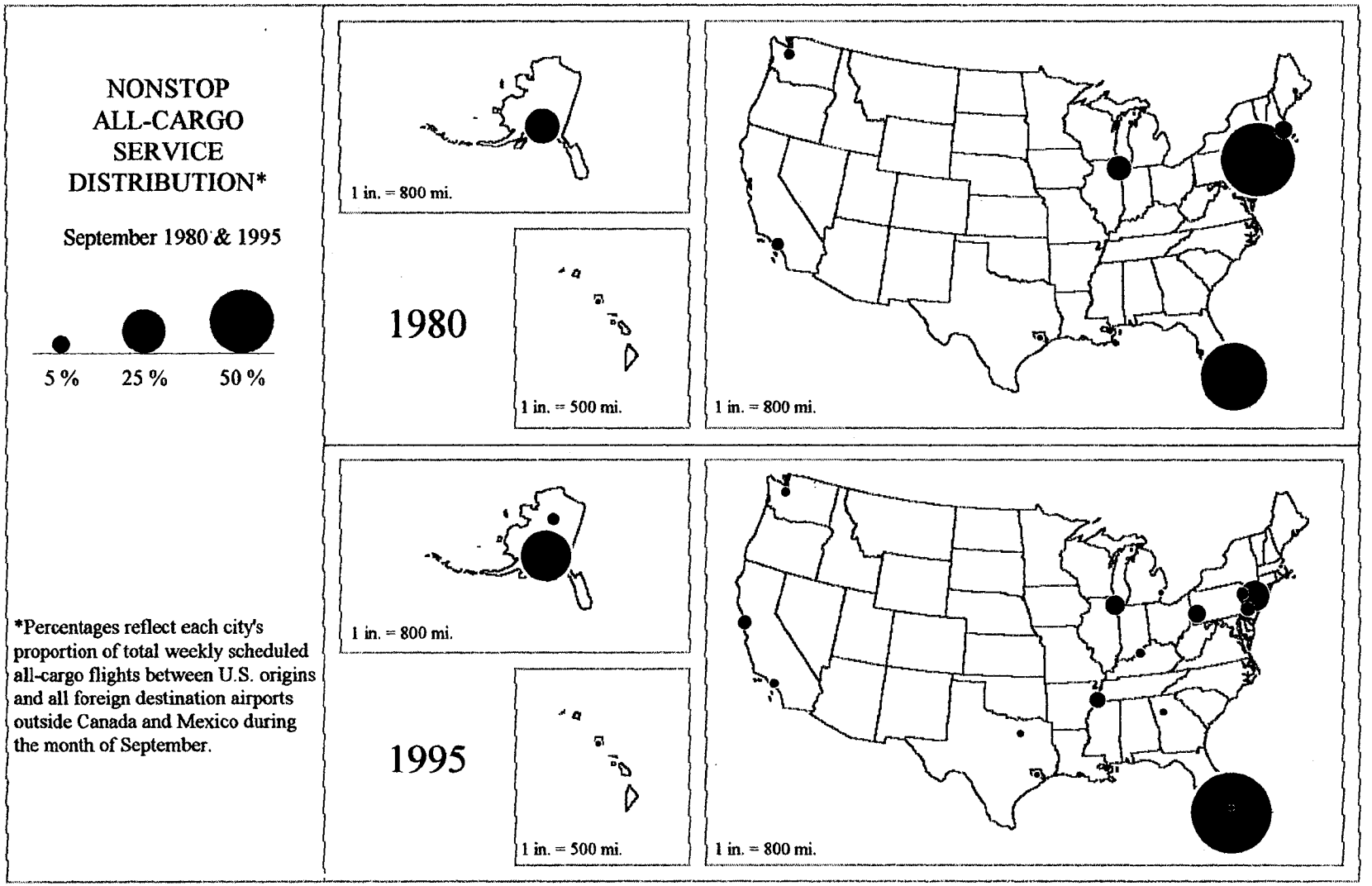


Figure 3.7. Nonstop All-Cargo Service Indices, September 1980 & 1995. Each index represents the airport's percentage of all weekly flights departing the United States. SOURCES: Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services). Oak Brook, IL: Reed Travel Group; Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group;

overseas-bound all-cargo flights departed from U.S. airports. Twenty-two such flights left from Anchorage. Anchorage's 1980 all-cargo service index, therefore, equals 22/213 (or roughly 10 percent of all flights).

The All-Cargo Service Hierarchy

The distribution of gateway service of all types is uneven across the United States., just as the distribution of cities themselves varies. However, the case of nonstop all-cargo departures in 1980 shows particularly extreme imbalances among U.S. airports. All-cargo service was concentrated at a small number of airports (Figure 3.7). Together, New York and Miami accounted for over three-fourths of the nation's nonstop all-cargo service. Adding Anchorage and Chicago to New York and Miami accounted for over 93 percent of all-cargo gateway traffic. The lack of nonstop service activity from the West Coast is striking, but can be explained by the need for technical stops on flights with older and/or heavily-loaded aircraft that made Anchorage or Honolulu the logical last U.S. stop on flights to East Asian or South Pacific destinations from the mainland.

By 1995, the number of cities with nonstop all-cargo overseas service had doubled (Figure 3.7). Although service remained focused on a few key gateways, the important gateways had changed. Miami's dominance grew by more than one-third, accounting for an amazing 48 percent of all all-cargo overseas flights. Anchorage's share of total service doubled, surpassing JFK in terms of relative importance. High volumes of passenger flights at many of the nation's traditional overseas service gateways pushed some all-cargo activity to airports that either previously did not have such service or have remained relatively uncongested.

Although JFK's decline as the dominant all-cargo gateway in the Northeast was dramatic (from a service index of 41 in 1980 to 7 in 1995), the airport continued to host a greater proportion of all-cargo service than any other facility in the region. Chicago, Boston, Seattle, and Los Angeles, other traditional overseas service gateways, also saw declines in their importance for nonstop all-cargo traffic.

While congestion pushed some traffic away from traditional gateways, other factors pulled traffic concentrations to new centers of air cargo activity. The emergence of service at Fairbanks, Memphis, Pittsburgh, and Louisville illustrates the rise of regional sort centers as feeders for

overseas cargo routes. These developments reflect consolidation in the air cargo industry as integrators like Federal Express, UPS, and others reorganized route networks to maximize economies of scale and scope at service centers free from passenger traffic congestion. Likewise, Anchorage and Miami both attracted increased service shares as their flight frequencies and geographic reach multiplied and their positions as global cargo hubs further solidified.

The Mixed-Cargo Service Hierarchy

Mixed-cargo service, analyzed separately here because of its sensitivity to passenger traffic demand fluctuations, was more widely dispersed than all-cargo service. Even in 1980, before many of the trends that stimulated dispersion of all overseas service had gathered momentum, nonstop mixed-cargo flights were distributed among 20 airports—twice as many facilities as had nonstop all-cargo service at the same time (Figure 3.8). Although JFK and Miami dominated the mixed-cargo picture as well as the all-cargo distribution in 1980, their combined share of all U.S.-originating nonstop mixed-cargo flights was just over half (rather than three-quarters of the total all-cargo service).

Strong markets for international passenger traffic have consistently defined mixed-cargo service concentrations that differ from all-cargo service gateways. Hawaii, with over 8 percent of the total mixed-cargo service in 1980, was twice as important as Anchorage for this type of route—reiterating the distinctions made between these markets above. Three cities on the mainland West Coast accounted for over 11 percent of all mixed-cargo departures, reflecting the propensity for trans-Pacific flights to use these cities rather than Anchorage or Honolulu as last in-country stops because of passenger preference for more direct service and lighter loads on passenger aircraft.

On the mainland, interior cities serving as home bases for major U.S. passenger carriers already enjoyed small levels of mixed-cargo gateway traffic in 1980. Minneapolis (Northwest), St. Louis (TWA), Dallas (American), and Atlanta (Delta) all had at least a few mixed-cargo nonstop overseas flights each week. Ft. Lauderdale enjoyed the only overseas passenger service in Florida besides that at Miami. Other than Boston, with over 6 percent of total mixed-cargo service, JFK's competition for nonstop routes from the Northeast was limited to Newark, Philadelphia, Washington, and Bangor—accounting for only 2.4 percent of all U.S. flights among

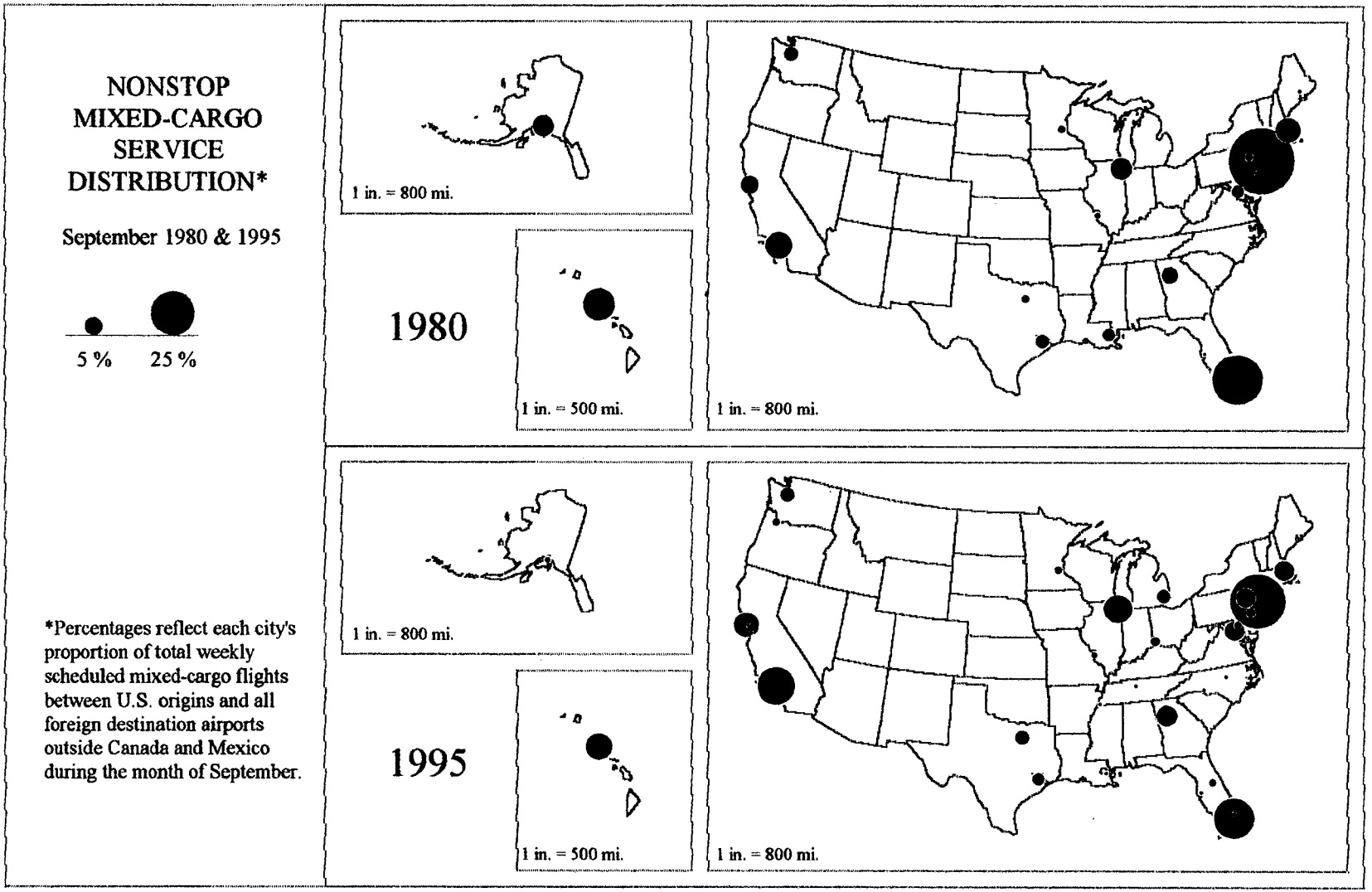


Figure 3.8. Nonstop Mixed-Cargo Service Indices, September 1980 & 1995. Each index represents the airport's percentage of all weekly flights departing the United States. SOURCES: Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services). Oak Brook, IL: Reed Travel Group; Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group;

them. In all, the 1980 mixed-cargo service distribution was much more dispersed than its all-cargo counterpart.

Service had spread to a total of 31 gateways by 1995 (Figure 3.8). Twelve airports obtained new mixed-cargo routes during the fifteen year period, with only Bangor losing scheduled passenger service. Bangor, like Anchorage and Honolulu, was simply not needed as a technical stop any longer on long-haul routes. JFK and Miami, again the most significant traffic gateways, accounted for less than 40 percent of all routes in 1995.

The West Coast and the Southeast improved the most dramatically in terms of overall regional importance. By 1995, the number of West Coast mixed-cargo gateways had doubled to six, and their traffic accounted for over one-fifth of the nation's nonstop overseas departures. Miami's proportion of total traffic declined, but Atlanta, Charlotte, Raleigh-Durham, Nashville, and Memphis all enjoyed growth in their share of flights.

Airline route network reorganization around domestic passenger hubs influenced other areas of the country. Dallas, Houston, and New Orleans continued to have a total of just under four percent of all service, but service shifted within the region away from New Orleans to Dallas. (New Orleans is not home to a hub for any major U.S. passenger or cargo airline.) Houston's share declined, but only slightly compared with New Orleans. Farther north, Chicago (now home to American as well as United), Detroit (Northwest), and Cincinnati (Delta) all enjoyed stronger service. St. Louis (TWA) held on to a relatively stable share of total mixed-cargo service, while Minneapolis (Northwest) saw a stronger increase in its dominance.

Dominance among gateway airport hierarchies of both all-cargo and mixed-cargo service shifted between 1980 and 1995. More U.S. airports were served by nonstop overseas flights than ever before; these newly-served airports had successfully cut into the strength of traditional gateways like JFK and Boston. One final step in this overseas cargo service supply analysis considers all mixed-cargo *and* all-cargo nonstop overseas flights and compares service shares by metropolitan regions rather than individual airports.

Shifts in the Aggregate Service Hierarchy

One of the service distribution trends identified above is the documented shift in service away from traditional gateways to other, often less-congested, airports. While some of these

changes have occurred at a regional scale, the pattern is also strong within metropolitan regions with multiple airports served by international service. Chicago now shares nonstop overseas service from the Midwest with Detroit and Cincinnati, for example, but San Francisco's International Airport faces new local competition for flights from San Jose and Oakland (both in the San Francisco metropolitan region). Metropolitan regions with multiple overseas-service airports include Baltimore-Washington, San Francisco, New York City, and Miami. (Appendix A lists metropolitan region definitions and airport codes for major facilities included in each. Appendix E provides airport code definitions.) To better address the total overseas service available at the aggregate metropolitan region level rather than at individual airports, we couple nonstop mixed- and all-cargo flight frequencies at each airport and then merge the totals for multiple-airport metropolitan regions. (Metropolitan region service totals are included in Appendix F and are discussed further in Chapter 6.) This method allows a clear depiction of the shifting dominance among metropolitan regions between 1980 and 1995 (Figure 3.9).

Metropolitan regions that are home to traditional gateways in the Northeast faced relative declines as a result of strong traffic growth to Asia. Those airports with the most service to lose from their strong positions in 1980 stand out on the map of proportion changes; losses in dominance at Miami, Anchorage, and the mega-gateway combined from JFK and Newark International serving the New York metropolitan area and northern New Jersey are particularly dramatic. Conversely, all West Coast metropolitan regions enjoyed clear gains in their competitive position relative to the rest of the country because of their geographic proximity to Asian markets, the improvements in technology that allowed nonstop European service to grow, and the entrance of (especially Californian) airports into Latin American markets.

Overall service trends illustrated by the changes in each metropolitan region's share of total national overseas service mirror those identified in the analyses of nonstop and direct, all-cargo and mixed-cargo, service earlier in this chapter. Figure 3.9 makes clear the changes in the structure of overseas air cargo service, and which U.S. metropolitan regions have gained and lost ground in the process during the fifteen year period.

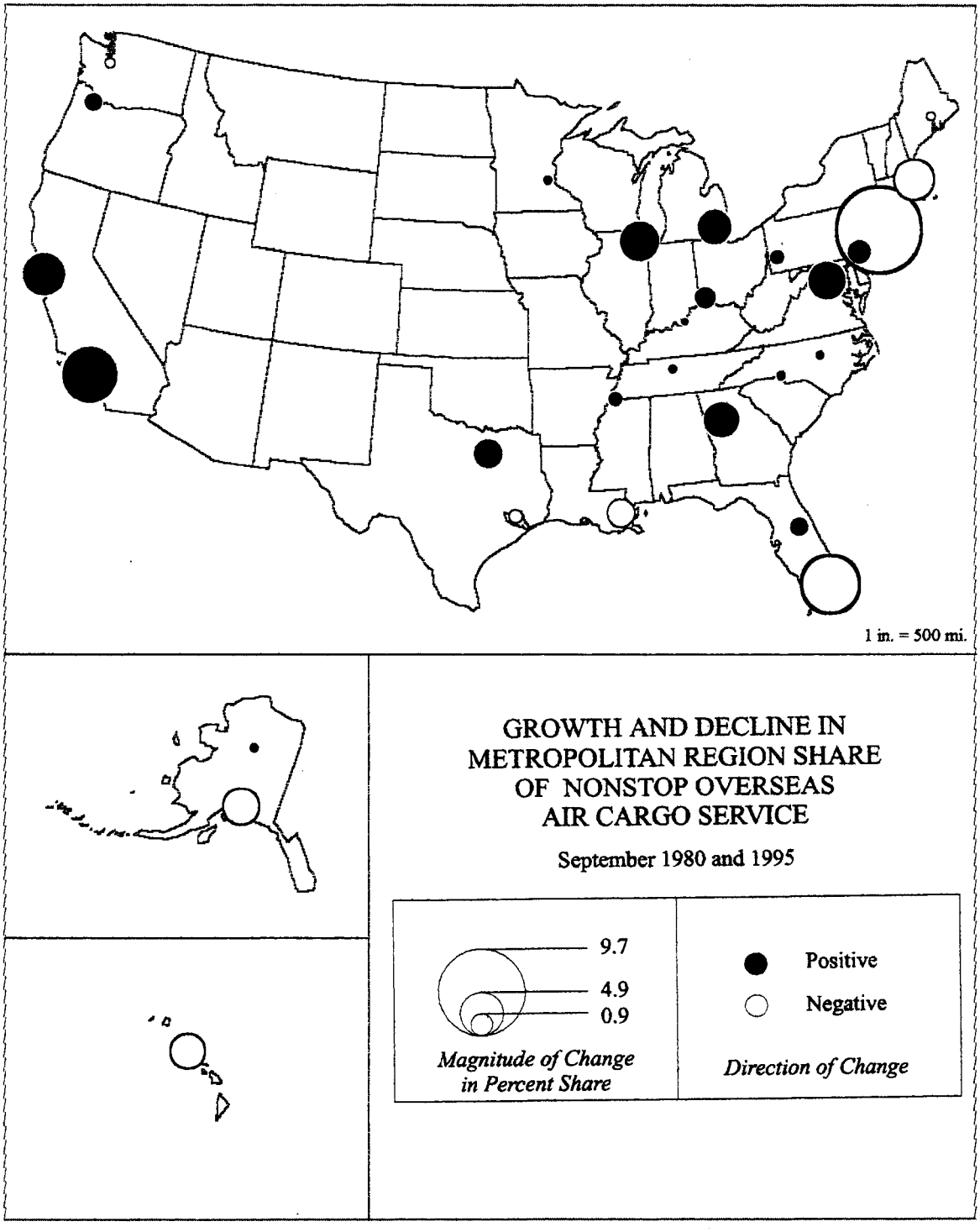


Figure 3.9. Shifts in the Aggregate Overseas Air Cargo Service Supply Hierarchy, 1980 - 1995. Using changes in metropolitan region percentages of total nonstop overseas flights with cargo capacity, this map shows which U.S. cities gained or lost local supply of overseas air cargo service between 1980 and 1995. Appendix F lists each city's flight total and percentage. SOURCES: Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services). Oak Brook, IL: Reed Travel Group; Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group.

SUMMARY: THE CHANGING URBAN HIERARCHY OF OVERSEAS AIR CARGO SERVICE SUPPLY

Technological, industry, regulatory, and selected local developments between the late 1970s and the mid-1990s help to interpret the service trends documented in this chapter. Most obvious are the advances in aircraft technology and the increased variety and flexibility of equipment available. Introduction of the Boeing 767 long-range, widebody airplane with smaller capacity than earlier long-range aircraft enabled airlines to profitably serve smaller markets with nonstop flights. Advances in aircraft configuration schemes allow airlines to modify their equipment's cargo and passenger capacity configurations as appropriate for various routes or service types. Also, fewer older-model aircraft such as Boeing 707s and DC-8s were in use on overseas routes by the mid-1990s, meaning that less overseas service was subject to their capacity and range limitations. These developments combine to make a greater variety of markets and operations eligible for profitable and more convenient services today than was possible in the early 1980s.

Technological developments in other industries have had drastic implications for freight movement in general and the air cargo industry in particular. Integrated carriers harness improved computer and packaging technology to track their shipments from pickup to delivery using sophisticated computers on board their trucks and planes and computer-recognizable labels on all shipments. Real-time tracking and improved electronic data interchange (EDI) allow service providers to streamline their operations and speed up documentation filing, thereby reducing handling time and improving service.

Improvements have also been made in the means by which cargo is loaded and packed on board aircraft. Pallets and containers come in an increasing array of shapes and sizes—both closed containers provided by the airline but packed by the shipper, and open pallets that are packed by the airline and can accommodate unwieldy shipments. Rollers installed in the floors of aircraft ease and speed loading, and automated modeling systems enable carriers to maximize their use of cargo capacity in minimal time.

Harnessing these developments in aircraft and cargo-handling capabilities has enabled the dedicated cargo industry to organize its domestic freight activities around service centers where cargo is flown in from numerous origins, sorted, and shipped to an equally large number of

destinations. Memphis and Louisville are two of the largest and best known sort centers for Federal Express and UPS respectively. As the cargo industry has grown to serve more and more domestic destinations, the economies of scale and scope achieved at sort centers has made expansion of international service at these centers a logical next step. Cargo sort centers like Memphis, Louisville, Miami, and Anchorage have proved their value in reducing the duration of door-to-door shipping times, and now have growth momentum of their own.

Similar scale and scope economies have been utilized by passenger carriers in the formation of hub and spoke systems. As in the case of the integrated carriers, U.S. passenger airlines began concentrating their service at domestic hubs to maximize the number of destinations reachable with only one stop from anywhere in their networks. Passenger hubs serve the same function as cargo sort centers. This trend effectively pulled traffic into any airport where a major U.S. carrier either has its home base or a regional operations center. Widebody passenger aircraft used on overseas routes can be filled more easily and more often if departing from such traffic concentration centers. The geographic scope of mixed-cargo service availability reflects these developments in the passenger industry.

As hub and spoke reorganization in the passenger industry affected domestic cargo service networks between 1980 and the mid-1990s, so also did new alliances between U.S. and foreign carriers. Out of these cooperative agreements emerged intercontinental hub and spoke systems and service networks spanning the globe. Their developments in turn solidified some medium-sized U.S. cities as gateways to the worldwide systems; examples include Charlotte and Pittsburgh (then USAir and British Airways), Cincinnati (Delta and Sabena), and Minneapolis-St. Paul (Northwest and KLM). Some of the new gateways may not have had local markets large enough to fill a widebody aircraft in 1980, but combining local traffic with behind-gateway traffic from elsewhere in the home carrier or its partner's network provided enough passengers to make widebody service expansion profitable at these cities. As a result, mixed-cargo overseas service availability also grew.

The liberalizing regulatory environment since the late 1970s has enabled these industry developments to occur. Foreign-U.S. carrier cooperation accelerated in the late 1980s and early 1990s as a result of more lenient ownership and information-sharing agreements. Re-negotiated bilateral agreements with individual foreign countries allowed greater flexibility in the amount and

geographic scope of service between the two nations. The most liberal of these agreements were the "Open Skies" pacts signed between the U.S. and many smaller foreign countries, virtually removing origin and destination city constraints. These decreases in regulatory barriers to international service enabled all- and mixed-cargo service on overseas routes to blossom.

Finally, local issues also contributed to either stimulate, slow, or even stop service growth at different U.S. airports. Congestion at traditional gateways slowed or prevented the addition of new service, while excess capacity or capacity expansion at other facilities encouraged new service. Very few cities lost all 1980 overseas service by 1995; those that did (Bangor, Cleveland, Las Vegas, and New York's LaGuardia airport) can be explained by local market size, the reduced need for technical stops on long-haul overseas flights, or shifts in local airport and carrier network international service distributions. Local airport authorities took on a new function as they sought to compete for overseas service controlled more tightly by profit-seeking airlines than by government regulation.

The two-fold expansion in both the total amount of overseas service from the United States and the number of cities with nonstop service is clear. Evidence indicates that not only were the same people who flew overseas regularly in 1980 flying more by the mid-1990s, but people began flying internationally who had not previously done so. Likewise, traditional shippers shipped more and companies who had never served overseas markets began to do so as trade expanded, an issue addressed further in the next chapter.

CHAPTER FOUR

POTENTIAL U.S. DEMAND FOR OVERSEAS AIR ARGO SERVICE: EMPLOYMENT IN SELECTED AIRBORNE EXPORT-PRODUCING INDUSTRIES

In this chapter we use multiple data sources to map the spatial distribution of potential demand for overseas air cargo service among U.S. cities. We first review the data sources incorporated in this research phase and the methodological constraints they pose. Next we identify industries that rely most heavily on air transportation for their export activities according to various trade measures. In the third section we determine the geographic distribution of employment in these industries among U.S. metropolitan regions to indicate demand for overseas service, and compile and interpret a map of the changing dominance among U.S. cities in terms of 1980 and 1994 potential export-producer demand. (1995 County Business Patterns data were not yet available at the time of study preparation, so we have substituted 1994 figures for this part of the project.) A major goal of this study is to demonstrate the dynamic nature of U.S. metropolitan regions' competitive positions in a nationwide hierarchy based on markets for overseas air cargo service. We address that goal in this chapter through documentation and analysis of the geography of demand for such service.

DATA SOURCES

Two separate data sets are required to piece together a map of potential overseas air cargo service demand. The first, *U.S. Exports and Imports of Merchandise*, enables identification of commodities that are commonly exported from the United States by air. The second, *County Business Patterns,* reveals the distribution of employment in selected industries, referred to as "target" industries, that produce the most important airborne exports identified from the trade data.

The U.S. Bureau of the Census publishes import-export information that includes foreign trade statistics by commodity and mode of transportation. These data are compiled from Shipper's Export Declarations (SEDs), documentation that must be filed with Customs officials at

the port of exportation from the United States. Published Census figures do not include low-value shipments or shipments that have been modified in designated U.S. foreign trade zones. Because geographic specificity is limited to the customs district of exportation, it is impossible to determine from these data alone where airborne or other exports actually originate within the United States [27].

Census reports of import-export data are more helpful with regard to weight and value figures for air- and waterborne exports by commodity groups. Annual valuation figures for all exports and specifically airborne/waterborne shipments reflect the dollar value for the current year. For this project, 1980 dollar values have been converted to 1995 dollars based on the consumer product indexes for all commodities [28]. All weight values from 1980, originally released in pounds, have been converted to kilograms.

Merchandise export data are organized according to the current standard classification scheme of each year. Internationally agreed-upon commodity classification systems attempt to provide standard, comparable categories for export and import figures among countries. These classification schedules are altered periodically by international agreement to accommodate development of new products being traded and/or new data collection and analysis needs.

In 1980 and 1995, export data were collected under two different classification systems and partially reported in yet another system (The Tariff Schedule of the United States (TSUS), The Harmonized Commodity Description and Coding System (HS), and the Standard International Trade Classification (SITC) respectively). In 1980, export data were collected in terms of Schedule B, Statistical Classification of Domestic and Foreign Commodities Exported from the United States (1978 edition), which in turn is based on the classification in The Tariff Schedule of the United States (TSUS). However, summary reports of these data released by the Census Bureau aggregate commodity data based on another system: the Standard International Trade Classification (SITC), from Schedule E, Statistical Classification of Domestic and Foreign Commodities Exported from the United States. The 1995 data were collected under a third system: The Harmonized Commodity Description and Coding System (HS). Unlike the SITC system, HS categories can be collapsed relatively smoothly into four-digit SIC classes.

In this study, general 1980 categories are used to verify the importance of commodity groups identified through 1995 data, but cannot be relied upon to characterize export flows at the

same level of industry specificity. Only the 1995 trade categories translate smoothly enough into Standard Industrial Classification industry groups, a critical feature for deriving meaningful data on domestic production of these export commodities [29]. Thus, 1995 export figures are the primary source for identifying the most important airborne exports and the industries that produce them.

SIC groups are the standard industry units for employment and payroll information on domestic production collected by the Census Bureau and reported in *County Business Patterns* (CBP) publications. This is the second major data source required to characterize potential demand for air cargo. The Standard Industrial Classification is the statistical classification framework underlying all *establishment-based* Federal economic statistics classified by industry. The classification covers the entire field of formal economic activities and defines industries in accordance with the composition and structure of the economy. Each establishment or workplace is classified according to its primary activity.

The hierarchical structure of the classification of establishments makes it possible to tabulate, analyze, and publish establishment data at varying levels of industrial detail. The range of specificity options includes:

- the most general level (all industries),
- one of the ten major divisions of the classification;
- a two-digit major industry group,
- a three-digit industry group, or
- a four-digit industry code basis (for the greatest detail).

The industry level chosen varies according to the degree of precision or detail considered most appropriate to the analytical task at hand. However, tradeoffs exist between industrial and geographic specificity.

Unlike foreign trade data, CBP data are geographically exhaustive at the most general industry level. Data are available for every county in the United States, but disclosure of detailed data for individual counties is restricted where fewer than 50 employees work in an industry at any SIC code level [30]. Although this study is concerned with target industry characteristics at the metropolitan area level (a variable scale, though generally broader than county level), the Census Bureau provides only this mid-level of geographic detail for two-digit SIC codes—a level

not specific enough to limit figures to those industries whose products are generally exported by air.

The industry data contained in this study are at the three-digit SIC code level. However, because many counties lack the threshold number of employees per industry group required to allow detailed disclosure, the total employment figures must be estimated for many counties. (Appendix G shows data suppression codes, ranges of total employees represented, and estimates used.) Using estimates of total employment rather than actual figures could be avoided if industries were examined at the two-digit SIC code level, but doing so would require sacrificing the needed industry specificity. Each metropolitan region total employment figure is determined by summing the estimated or actual employment of the individual counties within it. (Appendix A explains the metropolitan region definitions and lists the counties included within each.)

CBP data are collected annually from tax documentation; workers under jurisdiction of the Federal Insurance Contributions Act (FICA) are generally included. This group excludes government employees, agriculture production workers, and workers employed in several other specific types of work. The most recent CBP data available at the time of this study's preparation were from 1994. Differences between 1994 and 1995 are assumed here to be minimal relative to the overall changes in trade and production since 1980. Because the trade and domestic production data sets are used independently, the inconsistency between the two years is not problematic.

U.S. AIRBORNE EXPORTS

In 1995, the value of all U.S. exports reached $583 billion [31]. Airborne exports accounted for nearly one-third of this value, over $175 billion (Table 4.1). Expansion in the value of exports shipped from the United States by air outpaced total export value growth by more than two to one between 1980 and 1995 [32]. Airborne export growth of over 110 percent dwarfed the 43 percent increase in total export value during the 15-year period. By weight as well, airborne exports more than doubled from their 1980 level of one billion kilograms to reach an historical high of 2.3 billion kilograms in 1995. These dramatic increases in both total airborne export value and weight indicate the growing role of international air cargo service in facilitating U.S. trade.

Table 4.1. The Importance of Airborne Exports, 1980 - 1995

	1980	1995	1980 - 1995 percent change
Weight of Airborne Exports (billions of kilograms)*	1.0	2.3	123
Value of Airborne Exports (billions of 1995 dollars)**	85.2	181.1	112
Value of All Exports (billions of 1995 dollars)**	408.2	583.0	43
Proportion of all exports shipped by air (percent of total export value)	20.9	31.1	49

*Weight refers to the gross shipping weight of all shipments, including the weight of moisture content and packing materials.

**Export value refers to f.a.s. (free alongside ship) value, or the value of exports at the U.S. seaport, airport, or border port of export, based on the transaction price, including inland freight, insurance, and other charges incurred in placing the merchandise alongside the carrier at the U.S. port of exportation. Export value excludes the cost of loading the merchandise aboard the exporting carrier and also excludes freight, insurance, and any charges or transportation costs beyond the point of exportation. 1995 dollar values calculated for 1980 export figures are based on *Statistical Abstract of the United States* consumer price indexes for 1980 and 1995 (all commodities).

SOURCES: (1) U.S. Bureau of the Census. (1996). *U.S. Exports and Imports of Merchandise on CD-ROM, December 1995.* Washington: The Bureau. (2) U.S. Bureau of the Census. (1981). *Highlights of the U.S. Export and Import Trade,* Report FT 990, December 1980. Washington: U.S. Government Printing Office. (3) U.S. Bureau of the Census. (1992). *Guide to Foreign Trade Statistics.* Washington: U.S. Government Printing Office. (4) U.S. Bureau of the Census. (1996). "Table No. 745. Consumer Price Indexes (CPI-U), by Major Groups." In *Statistical Abstracts of the United States* [Online]. Available: http://www.census.gov/statab/freq/96s0745.txt [1997, January 5].

But do airborne export weight and value growth indicate expansion in the same types of industries? Are these also the industries that rely more heavily on air than on any other transportation mode to reach their customers overseas? The following three sections examine different ways to measure air cargo service's significance to an industry's export activities, the specific industries that are either important air cargo customers or for whom air cargo service is critical to their export operations, and the target industry categories selected for geographic analysis in this project.

Measuring Air Cargo Service's Importance Among Export-Producing Industries

There are three ways to measure which industries account for the most air cargo service demand using U.S. import-export statistics. Weight of airborne exports, total airborne export value, and airborne export value as a percentage of the value of all exports (regardless of mode) show different ways in which air cargo service providers and users are linked. The first reveals industries that use the most air cargo capacity, the second indicates industries that are likely to add the most value back to the local economies where they operate, and the third identifies businesses that are most dependent on air cargo to reach their overseas customers.

Weight is the most obvious indicator of air cargo capacity usage. Measured only by weight, airborne exports seem quite inconsequential compared with other modes. Waterborne exports alone totaled over 400 billion kilograms in 1995—nearly two hundred times the total weight of airborne exports [31]. As discussed in Chapter 3, air is the most expensive means of transportation because of the high costs of fuel, equipment, and labor. These fixed and operating costs combine with the volume, dimensional, and load-bearing constraints of aircraft to make transporting particularly heavy, cumbersome, or inexpensive goods by air prohibitive in most cases. Generally, air is only cost-effective for the shipper when a shipment is perishable either in terms of physical freshness or time sensitivity, or when the cost of air transport represents only a trivial fraction of the market value of the product. Because carriers sell aircraft space by the weight and volume rather than the value of each shipment, it follows that those industries accounting for the greatest weight of airborne exports are likely to be the carriers' most important customers.

Total shipment value is the indicator by which air transportation compares most favorably with other modes. Traditionally, high-value/low-weight items have been cost-effectively shipped by air. High value items may be naturally scarce resources like rare metals, high value-added items such as high-technology precision instruments, or low-weight, low-bulk goods whose value is attributable to their physical or temporal perishability. Regional economies benefit in two ways from local production of high-value air-eligible goods: profits earned may re-enter the regional economy, and other economic activities develop to support their production. Returns are especially high for high value-added goods because of the multiple inputs and complex production processes required. Although industries producing high-value/low-weight goods may not be the largest customers for air cargo service providers in terms of shipment size and capacity usage, their importance in terms of value added to the local economy makes them important targets for this study.

Weight and value of airborne exports alone do not reveal an industry's reliance upon air for exportation over other transportation modes. The final measure of an industry's link to air cargo service is the proportion of its exports (in terms of value) that leaves the United States by air. The higher the percentage, the more an industry depends upon air cargo service to reach its markets abroad. Other modes or closer markets may be feasible substitutes in the absence of air cargo service, but without cost-effective access to markets reached only by air, some producers in these industries would go out of business.

Specific Industries

The three measures of potential demand outlined above are available for 1995 in 10-digit HS categories. Once HS categories are converted to four-digit SIC codes, the list that emerges is of industries that produce exported commodities, rather than of the commodities themselves. For example, the category entitled "meat packing plants" (SIC 2011) means neither that meat packing plants themselves nor the equipment used at these establishments is exported, but that the *commodities produced* at meat packing plants are shipped to foreign customers.

Ranking the completely converted SIC categories according to each measure reveals outstanding airborne export-producing industries according to each. (Tables in Appendix H list the highest tier of industries based on weight, value, and value percentage respectively.) Only

three industries rank in the highest group in all three measures: "electrical components" (SIC 3571), "radio & TV communications equipment" (SIC 3663), and "semiconductors & related devices" (SIC 3674). Airborne exports from these three industries together weighed over 190 million kilograms and were worth nearly $60 billion in 1995, accounting for about 5 percent of the total airborne export weight and a third of total airborne export value [31]. Among the products included in these categories are personal and mainframe computers, amplifiers, antennas, cable TV equipment, radio receivers and transmitters, televisions, fuel cells, and microprocessors. All are high-tech, high value-added products requiring skilled labor and complex production processes.

The computer category (SIC 3571) ranks highest in weight at 127 million kilograms, over 50 million kilograms more than "motor vehicle parts & accessories" (SIC 3714), a distant second. Export shipments from most top-tier industries in this category weighed between 27 and 37 million kilograms total. Several industries are important cargo customers on the basis of weight, although they are not in the top tier in terms of value or percentage value. They produce items such as steel and iron, industrial chemicals, meat, fish, books, and factory machinery and equipment. Meat and fish are air-eligible because of their physical perishability. The other goods may be time sensitive if they are imperative for the foreign customer's business operations.

The 11 industries that stand out in terms of total airborne export value account for $99 billion in exports—well over half the total value of all items exported from the United States by air in 1995. Besides the high-tech computer and radio/TV communications equipment already mentioned, other computer-related items and products of the aircraft industry dominate. (The "aircraft engine and engine parts" and "aircraft parts and equipment not elsewhere classified" categories are included in this group. Vessels exported under their own power [be they waterborne or airborne vehicles] are not included in the export data at all.) Production machinery, instruments to measure electricity, and telephone equipment also appear. None of these items comes close to the semiconductor and computer categories, each with over $24 billion in exports during 1995. These airborne exports accounted for 86 and 84 percent of their industry's total exports as well, making the semiconductor and computer industries important customers for overseas cargo service *and* the air service crucial to these industries' abilities to get their products to export markets as well.

Several industries have neither high total airborne exports weight nor value, yet the vast majority of their export activities are conducted by air. These industries rank above semiconductors, computers, and radio/TV communications equipment in terms of their airborne export value as a percentage of total export value. Products from these industries include jewelry and precious metal, of which over 94 percent of total export value is shipped by air. Aircraft engines and parts, one of the top-tier industries in terms of total airborne export value as well, shipped nearly 90 percent of its 1995 exports by air. Although the industries with airborne export value percentages greater than 80 (the top tier) are not all significant in terms of their total value or weight nationwide among other industries, they are likely to be very important economic players in their home regions.

Target Industries for Airborne Export Analysis

The industries identified above because of their dominance in terms of weight, value, or percentage value of total airborne exports are classified at the four-digit SIC code level. To investigate the domestic production side of these industries, however, meaningful data are available only at the three-digit SIC code level. Selection of the three-digit SIC-code industry groups for analysis must be based not only on the presence of highly-ranked four-digit industries, but also on the characteristics of the more general industry category (Table 4.2).

Among the four-digit SIC industry groups we chose are the three categories that appear in the highest tier of each measure considered above: electronic computers, semiconductors, and radio/TV communications equipment. The industrial categories in which each of these industries is classified shipped respectively 81, 80, and 81 percent of their total exports by air in 1995. Each of these percentages is lower than that of the four-digit category; other industries within the more general grouping do not rely as heavily on air for their export activities. (In some cases, a four-digit SIC subgroup is one of nine that comprise the three-digit industry group. Each group's subgroups are listed in Table 4.2.) Value and weight totals reflect the sum of all subgroups within each category; the airborne export percentage of total export value is weighted by subgroup across the industry group. Those four-digit subgroups that produced more exports by value than the other subgroups count more than those that made up a smaller proportion of the three-digit category's total export value.

Table 4.2. Target Airborne Export-Producing Industries, 1995

S.I.C. Code	Industry Group and Subgroups	Value of Airborne Exports Billions of Dollars	Percent of Total Export Value Shipped by Air	Weight of Airborne Exports Millions of Kilograms
283	**Drugs**	**6**	**78**	**49.4**
	Medicinals and botanicals			
	Pharmaceutical preparations			
	Diagnostic substances			
	Biological products, except diagnostic			
357	**Computer and Office Equipment**	**33**	**81**	**201.9**
	Electronic computers			
	Computer storage devices			
	Computer peripheral equipment, n.e.c.			
	Calculating and accounting equipment			
	Office machines, n.e.c.			
365	**Household Audio and Video Equipment**	**4**	**65**	**39.5**
	Household audio and video equipment			
	Prerecorded records & tapes			
366	**Communications Equipment**	**11**	**80**	**62.0**
	Telephone and telegraph apparatus			
	Radio & TV communications equipment			
	Communications equipment, n.e.c.			
367	**Electronic Components and Accessories**	**35**	**80**	**79.3**
	Electron tubes			
	Printed circuit boards			
	Semiconductors & related devices			
	Electronic capacitors			
	Electronic resistors			
	Electronic coils and transformers			
	Electronic connectors			
	Electronic components, n.e.c.			
372	**Aircraft and Parts**	**15**	**82**	**162.5**
	Aircraft (not exported under their own power)			
	Aircraft engines and engine parts			
	Aircraft parts & equipment, n.e.c.			
382	**Measuring and Controlling Devices**	**10**	**75**	**55.4**
	Environmental controls			
	Process control instruments			
	Fluid meters and counting devices			
	Instruments to measure electricity			
	Analytical instruments			
	Optical instruments and lenses			
	Measuring and controlling devices, n.e.c.			
384	**Medical Instruments and Supplies**	**8**	**77**	**52.8**
	Surgical and medical instruments			
	Surgical appliances and supplies			
	Dental equipment and supplies			
	X-ray apparatus and tubes			
	Electromedical equipment			

n.e.c. - not elsewhere classified

SOURCES: U.S. Bureau of the Census (1996). *U.S. Exports and Imports of Merchandise on CD-ROM,* December 1995, Washington: The Bureau; and U.S. Bureau of the Census (1992). *Guide to Foreign Trade Statistics*. Washington: U.S. Government Printing Office.

Five other industry groups augment the "Computer and Office Equipment" (SIC 357), "Communications Equipment" (SIC 366), and "Electronic Components and Accessories" (SIC 367) categories. (The Electronic Components and Accessories industry group (SIC 367) includes semiconductors (SIC 3671).) At least one subgroup identified in the top tiers of all industry subgroups in terms of weight, value, and/or percentage value is included in the "Drugs" (SIC 283), "Aircraft and Parts" (SIC 372), "Measuring and Controlling Devices" (SIC 382), and "Medical Instruments and Supplies" (SIC 384). Only "Household Audio and Video Equipment" (SIC 365) did not have one of its subgroups included in the top tier of at least one measure. With only two subgroups, this is a very narrow, easily identifiable category. It includes manufacturers of home and automotive entertainment systems and the prerecorded music used with them. The prerecorded record and tape subgroup dominates, accounting for most of the weight and value exported by air in this category. Fickle consumer demand makes this a highly time-sensitive industry; that and the small number of subgroups make it worthy of analysis.

The eight industry groups summarized in Table 4.2 are used as target industries to indicate demand for overseas air cargo service based on their propensity to export by air and their importance as air cargo service customers. They account for over two-thirds of the $181 billion in airborne exports and roughly half of the total airborne export weight from the United States in 1995. They are geographically disparate, as is shown in the next sections. Some of these industries have traditional strengths in certain regions: this feature provides incentive rather than discouragement to study their geographic distributions of employment on a nationwide basis. These industries are not a statistically valid sample of all industries that have been or may become consumers of overseas air cargo service for their export activities, but their past usage indicates an important dimension of nationwide demand for overseas air cargo service.

THE GEOGRAPHY OF EMPLOYMENT IN AIRBORNE EXPORT-PRODUCING INDUSTRIES

The following sections analyze overall employment trends in the eight target industries, changes in location patterns of employment in each of the industries, and the shifting geographic distribution of the service demand hierarchy. Detailed tables in Appendix we list the metropolitan region employment figures discussed below.

Nationwide Trends in Target Industry Employment

Total U.S. employment in the eight airborne export-producing industries identified above fell by nearly 20 percent between 1980 and the mid-1990s [33,34]. This decline can be attributed to the overwhelming employment decreases in the computer (SIC 357), communications equipment (SIC 366), and aircraft parts (SIC 372) sectors (Figure 4.1). Home entertainment equipment employment (SIC 365) also declined; employment reductions in these four sectors outweighed increases in the remaining four industries by over 490 thousand jobs.

Three main factors contributed to the employment declines shown [35]. First, automation and productivity gains in many high-tech sectors meant fewer employers were needed to maintain or even expand output levels. Second, industry consolidation through mergers during the period led to employment reduction in redundant activities. For example, a new company formed by the merger of two smaller operations might find itself with more administrative, sales, or research and development personnel than necessary for a single business, resulting in layoffs of employees whose skills were no longer needed. Finally, outsourcing manufacturing activities to low-cost foreign producers has limited growth in traditional manufacturing jobs in the United States.

In the computer industry, U.S. job levels peaked in the mid-1980s and have steadily declined since. The job outlook for the industry through the year 2005 is bleak; the only occupations for which demand is expected to rise in SIC 357 are computer engineers, systems analysts, purchasing agents, and writers/technical writers. Altogether these occupations accounted for only 13 percent of industry employment in 1994 [36]. Each of the remaining 30 occupation categories is expected to endure double-digit percentage declines between 1994 and 2005. At the same time, the total number of units shipped and the value of U.S. and global markets are expected to increase [37].

Employment gains were modest in the drugs (SIC 283), electronic components (SIC 367), and measuring devices (SIC 382) groups. Only the medical instruments sector (SIC 384) enjoyed strong job growth: employment nearly doubled to 272 thousand jobs by 1994. The outlook in this industry group is the opposite of that for the computer sector; only four occupation categories are expected to decline (less than 9 percent of 1994 industry employment) while 24 categories are predicted to rise between 1994 and 2005 [36]. Although 15 percent of industry executives surveyed in 1993 expressed strong desires to move manufacturing operations to

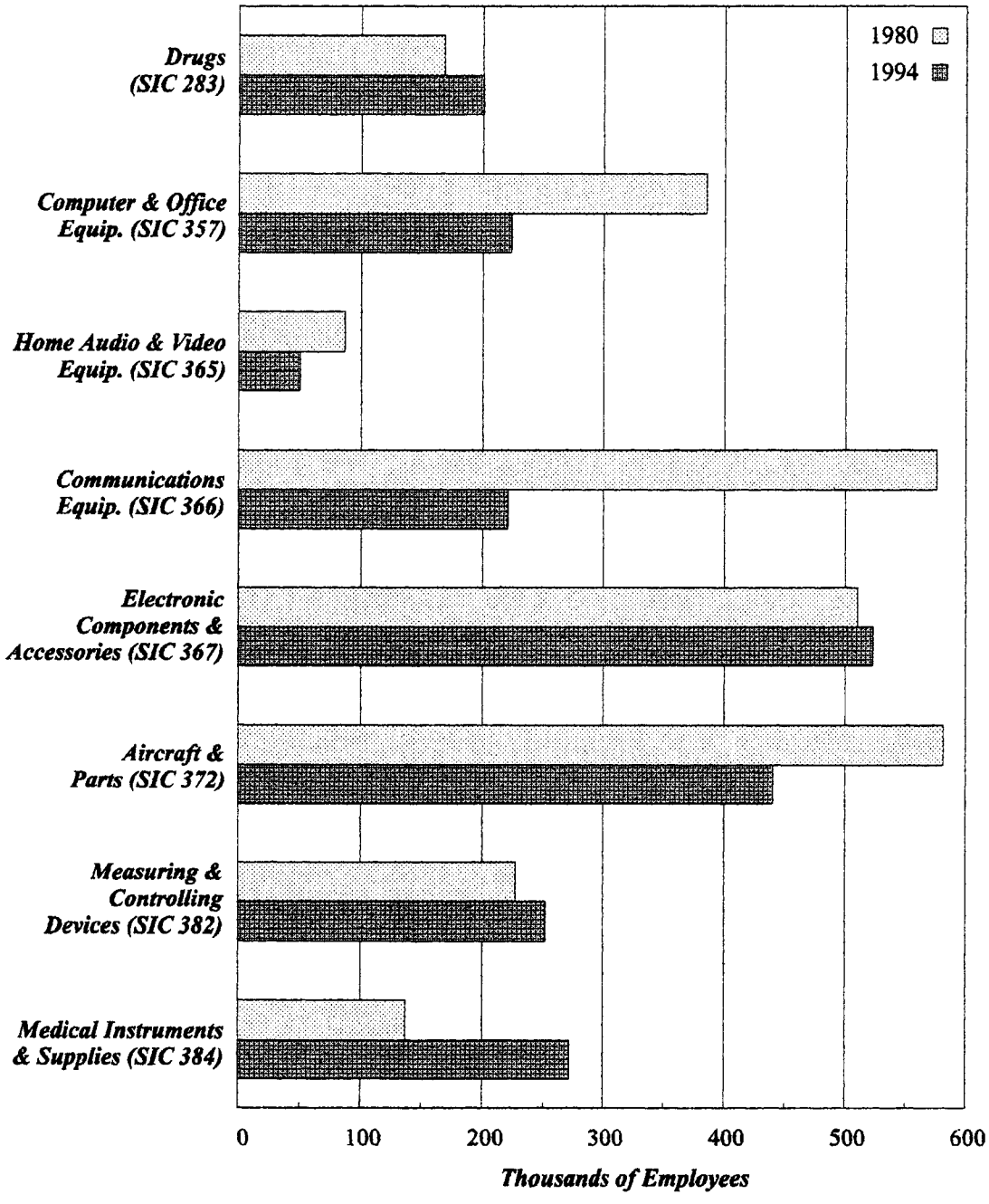


Figure 4.1. U.S. Employment in Target Industries, 1980 & 1994. The total number of full- and part-time employees in the eight airborne export-producing industries dropped from 2.1 million to 1.7 million nationwide between 1980 and 1994. Drastic employment declines in the computer, communications equipment, aircraft manufacturing, and home entertainment industries outweighed job growth in the other four categories. The largest employment gain in raw and percentage terms was in the Medical Instruments & Supplies industry group.
SOURCES: U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; and U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.

cheaper foreign countries and increase automation, these trends have not outweighed overall industry expansion [38].

The eight target industries' mixed employment decline and expansion trends do not indicate that these industries will cease to be important employers within individual metropolitan regions. In fact, fewer jobs overall stiffens competition for employers among places struggling to keep the workforce employed and tax base in place. Agglomeration economies, including air cargo service activities, provide competitive advantages to those metropolitan regions that already have employers in any or all of these industries. Where target industry employment exists, there is already some local demand for links to international transportation networks needed to reach foreign customers.

Target Industry Employment Concentrations

The geographic patterns of employment vary considerably among the eight target industries examined. How the industry-wide trends discussed above play out locally is evident from comparing national metropolitan region maps of 1980 and 1994 employment in each industry (Figures 4.2 and 4.3). The employment distributions shown raise numerous questions that are outside the scope of this project about trends across the separate industries; the maps are included to demonstrate the complex industry dynamics that contribute to potential demand for international air cargo service.

The employment distribution in each industry remained roughly the same between 1980 and the mid-1990s, illustrating the continuing importance of traditional industry location structures. Places like Seattle, Los Angeles, and Hartford that were originally high employers in aircraft and parts manufacturing (SIC 372) remained strong in relative terms, although individual employment totals declined slightly. In the medical instruments sector (SIC 384), employment tended to grow where at least some employment had already existed rather than at new sites.

Employment in the Drugs industry group (SIC 283) shifted away from smaller Midwestern cities like St. Louis, Indianapolis, and Detroit to concentrate in Chicago. Boston gained a bigger share of New England's industry employment by 1994, as did San Francisco on the West Coast. The Research Triangle area in North Carolina (Raleigh-Durham) and other Southern cities also picked up more industry employment.

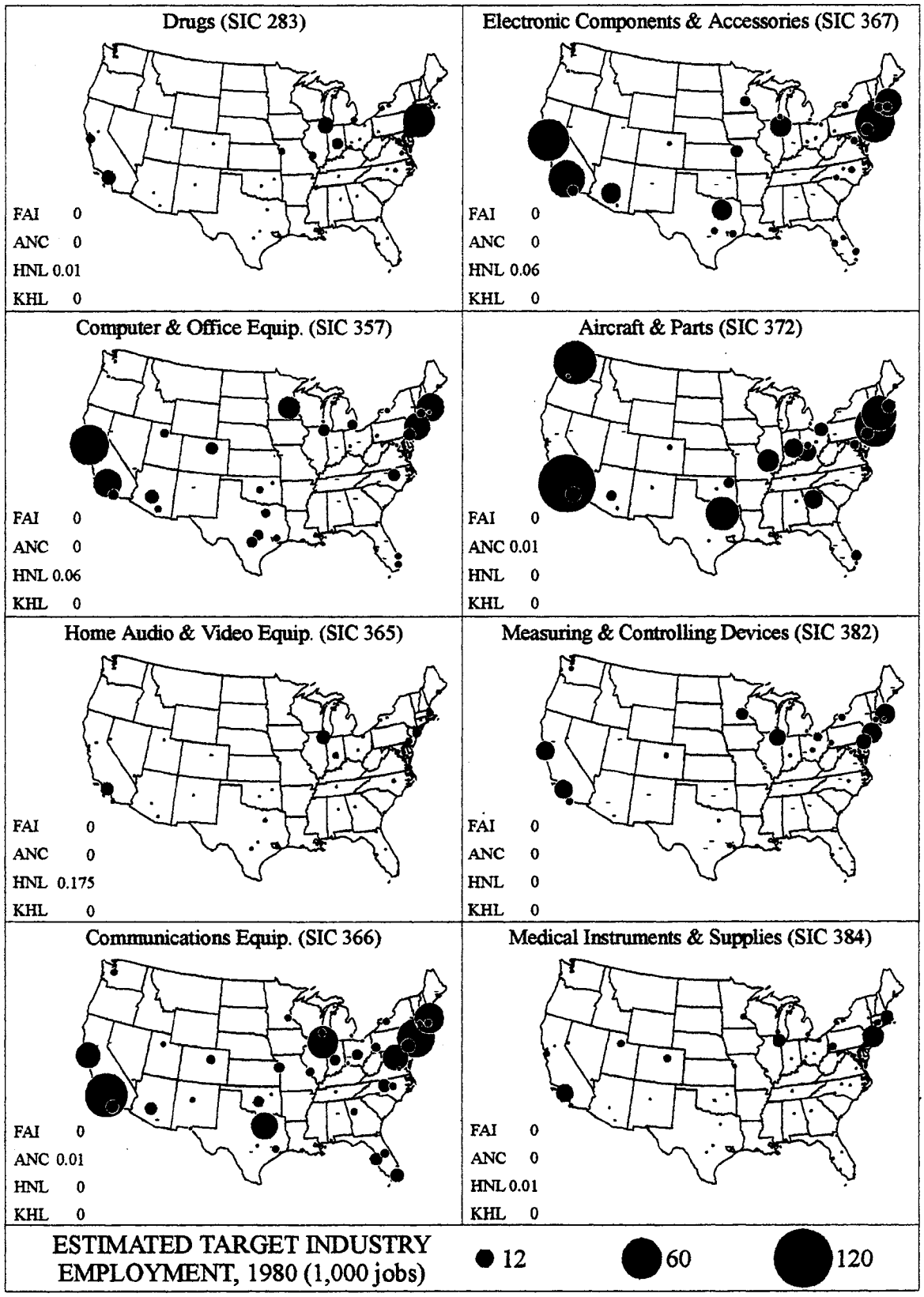


Figure 4.2. Estimated Target Industry Employment, 1980. See Appendix I for full metropolitan region data. SOURCE: U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau.

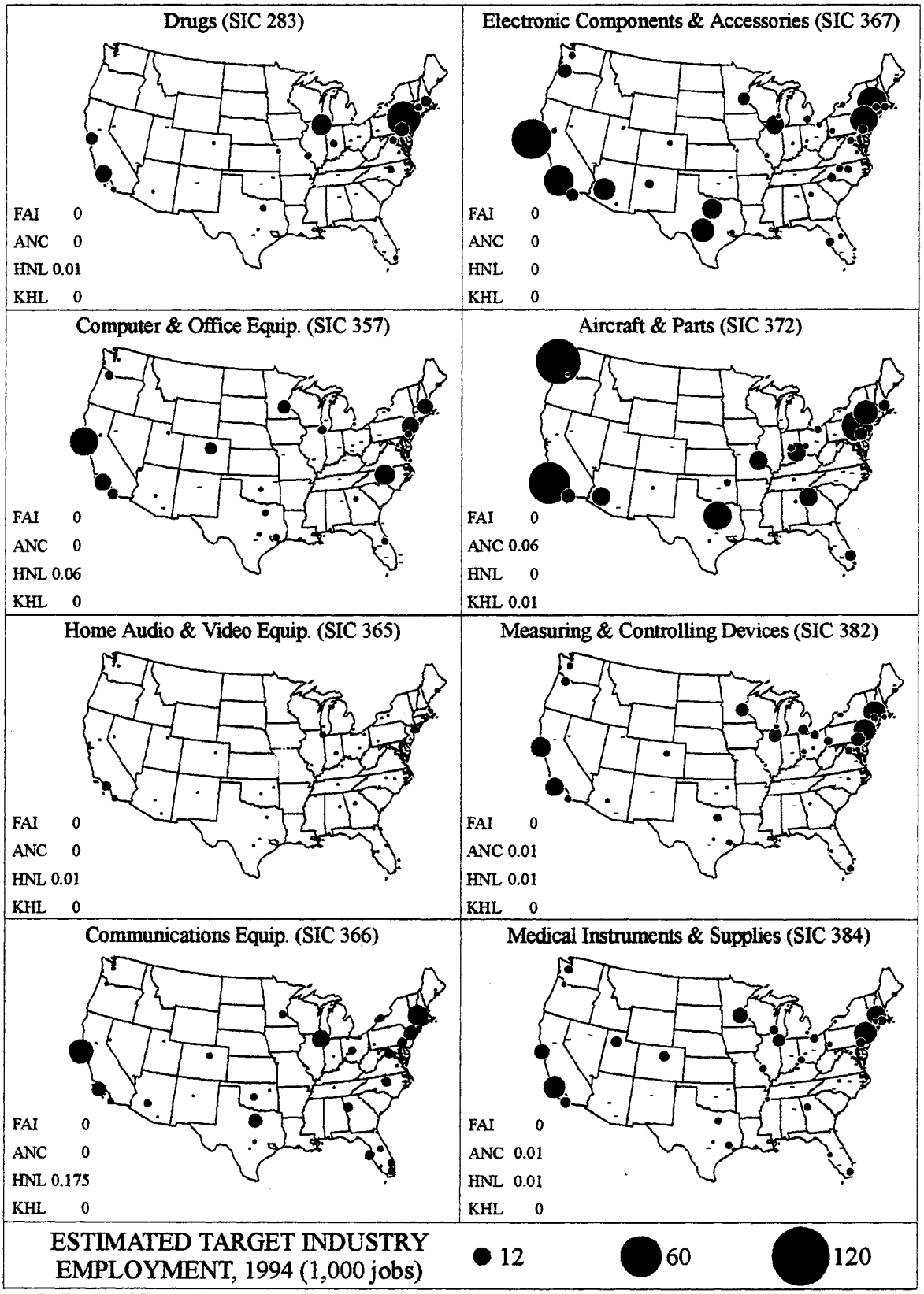


Figure 4.3. Estimated Target Industry Employment, 1994. See Appendix I for full metropolitan region data. SOURCE: U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.

Computer & Office Equipment (SIC 357) employment declines impacted metropolitan regions across the country. Only Raleigh-Durham (Research Triangle), Atlanta, Portland (home of Intel Corporation), and Seattle (Microsoft corporate headquarters) enjoyed marked growth; smaller job increases occurred in sunbelt cities like Greensboro, Birmingham, and Las Vegas. Minneapolis-St. Paul and Detroit led the Midwest in industry employment declines, each losing over half their jobs. Chicago, Pittsburgh, Albany, Indianapolis, and all of the mid-sized cities in Ohio saw declines as well. Four Texas and two Oklahoma metropolitan regions lost some or all of their computer industry employment. In the Southwest from San Francisco to Phoenix, all metropolitan regions lost at least one-third of their jobs.

Home Audio & Video Equipment (SIC 365) is the smallest target industry examined in terms of total employees. Its employment declines were felt most heavily in traditional recording industry centers: Chicago, New York, Los Angeles, and Boston. Norfolk, surprisingly strong in 1980, had lost all of its estimated 3,760 industry jobs by 1994. (The case of home entertainment job declines in Norfolk is one of many revealed by this analysis that warrant further research.) Atlanta, Minneapolis-St. Paul, Nashville, and Portland were among the metropolitan regions with slight employment gains.

In contrast to the home entertainment industry's modest changes, the Communications Equipment sector (SIC 366) saw dramatic changes in its overall size and employment patterns between 1980 and 1994. The net loss of over 350 thousand jobs nationwide meant widespread employment turmoil at the metropolitan region level. Large cities experienced the greatest declines, but mid-sized and smaller cities had drastic losses as well: Los Angeles and New York lost 64 and 48 thousand jobs respectively, Boston, Chicago, Dallas-Ft. Worth, and Washington each lost between 20 and 30 thousand positions, and Greensboro, Indianapolis, Kansas City, Miami, Philadelphia, San Diego, and St. Louis lost over 5,000 jobs each. Automation was the key factor in the this industry's depressing employment picture.

Very little total employment growth occurred in the Electronic Components and Accessories industry group (SIC 367), but shifts in the geographic distribution of jobs were evident. Dispersion away from traditional centers of Los Angeles, Chicago, and New York was clear, with substantial growth in Austin, Portland, and Albuquerque. This is one of the few

sectors in which more metropolitan regions gained jobs rather than lost target industry employment between 1980 and 1994.

The Aircraft and Parts group (SIC 372) is located where airlines are based, where the weather is conducive to outdoor maintenance, and/or where major manufacturers are located. Maintenance operations serving TWA in St. Louis, American in Dallas, and the various airlines that have been based in Atlanta over the years contribute to the picture, as do warm areas such as Phoenix and San Diego. Boeing in Seattle, McDonnell Douglas in Long Beach (part of the Los Angeles metropolitan region), and Pratt & Whitney in Hartford are among those aircraft and engine manufacturers who define the map of sector employment. This three-digit SIC group includes both defense and civil aircraft industries. In addition to the three factors leading to decreased employment mentioned above, this industry also fell victim to decreased defense spending.

The Measuring and Controlling Devices sector (SIC 382) experienced a smaller net growth in employment nationwide than many other sectors saw in individual cities. The 64 metropolitan regions examined here gained about 41 thousand jobs, but the net increase nationwide was only 24 thousand. This indicates that the losses in this sector occurred in smaller cities and rural areas. Products from this sector include thermostats, laboratory equipment and field monitors purchased largely by other manufacturers, builders, and research centers. No metropolitan region saw a loss or gain of more than six thousand industry jobs over the period: Chicago experienced the sharpest decline (4,900 positions), but Portland and Detroit gained over five thousand jobs each.

Employment in the final target industry, Medical Instruments and Supplies (SIC 384), enjoyed stronger growth than any other sector. Three-fourths of the new jobs were created among the 64 metropolitan regions. In 1980, employment was clustered in Los Angeles, Chicago, New York, and Boston. Each of these cities enjoyed a net job increase during the period (the only target industry to benefit all of these traditional manufacturing centers, and growth spread to surrounding cities as well. Major job growth occurred in Minneapolis-St. Paul, Milwaukee, San Francisco, and San Diego. The South and West also benefited from this industry's expansion, with employment improvements in Dallas, Houston, Atlanta, Memphis, Portland, Seattle, Salt Lake City, and Denver, among others.

When examined separately, the eight target industries exhibit complex patterns of employment change between 1980 and 1994. When considered as a total of all target industry jobs, however, the employment patterns among the 64 metropolitan regions were quite similar (Figure 4.4). These maps of target industry employment nationwide represent estimates for potential air cargo service demand in each year: where the greatest number of airborne export-producing industry employees work is also where there is likely to be the greatest need for international transportation to move their products to foreign markets.

Altogether, the metropolitan regions experienced a decline of 438 thousand jobs, but nearly half had at least some employment growth. Magnitudes of metropolitan region employment changes varied considerably (Table 4.3). Those regions ranked tenth in terms of net gain and loss (Cincinnati and Philadelphia respectively), saw only about ten percent of the net change experienced by those cities with the greatest overall shifts (Austin and Los Angeles). Fourteen metropolitan regions had remarkably stable employment in the industries overall, experiencing net changes of fewer than 500 jobs over the period. Analysis of net industry employment change is heavily influenced by the size of individual metropolitan regions. The next section examines which metropolitan regions experienced increases and decreases in their *share* of U.S. target industry employment between 1980 and 1994. Doing so reveals more subtle changes in the urban hierarchy of airborne export-producing industry employment.

Shifts in the Employment Hierarchy

The metropolitan regions with the greatest net changes in total target industry jobs did not necessarily experience similar changes in their positions relative to other cities. A look at the dynamics of each city's share of total employment among the 64 metropolitan regions reveals shifts in this urban hierarchy. Some cities gained ground while the status of others slipped based on their shares of employment in the industries most reliant upon air transportation for their export activities. Patterns of proportion change are shown in Figure 4.5.

Metropolitan regions whose shares rose are concentrated in the western and southeastern United States. Los Angeles was the only city on the West Coast to lose standing in the nationwide picture; its share dropped more dramatically than any other U.S. city (-4.3). (Proportion changes are calculated by subtracting each metropolitan region's 1980 percentage of

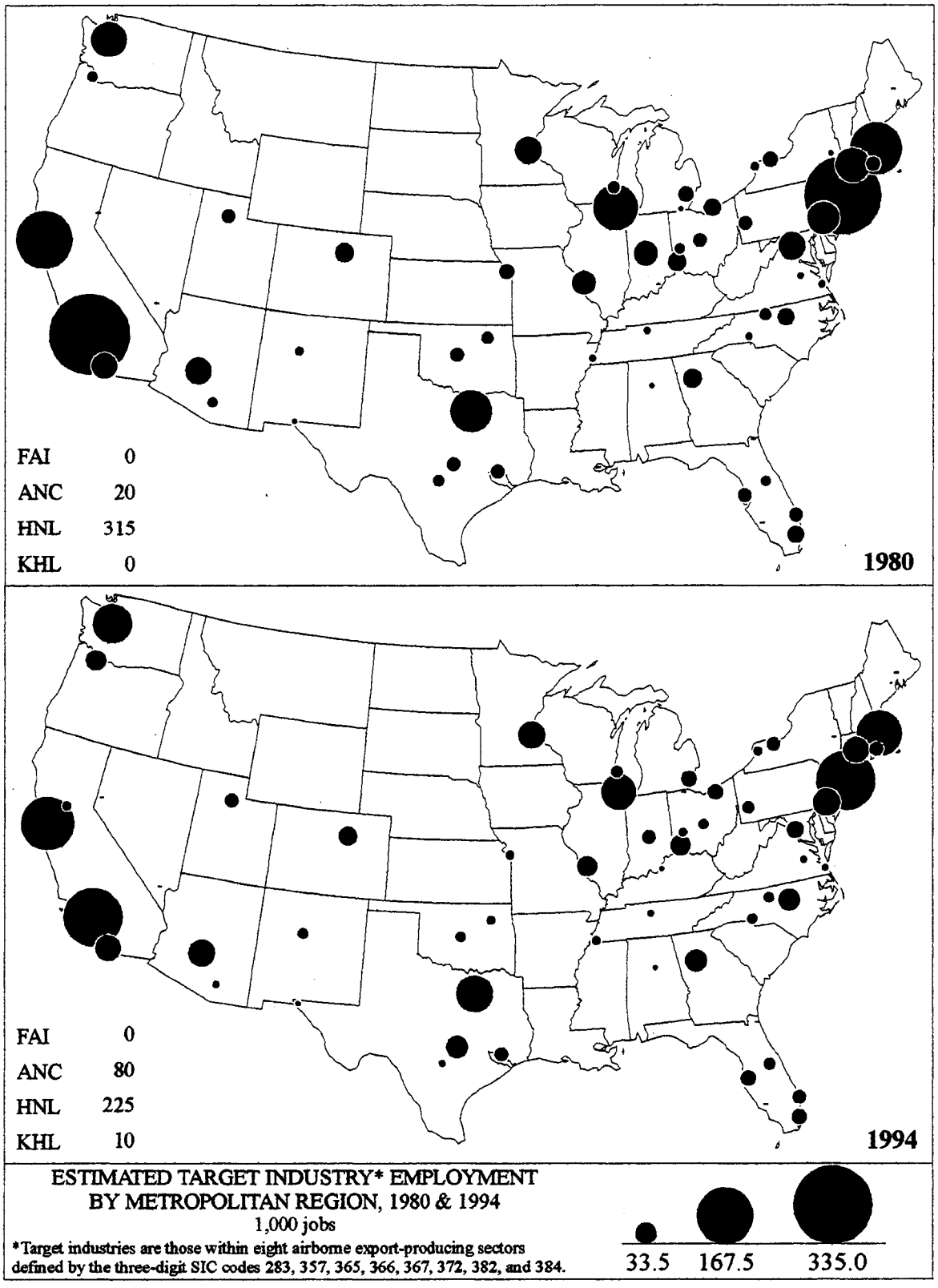
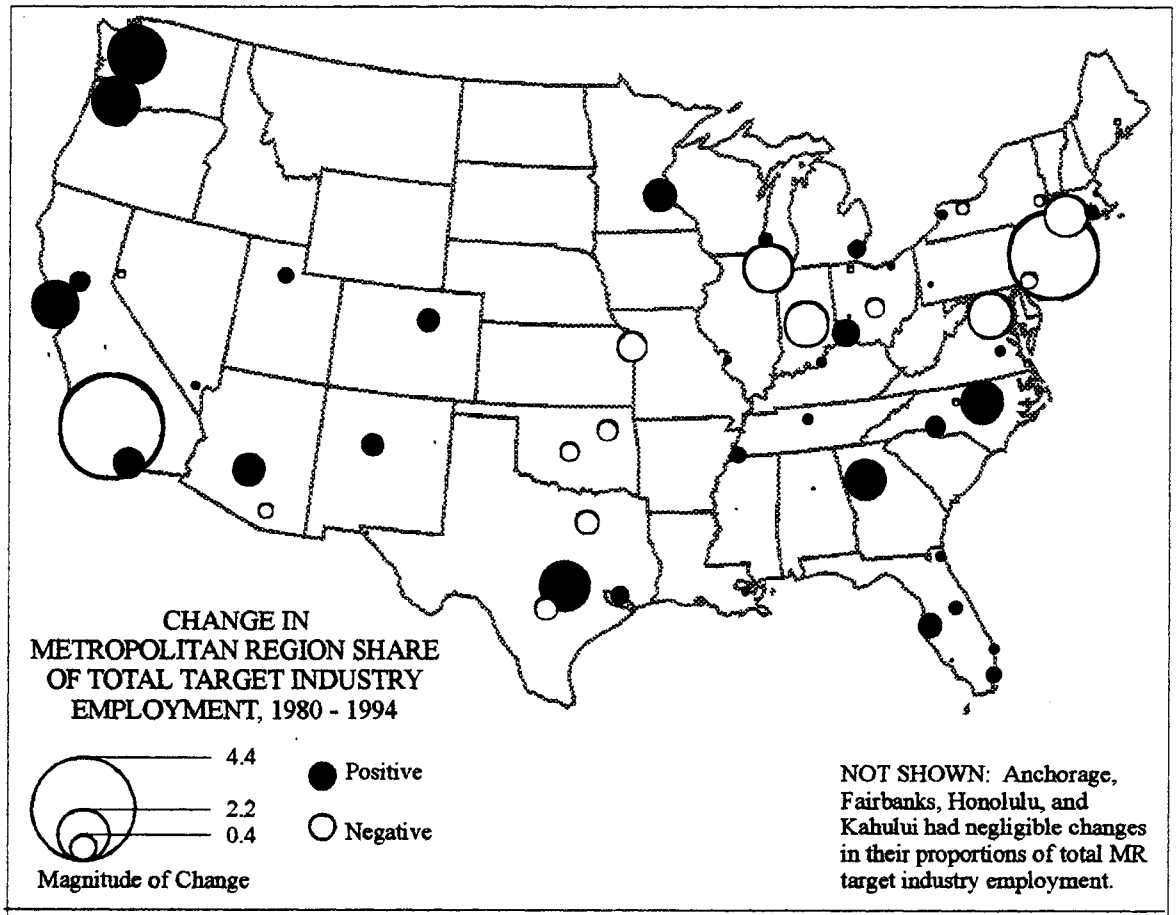


Figure 4.4. Estimated Total Target Industry Employment, 1980 & 1994. SOURCES: U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; and U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.

Table 4.3. Metropolitan Regions with the Greatest Net Changes in Total Target Industry Employment, 1980-1994

Metropolitan Region (MR)	Net Employment Change (1,000 jobs)	Change in Proportion of all MR Employment
Greatest Net Job Growth		
Austin	21.0	1.4
Portland	20.5	1.3
Seattle	13.4	1.7
Raleigh-Durham	13.2	1.0
Atlanta	11.3	0.9
Sacramento	4.7	0.3
Albuquerque	4.5	0.3
Charlotte	4.1	0.3
Tampa	3.5	0.4
Cincinnati	2.5	0.4
Worst Net Job Losses		
Los Angeles	-143.1	-4.4
New York	-120.7	-3.4
Chicago	-44.1	-1.1
Boston	-30.6	0.0
Hartford	-30.4	-0.9
Dallas-Ft. Worth	-26.7	-0.3
Washington	-26.0	-1.0
Indianapolis	-24.5	-1.0
San Francisco	-16.9	1.2
Philadelphia	-16.0	-0.1

SOURCES: U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; and U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.



Strongest Improvements

Metropolitan Region (MR)	Net Employment Change	Change in Proportion of all MR Employment
Seattle	13,384	**1.73**
Austin	21,042	**1.39**
Portland	20,511	**1.29**
San Francisco	-16,893	**1.21**
Raleigh-Durham	13,189	**1.01**
Atlanta	11,272	**0.93**
Phoenix	1,444	**0.67**
Mpls.-St. Paul	1,853	**0.66**
San Diego	676	**0.55**
Cincinnati	2,503	**0.45**

Most Severe Declines

Metropolitan Region (MR)	Net Employment Change	Change in Proportion of all MR Employment
Los Angeles	-143,113	**-4.36**
New York	-120,681	**-3.35**
Chicago	-44,124	**-1.11**
Indianapolis	-24,485	**-0.98**
Washington	-25,961	**-0.95**
Hartford	-30,376	**-0.90**
Kansas City	-11,926	**-0.47**
San Antonio	-7,480	**-0.30**
Dallas-Ft. Worth	-26,688	**-0.26**
Tulsa	-6,748	**-0.24**

Figure 4.5. Shifts in the Potential Overseas Air Cargo Service Demand Hierarchy, 1980 - 1994. Using changes in metropolitan region proportions of total target industry employment, this map shows which U.S. cities gained or lost potential local demand for overseas air cargo service between 1980 and 1994. The total target industry employment decline explains why San Francisco lost jobs but still saw improvement in its place within the hierarchy. SOURCES: U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; and U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.

total metropolitan region target industry employment from the 1994 percentage. For example, in 1980 the Los Angeles metropolitan region accounted for 15.6 percent of all target industry jobs in the 64 metropolitan regions considered (or 335,779 of 2.2 million full- and part-time jobs). The city's proportion fell to only 11.2 percent of the total jobs by 1994 (or 192,666 of 1.7 million jobs), a fall of 4.4 its proportion. This was the greatest total decline within the hierarchy.) The area's plight is especially noticeable because four of the ten metropolitan regions with the greatest proportion improvements were in Washington, Oregon, and California. Besides Los Angeles, Tucson was the only other city west of Texas that experienced proportion decline. San Francisco's increase (1.21) initially seems illogical because it ranked ninth in terms of actual employment decline (net loss of -16,893 jobs). However, the city's target industry employment decline was proportionally smaller than that of the net employment loss among all metropolitan regions. Its job loss was outpaced by the overall decline in employment in these sectors.

In the Southeast, every metropolitan region from Houston to Richmond saw its share of target industry employment improve. Austin and Cincinnati, two cities that were among the top ten in terms of both net growth and proportion expansion, fit this trend as well. This pattern of employment share growth among southeastern cities reflects wider movement of economic activities from the old Rust Belt southward to warmer weather and perceived lower labor costs.

The old industrial powerhouses in the Northeast and Midwest nearly all saw their importance within the target industries decline. Hartford, Albany, New York, Philadelphia, Washington, Rochester, Columbus, Indianapolis, Chicago, and Kansas City no longer garnered as much of the total target industry employment as they once did. Among the regional exceptions were Detroit, Milwaukee, and Minneapolis-St. Paul; the Twin Cities saw the sixth strongest proportional improvement nationwide.

A final cluster of cities with declining outlooks is south of Kansas City. San Antonio, Dallas-Ft. Worth, and Tulsa were among the cities with the worst proportional declines, and Oklahoma City did not fare much better. Given this concentration's proximity to Austin and Houston, it is likely that many of the 1980 jobs shifted to these cities that enjoyed net and share increases.

The trend is clear: metropolitan regions that once dominated the eight target industries now account for a smaller share of employment, even as total employment has declined. Los

Angeles, New York, and Chicago have had to make way for Raleigh-Durham, Atlanta, Phoenix, Austin, and the cities of northern California and the Pacific Northwest. Even Florida, whose economy is increasingly centered around leisure activities and the permanent and semi-permanent retired population that uses them, saw improvements in all of its metropolitan regions' employment shares. These cities, all with positive movement within the hierarchy, are the most likely to also become increasingly important as airborne export production centers.

SUMMARY: THE CHANGING URBAN HIERARCHY OF OVERSEAS AIR CARGO SERVICE DEMAND

A crucial component to understanding the organization and operation of any transportation industry is the *demand* side of that business: the nature and location of what needs to be moved. This chapter has addressed these demand issues with regard to overseas air cargo service, identifying (1) the most important producers of airborne exports from the U.S. economy as a whole and (2) which U.S. cities have been the most important locations for these target industries (and therefore where demand for overseas cargo service is likely to be greatest).

Eight Standard Industrial Classification-defined industry groups are identified as sectors that produce significant quantities of goods for airborne export (by weight and by value), and/or rely heavily on air transportation to facilitate their export activities (according to airborne export value as a percentage of total export value). Important airborne export commodities include products from the drug, computer, telecommunications, medical instruments, home entertainment, measuring devices, and electronic components industries based on 1995 trade information.

Employment in these target industries is the most geographically comprehensive indicator of where highly air-eligible goods originate in the United States. It is assumed that where an industry's employment is high also indicates where production is high, and therefore where these industries' exports need overseas air cargo service. Industry employment trends varied widely among the targeted sectors between 1980 and 1994; four of the industries experienced net employment losses while four enjoyed expansion. Productivity improvements, exportation of production processes, and industry consolidation contributed to the nearly twenty percent net decline in total employment among the eight airborne export-producing industries.

Patterns of employment in each of the eight industries were similar nationally in 1980 and 1994, but varied considerably in individual metropolitan regions. The most dramatic local

changes were in the Communications Equipment industry group (SIC 366), which by 1994 had lost the majority of its employment in most places where it had been in 1980. Each of the eight industries had distinctive employment distributions. The complexities of individual industries, however, are largely masked once each metropolitan region's total employment among all eight target industries is considered together.

Net employment losses were greatest in some of the country's largest metropolitan areas, including Los Angeles, New York, Chicago, Boston, Dallas-Ft. Worth, Philadelphia, and San Francisco. These are also the cities that had the most jobs to lose. At the other end of the spectrum, strongest net employment gains tended to occur in smaller cities like Austin, Portland, Raleigh-Durham, Sacramento, Albuquerque, Charlotte, and Tampa. Considering metropolitan regions on the basis of their share in total target industry employment in 1980 and 1994 reveals which cities are gaining and losing their standing as markets for overseas air cargo service.

Each city's proportion of target industry employment among all 64 metropolitan regions indicates its relative place in an urban hierarchy. The higher the proportion, the more important that city's target industry employment is to the industry's employment nationwide. Considering employment proportion changes rather than net changes reduces the influence of city size on the analysis. Metropolitan regions that enjoyed improvements in their shares of the total target industry employment between 1980 and the mid-1990s are concentrated on the West Coast (except for Los Angeles) and the southeastern United States. Proportional declines were greatest among traditionally strong industrial centers, many of which are located in the Midwest and on the East Coast.

Employment change in industries that are known to be important overseas air cargo customers or reliant upon air cargo service serves as an important indicator of overseas air cargo service demand. This procedure is a roundabout method of determining *what* exports produced *where* are shipped by air from the United States necessitated by the lack of comprehensive data from any single source. Weaknesses in this method of illustrating demand arise from further data constraints: the estimation of employment in small geographic areas, inconsistencies between trade and domestic production data classification systems, and the tallying of all employees at each enterprise's headquarters location. When coupled with a measure of overseas air cargo

service supply, however, target industry employment as an indicator of service demand enables effective characterization of local service markets on a nationwide scale.

CHAPTER FIVE

A CLASSIFICATION OF U.S. METROPOLITAN REGIONS BASED ON MISMATCHES BETWEEN OVERSEAS AIR CARGO SERVICE SUPPLY AND DEMAND

One feature of the modern global economy is a persistent question: how do our cities stack up against one another? Whether an individual city is maintaining, gaining, or losing standing among its competitors is of as much concern as how much raw change in employment or service it experiences. It is not enough to expand service; a metropolitan region must gain enough service to maintain its rank among other U.S. nonstop gateways [39,40]. Air service has joined professional sports teams, *Fortune* 500 company presence, and major development projects among those activities for which U.S. cities compete today. A major goal of this study is to shed light on which U.S. metropolitan regions have and have not been successful in the competition for overseas service and the global ties it represents.

In this chapter we present the final nationwide portion of the study. We determine which U.S. cities' competitive positions as overseas air cargo service markets strengthened and weakened between 1980 and the mid-1990s. My analysis is based on service supply and demand ranks derived from weekly nonstop overseas flight frequencies and employment in eight airborne export-producing industry groups respectively at each of 64 metropolitan regions. In the following three sections we review the methods used to measure and compare air cargo service supply and demand, analyze changes in the market hierarchy, and identify four case study metropolitan regions for investigation in the final phase of this study.

MEASURING AND COMPARING MARKETS

It is impossible to include all aspects of service and airborne-export industry health in a meaningful comparison summarizing U.S. overseas air cargo service markets. Four methodological issues must be overcome to characterize changing overseas air cargo service supply and demand hierarchies. How to measure supply, measure demand, reduce the impact of

nationwide industry changes over time, and standardize for varying metropolitan economy sizes are addressed in detail in previous chapters and summarized below.

How much air cargo service a metropolitan region has can be measured in terms of destinations served, flight frequency, or capacity. Service is either scheduled or non-scheduled (charter) and either all-cargo or mixed-cargo (passengers and cargo). For this study, we chose the frequency of weekly nonstop flights from all airports in 64 U.S. metropolitan regions to all non-U.S. overseas destinations as the indicator for service supply at the metropolitan region level. All-cargo and mixed-cargo flights are counted equally for simplicity despite the variation in capacity and reliability of these services, as are narrow-body and wide-body service. Flights to Mexico and Canada are not included as these international services face unique competition from surface transportation modes. Based on these specifications, the total overseas air cargo service supply from U.S. airports was 1,517 flights in 1980 and 3,451 in 1995 (an increase of nearly 130 percent).

Identifying and measuring location-specific demand for overseas air cargo service is less straightforward. Demand for overseas service from U.S. metropolitan regions is clearly thriving: airborne export value and weight both more than doubled between 1980 and 1995, outpacing other export sector expansion. Likewise, the strong growth in capacity offered indicates the presence of enough service demand to sustain profitable operation. Again, the dilemma of demand for any new transportation service: one of the best indicators of how much demand exists is how successful past services have been.

Commodities exported by air can be identified from U.S. trade data, but no useful geographic information about product origin within the United States is available from this source. We use metropolitan region employment in those eight industry groups with high propensities to export products via air (identified in Chapter Four) to indicate airborne export origin within the United States (the eight industry groups are defined in terms of three-digit Standard Industrial Classification codes and are detailed in the previous chapter). Despite the evident expansion in demand for service based on increased capacity and blossoming airborne trade, employment in these target industries nationwide had a net decline of nearly five hundred thousand jobs between 1980 and 1994. Metropolitan region target industry employment alone fell from 2.2 to 1.7 million jobs (1994 employment figures are used because 1995 data were not

yet available at the time of the study). The overall employment declines are largely attributable to industry consolidation, increased automation, and production outsourcing.

To negate the influence of overall net changes in supply and demand indicators over time, the 64 metropolitan regions are ranked according to each for 1980 and the mid-1990s. Comparing ranks in both years reveals which metropolitan regions experienced improvements or declines in their relative standings over time. Thus, the influence of overwhelming growth in service supply and dramatic decline in service demand as measured does not affect analysis of the competitive hierarchies. It is how the geographic distribution of supply and demand among metropolitan regions changed over time that is of interest for this study.

Analyzing rank changes rather than net supply and demand indicator growth or decline also standardizes for varying size among the 64 metropolitan regions considered. For example, the number of target industry jobs lost between 1980 and the mid-1990s in New York (120 thousand) was greater than actual 1994 employment in the same industries at each of the other metropolitan regions except Boston, San Francisco, and Los Angeles. These four metropolitan regions accounted for over one-third of all metropolitan region target industry employment in both years, making their dominance over other U.S. cities clear. While smaller metropolitan regions were unlikely to surpass these cities' supply or demand indicators in net terms, using rank analysis reveals that many smaller cities did, in fact, experience some change in their relative standing.

The results of comparing supply and demand indicator ranks for each city are summarized in Table 5.1, with detailed figures for each metropolitan region included in Appendix J. In the following section, we explain what the classification tells us about local service provider and consumer opportunities.

WHERE CARRIER AND SHIPPER OPPORTUNITIES ARE, AND ARE NOT

Columns and rows in Table 5.1 represent improvement, stability, or decline in each city's air cargo service supply and demand ranks according to the number of weekly scheduled nonstop overseas flights and airborne export industry employment, respectively. The relative standings of those metropolitan regions listed in the upper left cell improved in terms of both service and airborne export-producing industry employment; the ranks of cities in the lower right cell declined

Table 5.1 Metropolitan Region Classification
Based on Service and Employment Rank Changes, 1980 - mid-1990s.

		SERVICE RANK		
		Improved	**Remained the same**	**Declined**
EXPORT-PRODUCING INDUSTRY EMPLOY-MENT RANK	**Improved**	Orlando, Atlanta, Philadelphia, Portland	Memphis	Charlotte, Raleigh-Durham, Mpls.-St. Paul, Seattle, Houston, Anchorage, Louisville, *Austin, Sacramento, Albuquerque, Salt Lake City,* Tampa, *Milwaukee, Providence, Jacksonville, Las Vegas, San Diego, Phoenix, West Palm Beach,* New Orleans
	Remained the same	Detroit, Dallas-Ft. Worth, Los Angeles, San Francisco	New York	Nashville, Boston, *Birmingham, Buffalo, El Paso, Kahului, Richmond,* Bangor
	Declined	Washington, Cincinnati, Chicago	Miami	Pittsburgh, Honolulu, Fairbanks, St. Louis, *Dayton, Greensboro, Fort Myers, Cleveland, Denver, Hartford, Toledo, Norfolk, Reno, Albany, Rochester, Tucson, Columbus, Tulsa, Oklahoma City, San Antonio, Indianapolis, Kansas City*

NOTES: *Italicized* cities had no nonstop overseas flights in either September 1980 or 1995. Their ranks declined from 20th to 30th nationwide because ten cities gained new service during the period. Underlined cities are the four case studies under investigation.

SOURCES: (1) U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; (2) U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau; (3) Official Airline Guides. September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services). Oak Brook, IL: Reed Travel Group; (3) Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group.

with respect to both attributes. All other cells represent a combination of rank improvement, stability, and decline; each set of attributes reveals general trends in the market supply and demand for overseas air cargo service.

The Extreme Examples

Orlando, Atlanta, Philadelphia, and Portland all fared better in the mid-1990s than they had in 1980 in both their service and employment ranks. In terms of service, each city moved up only one or two places in the ranking; both Orlando and Portland gained their first scheduled nonstop overseas flights during the period. Because only 19 metropolitan regions had overseas cargo gateway airports in 1980, the remaining 45 were ranked 20th during that year (including Portland and Orlando). Atlanta, the highest ranking metropolitan region in this group and a major beneficiary of Delta's increased overseas service, moved from ninth to seventh. Philadelphia also moved up, from 17th to 15th, but remained overshadowed by busy neighboring airports at larger cities on the eastern seaboard.

The employment picture for this win-win category of cities is more diverse than their supply of service. Philadelphia's improvement was modest; the city's rank rose by only one and target industry employment actually fell by over fifteen thousand jobs (a rate of decline slower than that of the nation). The other three cities in the group did see net employment growth in addition to their rank improvements. Portland led the way,
revealing a major influx of jobs in high-tech industries through its rise from 40th in 1980 to 17th in 1994 (target industry employment increased threefold in Oregon's largest metropolitan region). Atlanta ranked highest within the group in both years, and Orlando consistently ranked in the lower half of all metropolitan regions. Each of the four markets in this group are potentially appealing options for both carriers seeking to expand service and export-producer in search of a new production location.

At the other end of the spectrum, 22 cities experienced rank declines in both service supply and target industry employment. All are generally smaller markets, and 18 had no nonstop overseas service in either 1980 or 1994. (Of these, all had direct overseas service with fewer than five stops en route in at least one of the years except Dayton, Greensboro, Norfolk, Reno, Albany, Rochester, Tucson, Columbus, Tulsa, Oklahoma City, San Antonio, and Kansas City.)

Honolulu and Fairbanks, two of the most unusual cargo markets nationwide, fall in this group. Despite its crucial geographic situation between South Pacific destinations and the U.S. mainland, Honolulu's small population and equally small economy relative to most mainland cities diminish its attractiveness as a site for export industry development. The city ranked among the top five metropolitan regions in terms of service in 1980 and 1995, but stayed within the bottom five cities based on target industry employment. Fairbanks also ranked at the bottom (63rd and 64th in 1980 and 1994 respectively) in terms of employment—it is one of the two cities in the study group that are too small to be considered metropolitan areas by the U.S. Census Bureau. Although Fairbanks' rank fell by three, it and Pittsburgh both gained their first overseas cargo service during the period.

Pittsburgh's rank fell by only one place in terms of both service and target industry employment. One of the U.S. cities associated most strongly with heavy industries, its weakness in airborne export-producing industries is not surprising. St. Louis was ranked higher in both 1980 and 1994, also falling only one place in terms of target industry employment. Like Pittsburgh, St. Louis is an interior domestic airline hub, but both St. Louis and Pittsburgh are relatively less advantageous for TWA and USAir (their respective home carriers) than coastal cities also dominant within their networks.

Together, the upper left and lower right categories shown in Table 5.1 are the extreme groups, and are two of the four major divisions from which WE draw case studies for analysis in the next chapter. Portland, Orlando, Atlanta, and Philadelphia are four of the healthiest markets for overseas air cargo service as evidenced by their improved ranks in both service supply and demand indicators. With the exception of Orlando's uniquely tourism-based market with multiple passenger carriers, all of these cities are at least minor gateways for a single U.S. carrier with international service. Their improvements contrast sharply with the 22 metropolitan regions that slipped in terms of both indicators, most of which were ranked in the bottom half of both hierarchies and are likely to be appealing only to those carriers and export-producing firms that are looking for relatively small, previously neglected (or at least under-served) markets to develop.

Stable Markets with Expansion Potential

Six cities had stable and/or improving ranks in terms of service and employment. Included in these categories are some of the nation's largest metropolitan regions: New York, for example, remained first in the nation in terms overseas air cargo service and second in terms of employment (despite its loss of over 120 thousand jobs). Ranks of Los Angeles, San Francisco, Detroit, and Dallas-Fort Worth improved in service but were stable in employment. Detroit ranked 24th nationwide for airborne export-related jobs in both years, but its service rank of 20 (no service) in 1980 shot up to 11th in 1995 due almost exclusively to Northwest Airlines' establishment of its major international hub there. The other three cities remained at or near the top in employment and within the top tier for service as well, causing them to remain attractive markets because of their sheer size despite congestion at their airports.

Memphis stands alone in employment rank increase accompanied by service rank stability. With the development of the Federal Express cargo hub at Memphis, its stable service rank highlights one of the weaknesses of the ranking method used in this study. The city's service rank remained 20th in 1995, yet it had gained 16 new flights per week over its previous absence of nonstop cargo service. If multi-stop flights had been included in the service measurement or if all-cargo service had been given more weight than mixed passenger/cargo service, the results would be quite different. With its Federal Express sort center, Memphis is a particularly attractive market for local production of air-eligible export goods. The improvement in its employment rank indicates that export producers recognize advantages to locating in Memphis, perhaps in order to take advantage of the metropolitan region's superior domestic and international distribution access.

Declining Demand: The Excess Service Dimension

The remaining two groups of metropolitan regions identified in the classification have disparities between their demand and supply rank changes. These are the strongest evidence of geographic mismatches between service supply and demand. Optimists may view these as growth opportunities for service or airborne export producing industries respectively, while pessimists may see only excess production at under-served locations or excess service at cities with limited local airborne export-producing industries.

The first group includes the left-most cells in the bottom row of the matrix in Table 5.1. Three metropolitan regions comprise the category defined by service rank improvement coupled with employment rank decline. There is a potential excess of service at these markets, since the significance of local economies seems to be declining in terms of airborne export-producing industries nationwide. For carriers serving overseas routes out of Washington-Baltimore (either Dulles or Baltimore-Washington International), Chicago, or Cincinnati, this means that a significant proportion of cargo does not originate locally. Capacity may not be fully utilized by local shippers, requiring carriers or their agents to look beyond the metropolitan region for shipping customers. The role of these cities as transit centers for cargo and passenger flights is stronger than as cargo origin markets; they are clearly serving broad regional hinterlands where air-eligible goods for export are produced.

Miami, with a consistent second-place service rank in 1980 and 1995 but a decline in employment rank, is a similar case. This metropolitan region maintained its high service standing in the face of overwhelming overseas service growth nationwide, yet its rank in terms of local employment in target industries slipped. Miami is known throughout the industry as the premier hub for cargo between Latin America and the rest of the world, but its role is primarily as gateway to the U.S. or en route transit point for regional traffic rather than an airborne export-producing economy itself.

These four cities have improving service supply dominance, but lack the same improvement in airborne export-producing industry employment standing. Because of this, they may be especially attractive for an airborne export producing firm to which good access to overseas markets is crucial. It also may indicate an over-supply of service at these markets that could drive down earnings for air carriers. Washington-Baltimore, Cincinnati, Chicago, and Miami represent one side of the supply-demand mismatch revealed by these ranks.

Shrinking Service: Where are the Exports Going?

A total of 20 metropolitan regions experienced the opposite pattern of rank change, declining in service rank while improving in target industry employment standing (the upper right category on the matrix). Of these, over half had no nonstop overseas service in either 1980 or 1995; their decline in standing was due to the increase in the overall number of cities with service.

Employment ranks for these metropolitan regions did improve, but most are small markets that ranked in the lower half of all 64 cities considered based on employment in both 1980 and 1994.

Rather than indicating excess capacity, the characteristics of metropolitan regions in this category point to a lack of overseas cargo service improvements similar to those in employment among local airborne export-producing industries. Exports that leave the country by air but originate in these markets that lack their own nonstop overseas service in most cases generally require transportation by air or motor carrier to another gateway. At the gateway, shipments from these under-served markets are consolidated with other exports from similar places for departure. Industries that produce air-eligible exports in markets without nonstop overseas flights must pay a price for their location in longer transport times and higher costs. Therefore, the markets shown in this category (particularly those that already have some overseas service) are potential service growth opportunities for carriers because of the strengthening of local airborne export-producing firms.

This category, in the upper-right corner of the matrix in Table 5.1, is the most difficult to understand but may be the most important potential markets for transportation service providers. Because of our lack of uniform, standardized information concerning the domestic portion of export distribution, it is difficult to know what potential for greater service exists at these markets. For example, there is widespread perception in Minneapolis-St. Paul that this metropolitan region sends more than enough export cargo to Chicago each night to fill a nonstop overseas flight departing directly from Minneapolis-St. Paul International Airport (MSP). Short of documenting complete routings and final destinations of all exports produced in the Twin Cities metropolitan region, however, it is difficult to make a convincing case to highly competitive airlines for additional cargo service in such smaller markets.

The final category from the classification includes a varied collection of metropolitan regions whose ranks in service declined and in employment were stable. Of the eight cities included, five are small cities that had no nonstop overseas service in either 1980 or 1995. Nashville gained its first nonstop overseas service over the period, and Bangor lost its only scheduled service (though this service was merely a technical stop).

Boston was the fourth largest airborne export-producing industry employer nationwide in both years, and was the fourth largest service gateway in 1980 as well. By 1995, however, its

position had fallen five places to 9th despite a net increase of 25 nonstop overseas flights per week. Boston, the northern anchor for the East Coast's sprawling megalopolis, encompasses nearly half of Massachusetts as well as parts of Connecticut, New Hampshire, and Rhode Island. It is also home to the Massachusetts Institute of Technology, Harvard, and a wealth of other highly-regarded colleges and universities, which helps to explain its consistent concentration of employment in high-tech, air-eligible export industries even in the face of major nationwide employment declines. The city's relative service decline reflects its decline as a necessary intermediate stop, its limited capacity for expansion as compared with many cities that had little or no service in 1980, and its proximity to other overseas service gateways in the Northeast.

CASE STUDY SELECTION

Aggregate analysis of so many U.S. metropolitan regions provides a broad picture of large-scale trends and geographic patterns in the competitive international air cargo service environment. However, the nationwide view cannot provide in-depth examples of how individual cities influence where they each fall in the dynamic hierarchy of overseas cargo markets. Locally-specific historical, economic, and political factors contribute, as do geographic situation and industry structure. To shed light on these influences, we select one metropolitan region to examine more closely from each of the four major market categories described above and shown in Table 5.1 (the four matrix corner categories that show extreme improvements, declines, and mismatches). We choose the case study cities to reflect diverse geographic and industry situations and other unique local features.

Portland represents the small group of metropolitan regions whose positions improved within both the service and target industry employment hierarchies. The city's employment rank jumped from 40th to 17th, and its seemingly modest improvement from 20th to 17th in terms of overseas flights hides the fact that the city went from no nonstop overseas service to 20 flights per week. Portland is the only city to be selected from the West Coast's several strong markets. It is neither a major passenger nor cargo airline hub, but Delta now uses the relatively uncongested international airport as its gateway to Asia.

Among those cities whose ranks in both service and employment declined between 1980 and the mid-1990s, we identify St. Louis as an example because of its size, location near the

geographic center of the continental United States, and long-standing role as TWA's headquarters. Besides Honolulu, St. Louis was the only city in this category to have nonstop overseas flights in both 1980 and 1995. Honolulu is naturally a much more significant overseas service center than St. Louis because of the tourism industry and cargo dependency afforded by its location.

St. Louis and the Twin Cities of Minneapolis-St. Paul are often compared because of their sizes, locations in the center of the continent rather than on the coast, and pricing structures as major domestic airline hubs. Unlike St. Louis, however, Minneapolis-St. Paul's airborne export-producing employment standing rose between 1980 and 1994. For these reasons we select the Twin Cities metropolitan region to examine from among those cities whose employment ranks improved but service ranks declined; it is one of the markets where there seems to be room for cargo growth to support the strong local sector that produces air-eligible exports.

Only three cities comprise the category of metropolitan regions whose service rank improved but employment rank slipped. The Washington-Baltimore metropolitan region is a suitable fourth case study because it improves this study's geographic scope and exemplifies the trends within multi-international airport metropolitan regions. It is on the East Coast but is not one of the traditional major gateways, has three airports (two with international service), and is not any carrier's primary domestic hub. Southwest and USAirways dominate Baltimore-Washington International, but neither operates overseas service from this facility (if at all). Dulles International Airport's many United flights pale in comparison to the carrier's international service at Chicago and Miami. The Washington-Baltimore metropolitan region's role as home to the nation's capital heavily influences the local demand for international air service, illustrating the importance of locally-specific qualitative characteristics in shaping air service markets.

CONCLUSIONS

Nine categories of the rank-based classification outlined in this chapter reflect varying combinations of supply and demand market strengths and weaknesses at metropolitan regions across the United States. Such a breakdown of the overseas cargo supply and demand market provides a general sketch of which U.S. metropolitan regions have the most promising, stable, and discouraging overseas cargo service environments. The healthiest markets seem to be non-

traditional gateways like Portland and Atlanta, while the weakest seem to be smaller markets where cargo service has been too long or heavily dependent on passenger traffic.

The most interesting categories reveal mismatches between supply and demand at certain markets. Washington-Baltimore, Cincinnati, and Chicago emerge as important passenger and cargo transit points rather than major airborne export origins. Conversely, cities like Charlotte, Raleigh-Durham, and Minneapolis-St. Paul may lack as much overseas air cargo service as their strong high-tech exporting industries could utilize if carriers made it available. Four case study investigations summarized in the next chapter examine local economic, historical, and political factors that contribute to overseas cargo service climates at Portland, St. Louis, Washington-Baltimore, and Minneapolis-St. Paul.

CHAPTER SIX

FACTORS INFLUENCING LOCAL MARKETS: EXAMPLES FROM FOUR METROPOLITAN REGIONS

The aggregate supply and demand analyses in the preceding chapters make clear the diversity of air cargo service and airborne export industry employment combinations among U.S. metropolitan regions. Comparison of air cargo service supply and demand indicators reveals a hierarchy of U.S. cities, but only allows cursory examination of the geographic, industry, and political forces that shape each metropolitan region's need for and access to overseas air cargo service. From the previous chapter's classification based on shifts in service supply and demand dominance between 1980 and the mid-1990s, we identified four cities to examine more closely in order to highlight some of the unique forces at work in individual locations. The varying air cargo service supply and demand profiles of Portland, St. Louis, Washington-Baltimore, and Minneapolis-St. Paul discussed below provide local-level insight into relationships between cities and the world economy.

PORTLAND

Portland is one of four metropolitan regions whose relative standing in both service supply and demand improved between 1980 and the mid-1990s. With no nonstop or direct overseas service and an airborne export-producing industry rank of 40 out of 64 metropolitan regions in 1980, the city arguably had nowhere to go but up. Portland's emergence on the overseas air cargo service map was particularly remarkable, however, due to its new role as Pacific gateway for a major U.S. combination carrier: Delta Air Lines. The city can serve as an example for other mid-sized cities that have traditionally lacked overseas service, but is also an illustration of serendipity.

Portland lies approximately 65 miles from the Pacific Ocean at the entrance of the Willamette River into the Columbia River. Its role as an international and domestic port dates from the mid-nineteenth century, when it was selected as the West Coast departure point for the first U.S. mail steamer service to Asia. The first of three transcontinental railroads to reach Portland arrived in 1883, further establishing the city as a transportation center. World War II

helped Portland develop as a ship-building and manufacturing center. Portland has a long association with high-tech industries. Major industries today include electronics, computers, and aircraft and electronics parts—examples of air-eligible products cited earlier in this study [41].

The growth of high-tech industries and air service to Asia have gone hand in hand at Portland since the late 1980s. By the mid 1990s, Portland enjoyed four nonstop routes and one one-stop mixed-cargo route to Asia, and a direct route to Frankfurt. (Appendix K lists details of each case study metropolitan region's 1980 and 1995 overseas air cargo service.) All eight airborne export-producing industry groups identified in this study experienced employment growth in the Portland metropolitan region, despite a nationwide net decline in these sectors combined. Job growth in the computer and office equipment, electronic components and accessories, and measuring and controlling devices groups more then trebled; these industries produce high-value, lightweight goods ideal for shipment by air (Figure 6.1). Portland's geographic situation at the edge of the economically dynamic Pacific Rim, success at cultivating a positive environment for high-tech industries that tend to ship by air, excess capacity and freedom from stifling incumbent carrier dominance, and assertive airport leadership all contributed to its emergence as a strong overseas air cargo service market.

The Edge of the Pacific Rim

Two facets of Portland's geographic situation contribute to its place within the overseas air cargo service system and its role as an airborne export distribution point: its proximity to burgeoning Asian markets, and its location vis-à-vis other U.S. mainland and West Coast population centers. Additionally, developments in aircraft technology and bilateral agreement structures during the study period disproportionately benefited Portland because of the city's geographic situation. Portland International Airport was able to benefit from being in the right place at the right time to capitalize on new opportunities.

Portland is naturally oriented towards the Pacific Rim since most of the continental United States lies between Portland and more traditionally strong American trading partners in Europe and Latin America. Fewer intervening opportunities lie between Portland and Asia than any other world region beyond North America, thereby focusing the city's international economic ties across the Pacific. During the period of strong economic growth in Japan and Asia's newly

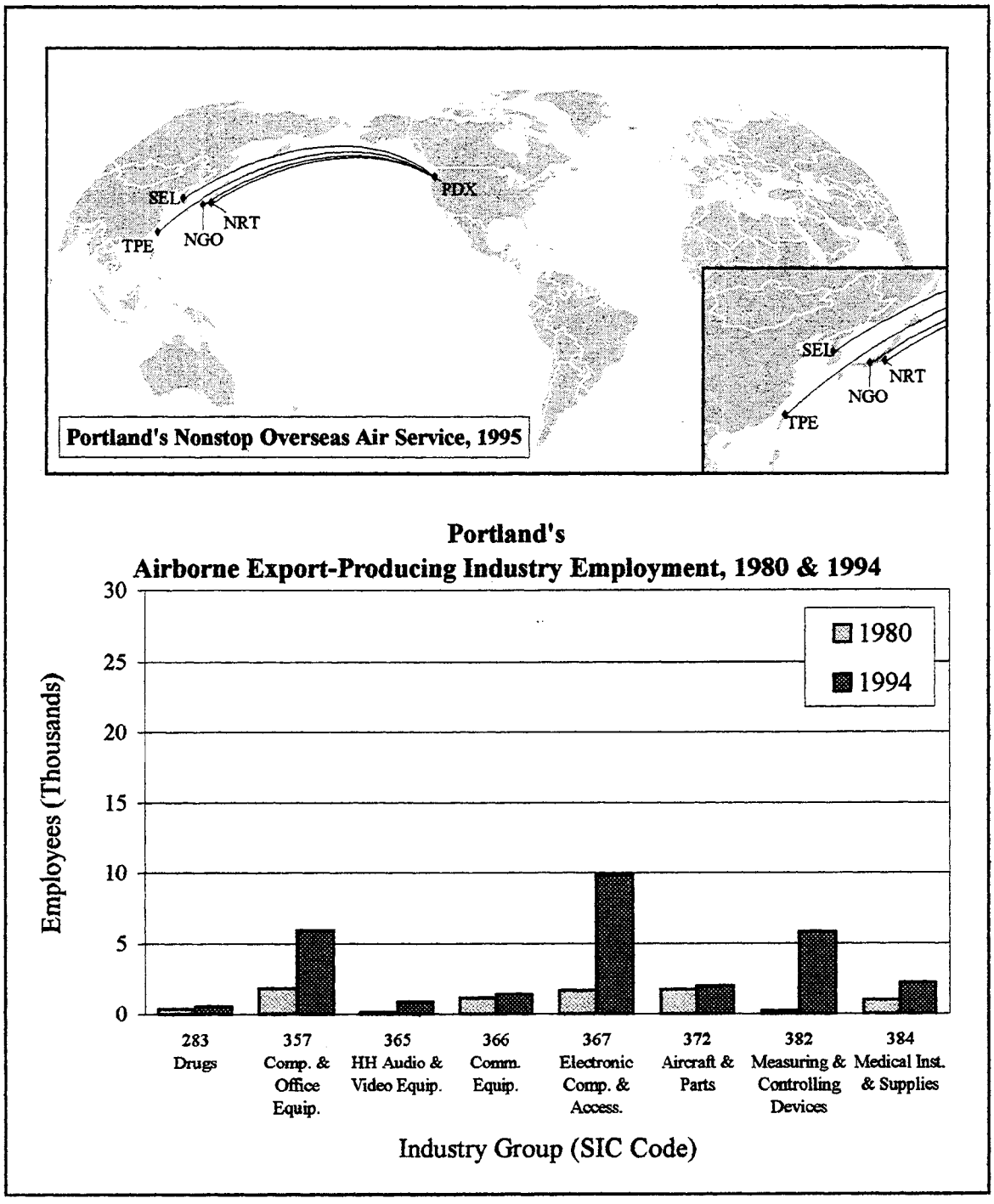


Figure 6.1. Portland's Nonstop Service and Target Industry Employment Growth. Portland's orientation towards Asia is clear from its 1995 service map. All eight economic sectors examined in this study experienced growth, despite nationwide declines during the period. SOURCE: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; and U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.

developing countries (NICs) during the 1980s and early 1990s, East Asia was arguably the best world region with which to be doing business.

Other cities along the West Coast share Portland's Asian orientation, but none showed the dramatic service increases enjoyed by Oregon's capital. Growth at Los Angeles, San Francisco, and Seattle, all larger local markets than Portland, was not as dramatic as Portland's because trans-Pacific service existed there in 1980. Portland had three advantages: underused airport facilities that could accommodate trans-Pacific service, excellent highway access via U.S. Interstate 5 to Seattle and San Francisco, and a lack of a single dominant carrier in the market. The sheer size of the total and immigrant populations at traditional West Coast gateways made them more logical choices for expanded Asian service to airlines faced with maximizing profit from government-limited route authorities, but it also meant that the L.A., San Francisco, and Seattle airports were busier and their markets were already carved up by incumbent carriers.

Nonstop air service between Asia and the mainland United States was, and remains to a lesser extent, limited by aircraft technology and restrictive bilateral agreements. Only the Boeing 747 could fly nonstop across the Pacific in 1980. By 1995, however, MD-11s and DC-10s could also handle trans-Pacific ranges. Fifteen years of long-range aircraft production increased the number of airlines with equipment able to fly between North America and Asia. Capacity, frequency, and routes across the Pacific remained tightly controlled by bilateral agreements designed to protect Asian flag carrier profitability, but service expansion was allowed where strong demand ensured that non-U.S. carriers could survive. Growth in service to Tokyo during the study period reflects limited bilateral agreement liberalization: eight U.S. mainland cities (including Portland) gained new nonstop service by 1995, bringing the total number of U.S.-Tokyo gateways to thirteen. (1980 U.S. mainland gateways to Tokyo were Seattle, San Francisco, Los Angeles, Chicago, and New York. In 1995, Portland, San Jose, Minneapolis, Detroit, Newark, Washington, Dallas, and Atlanta also had nonstop service.) The constrained service prior to 1980, ironically, benefited Portland because it had room to grow when the Asian market "took off," an effect heightened by the inability of Portland's regional competitors to expand at the same rate.

High-Tech Businesses on the Ground Fill Aircraft Aloft

Portland's economy, irrespective of air service, is strong. The city gained a reputation as a survivor of the 1982 recession that hit the Pacific Northwest particularly hard because of the dependency on lumber-related industries [42]. The full extent of the local economy's need for and use of international cargo service is difficult to determine, but it is clear that Portland's business ties to Asia have benefited greatly from the city's nonstop service.

Assessing how much volume and value produced within the Portland metropolitan area is then exported is virtually impossible, since the domestic movement of goods is not traced. Portland, like many other mid-sized metropolitan areas, claims that more local demand exists for nonstop cargo airlift to foreign destinations than is evident from airport statistics—though in Portland's case the numbers are quite striking: the value of air exports shipped from Portland to Japan rose from $225 million in 1987 to $510 million in 1996 [43]. That figure does not include Oregon-originating exports that are shipped out of other West Coast airports: the same excellent highway system that brings goods into PDX to fill Delta's aircraft bellies also carries exports north to Seattle-Tacoma International Airport and south to San Francisco for departure on overseas all-cargo and mixed-cargo service available there.

The Port of Portland, owner and manager of Portland International Airport, has much to boast about, however. Sixty Japanese firms have operations in Oregon today, and more than 25 of them located in Portland since Delta began its nonstop service. These firms together have made capital investments in Oregon and southwest Washington of more than $1 billion and created more than 7,000 jobs, according to the Port. Investment, employment, and export activities tied to air service all showed remarkable growth throughout the late 1980s and early 1990s, despite hard economic times elsewhere throughout the nation [42]. Japanese manufacturers Toshiba and Matsushita Electric Works are among those high-tech firms that have chosen the Portland area for new plant sites, and both cite direct air service to headquarters as a decisive factor.

But foreign companies factor many other considerations into their location decisions for new facilities in the United States, and Portland does well by many accounts. Multiple levels of government offer incentives for new businesses. Relatively cheap land and a well-trained labor force also attract foreign and domestic investment in the Portland area [42]. The metropolitan

area is renowned for its livability due to successful limitations to suburban sprawl, effective public transit systems, beautiful natural environment, and moderate climate. These benefits alone have made Portland a haven for high-tech firms that seek to keep their highly-trained professionals loyal to the company by locating where their employees will want to continue living. Without direct air service, however, the Portland area might not be economically feasible for Japanese firms to reach from their headquarters at home.

Who Needs a Major Hub?

No major U.S. carrier has its hub in Portland, and that works out quite well for the coastal city. There is no bully, no 800-pound gorilla scaring away potential service providers. Delta's international cargo service to Asia is augmented by single-plane service by Korean Air Lines, good domestic cargo service by a plethora of providers, and occasional nonstop international cargo charters [44]. Federal Express offered the first nonstop cargo service from Portland in the 1970s, but dropped it once the carrier bought out the Flying Tiger Line and did not need the Portland small package route authority. It was Delta Air Lines that put Portland on the international service map.

Delta's role as Portland's gateway service provider began with a route award granted to the Atlanta-based carrier by the U.S. Department of Transportation in 1986. In addition to American's first nonstop route from Dallas to Tokyo, Delta's proposed one-stop service from Atlanta via Portland to Tokyo met USDOT's goal of expanding access to Asia from underserved parts of the country: the South and nontraditional West Coast gateways [45]. Portland fit easily into Delta's plans because of its location along the great circle route between Atlanta and Tokyo: again, the city was in the right place at the right time.

Service to Tokyo gave Portland valuable new access to Asia. Delta became the third U.S. carrier to serve Japan from the Pacific Northwest thanks to the creation of two new passenger route authorities created by a new memorandum of understanding (MOU) reached by the U.S. and Japanese governments in the previous year (Silk Route authorities refer to eastbound service from Frankfurt to Eastern Europe, Istanbul, Bombay, and New Delhi) [46]. Delta followed United into the trans-Pacific market one year after the Chicago-based carrier took over Pan Am's historic Asian route; Northwest, United, and Delta were then the only three passenger carriers

serving Tokyo [47]. Delta's 1986 move into the Pacific was one of the carrier's first forays into international service, and found the West Coast and Pacific routes to be relatively clean slates upon which it and other U.S. carriers with new international ambitions could attempt to organize traffic. U.S. carrier service to Europe and Latin America went almost exclusively through New York and Miami, in part because most regulated domestic carriers had always sought to serve these East Coast cities and could therefore connect with Pan Am or foreign interline service internationally. No corresponding single gateway existed on the West Coast for trans-Pacific traffic, helping Portland's attractiveness vis-à-vis more populous West Coast cities. For decades Pan Am had operated the majority of U.S. carrier-authorized service to and from the United States while relying on other U.S. carriers to deliver passengers to gateways for international carriage on Pan Am. Conversely, other U.S. carriers had filled in domestic route maps and relied on Pan Am beyond the U.S. border. The longest-standing exception was Northwest Orient's (later Northwest's) early authority to serve Asia. Later, TWA and Braniff became the exceptions into London's Heathrow Airport and Latin American markets.

Like United, Eastern, Braniff, Continental, and others, Delta began acquiring and organizing new international routes around its domestic system. Atlanta, Cincinnati, and Dallas were the carrier's three strongest hubs in 1985, and Portland was a logical geographic solution for an accessible, uncongested gateway through which to funnel trans-Pacific traffic. When Delta began to develop Salt Lake City as a major regional hub after merging with Western Airlines in the late 1980s, its traffic also fed smoothly into Delta's Asia service over Portland. The multiple stops and/or plane changes required of most Delta passengers bound for Asia, however, mean that the Portland gateway may become an unaffordable liability if new, competing service becomes available on trans-Pacific routes. Delta's service to Asia from most U.S. origins is inferior to the nonstop service offered by American, Northwest, and United from their largest domestic hubs, potentially jeopardizing Portland's service in the long run.

Delta provides all nonstop scheduled international service available at Portland, but it does not exert the same dominance over all air service activities held by other incumbent gateway service providers operating international service from their domestic hubs. It also lacks the nonstop behind-gateway feed at Portland that other carriers can rely upon to fill international flights from their hubs. ("Behind gateway feed" refers to the non-local traffic that carriers bring

into their hubs to connect with nonstop international flights. Many cities with hub activities are too small to provide enough passengers for carriers to profit from operating the high-capacity aircraft needed for long international ranges, but the flow traffic from other cities in the dominant carrier's network augment local traffic). Delta has invested in its own new cargo facilities at the airport and structured aircraft purchases around plans for the Portland-Pacific routes in the past five years, demonstrating commitment to serving the Portland community [48]. However, other carriers also have strong footholds at PDX. Burlington Air Express and UPS have major sort facilities, occupying much of the $4 million, 60,000-sq.-ft. cargo facility build by Houston developers on the airport grounds in 1991. More than half the airlines serving Portland are all-cargo carriers, and Delta must work with them and/or forwarders and brokers to maximize their cargo lift to Asia.

On the passenger side, United Airlines' affiliate Westair and Alaska Airlines both operate substantial regional services at Portland, and both outranked Delta in terms of total passengers handled at PDX in 1996 [43]. Service for Delta's East Coast passengers bound for Asia would be swifter if a nonstop online flight were available from the carrier's Atlanta hub, but such service is not currently available on Delta. Japan Air Lines serves Tokyo nonstop from Atlanta, but the air distance of over 7,500 miles cannot be covered nonstop by any aircraft currently in Delta's fleet. If Delta acquires aircraft capable of bypassing Portland or gains new competition on trans-Pacific routes due to changes in the U.S.-Japanese bilateral air service agreement, Portland's position in Delta's international route structure and as an international gateway may be threatened. For now, however, Delta seems more rather than less interested in staying at Portland, undaunted by its position as one of three strong passenger carriers. The airline's September 1997 announcement of its intent to seek additional nonstop service to Japan (Osaka and Fukuoka) under the anticipated new bilateral air service agreement with Japan seems to indicate Delta's confidence in the local market and a strong role for Portland in Delta's long-term international service plans.

An Assertive Airport Authority Goes After Business

One local advantage that surely increases Delta's conviction of Portland's viability as a base for its trans-Pacific service is the foresight and effectiveness of the Port of Portland. The Port manages all airport and seaport facilities for domestic and international trade in and out of

the Portland metropolitan area. A public agency, it was well ahead of its time in appreciating and acting upon the need for local communities to seek out (1) carriers to serve their airport after domestic airline deregulation, and (2) customers to use the service. The Port's continuous efforts to define and redefine the airport's niche, fill that niche with loyal customers with a stake in the local community, and plan for the future have been critical elements to PDX's success as an international cargo gateway.

Without a home-based carrier to either depend on, cater to, or protect, the Port of Portland has been able to court a wide range of carriers. United, Federal Express, Delta, and Korean have all originated international service from Portland, and Lufthansa expressed strong interest in doing so as well. The Port is described as "pursuing" carriers—and its track record at securing international service for its relatively small city indicates that it does not let its targets escape easily [48]. It is wise about who it targets for prospective service, and supportive of incumbent carrier operations through international route application support and infrastructure planning. The Port filed numerous documents in support of Delta's successive applications for additional Asian service, and also for Korean Air Lines' addition of Portland on its Los Angeles-Seoul freighter service. The benefits of such efforts to attract new service may seem self-evident, but not all airport authorities are willing to take such steps.

Beyond merely bringing in new carriers, the Port of Portland also takes a variety of steps to help the carriers succeed once there. To facilitate trade with the Asian countries Delta serves or may someday serve from Portland, the Port maintains offices in Tokyo, Seoul, Hong Kong, Taipei, and Shanghai. Clever advertisements for the Portland airport, its cargo facilities, and its service opportunities appear regularly in *Air Cargo World* and *Traffic World*, two trade journals whose readership is made up largely of air freight forwarders and brokers. The former journal regularly runs articles based on airport surveys describing cargo traffic and facility profiles among different U.S. regions; many airports do not respond to these surveys at all. Portland, on the other hand, has always responded and is often highlighted as a success story. Surprisingly few airport authorities or commissions around the U.S. make these simple efforts to stay visible, promote themselves and attract service.

Finally, the Port of Portland keeps up with its larger West Coast competitors by constantly improving its facilities and emphasizing its available capacity. PDX is free of many local issues

that plague other U.S. airports such as noise, inclement weather, and lack of available land for expansion around the current facility. The airport is surrounded by four golf courses—neighbors that do not mind the noise and act as buffers for the closest residences. In the early 1990s, the airport received another large tract of land from the Air National Guard, further increasing its land holdings. Two master plans addressing passenger and cargo/maintenance development respectively have guided the Port's facility improvements since the mid-1980s.

Conclusion: Serendipity and Aggressive Marketing

Portland's classification in this study as one of the strongest overseas air cargo service markets in the United States is well-deserved. During the 1980s and early 1990s, the local economy was outperforming the nation, and the Port of Portland capitalized on the city's economic health, proximity to Asia, lack of congestion, and freedom from single-carrier dominance. But how much did serendipity account for Portland's success story during the study period? Given aircraft range limitations, trans-Pacific route controls, and the underdeveloped route networks in the western United States in the mid-1980s, Portland was able to establish an industry niche for itself that fit the times. A strong local economy, specializing in the high-tech products that boomed in the early 1990s and which are commonly shipped by air, helped Portland take advantage of its serendipitous advantages. Equally important, however, was the Port of Portland's early foresight and continuing role in identifying and redefining carriers and customers well-suited to Portland's International Airport—the best indication that this air cargo service market will continue to thrive as the industry environment changes around it.

ST. LOUIS

The converse of the study period success story is St. Louis. With twice the population of the Portland metropolitan area in 1990, one would have expected St. Louis to have a stronger industrial base to support international cargo service than it actually had. In fact, St. Louis dropped in both supply and demand rankings — six and one places, respectively — during the study period. The metropolitan region lost slightly more than 6,000 target industry jobs (roughly twenty percent) and gained a mere six new overseas flight frequencies (bringing its total to ten per week) during this time (Figure 6.2).

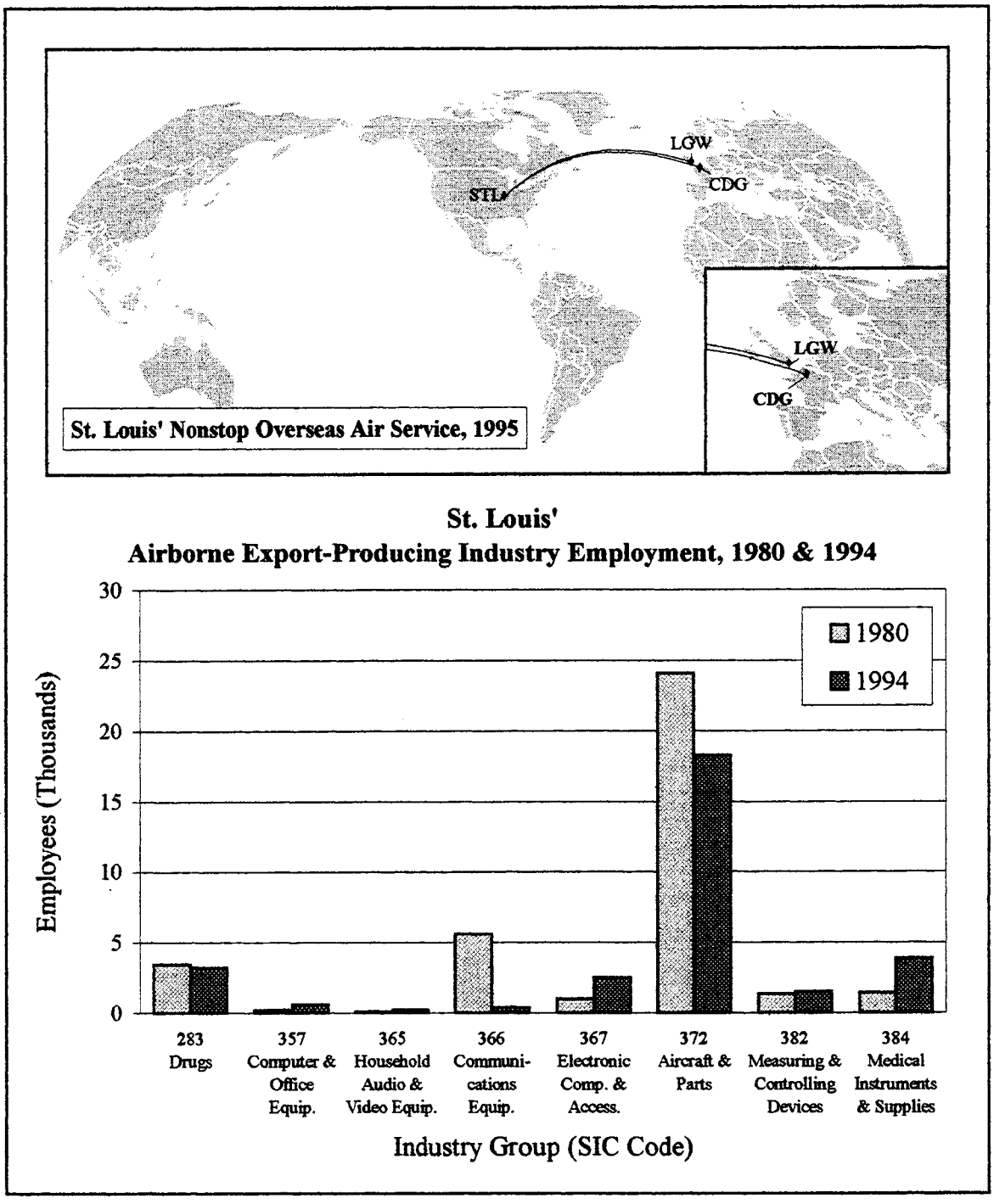


Figure 6.2. St. Louis' Nonstop Service and Target Industry Employment Growth. St. Louis' overseas route map is quite sparse, with service in 1995 to only two European destinations and none elsewhere. Although St. Louis has higher levels of employment in most target industries than Portland, two sectors showed marked declines during the period (Aircraft & Parts and Communications Equipment). SOURCE: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; and U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.

Declines in St. Louis' overseas cargo service supply and demand rankings reflect strengths elsewhere in the United States as much as failings at home. Still, St. Louis was dealt a tough hand: it suffered from a location deep in the U.S. interior, ringed by stronger regional hub competitors, and was trapped in a marriage with an ailing carrier (TWA) at an airport surrounded by neighbors determined to thwart its expansion. Despite these liabilities, the outlook for St. Louis had improved by the mid-1990s. The city's pragmatic airport authority has been working hard to take advantage of TWA's revitalization (the airline emerged from bankruptcy in 1994) and, indeed, its own disadvantages, to sell itself as a low-cost alternative to cities that enjoyed better track records in the 1980s.

Surrounded by Stronger Gateways and Far from the Border

St. Louis' location solidly in the interior of the U.S. mainland does not make the city an obvious choice for international air service. Indeed, the city's peak geographic advantage dates from the steamboat era, when its location on the edge of the U.S. frontier made it the premier population center west of the Appalachians and north of New Orleans. However, the rise of the railroads and the emergence of Chicago as the major East-West rail center later in the century firmly placed the Windy City at the top of the regional hierarchy. St. Louis has been on the losing side of the two cities' rivalry ever since, in terms of economic power and transportation access.

Today, St. Louis' Lambert International Airport faces similar competition with other airline hub cities that surround it. Catchment areas for Memphis and Chicago in particular encroach on St. Louis' service area for local origin-and-destination traffic. Dallas, to the southwest, and Atlanta, to the southeast, both have international service levels superior to that of St. Louis. Far from its days of prominence as a Mississippi River port and the last sizable town on the westward National Road, St. Louis now faces vulnerability as a "spoke" destination for American, United, Delta and (to a lesser extent) Northwest behind their international service out of Dallas/Chicago, Chicago/Washington, Atlanta, and Minneapolis-St. Paul/Detroit, respectively. Likewise, the strength of Federal Express' international all-cargo service from Memphis and the cargo carriers based along Interstate 70 to the east further weaken St. Louis' potential as an international cargo center.

True, St. Louis enjoys excellent interstate highway access at the junction of Routes 70, 40, 55, and 64. As with Portland's location along I-5 between San Francisco and Seattle, however, the roads go both ways: passengers, and especially cargo, can flow out of St. Louis and Portland to other stronger international gateways just as easily as in to fill the smaller number of flights available at these secondary hubs. And unlike Portland, St. Louis' local economic health was not strong enough to attract a new international carrier and new business to Lambert during the study period, but remained wedded to the fate of TWA.

International Business Ties Don't Always Mean Cargo Business

St. Louis' subservient economic role within the Midwest is of little help in overcoming its geographic disadvantage with regard to air cargo service. Indeed, the target industry in which St. Louis had the highest employment in 1980, Aircraft and Parts (SIC 372), suffered a blow during the study period. Struggling TWA, the hub carrier at St. Louis, did not order new equipment in the 1980s when other carriers that survived deregulation were improving their fleets. Now-defunct McDonnell Douglas chose to further emphasize its operations at Long Beach where weather constraints were minimal, instead of at St. Louis; TWA's importance as a client had shrunk to the point that keeping major McDonnell Douglas operations in St. Louis was not worth the difficulties caused by weather during St. Louis winters.

St. Louis has never been known as a major high-tech industrial center or international transportation gateway. Historically, its major manufacturing activities were related to the mining industry—not a frequent consumer of international air cargo services. However, the city has enough of a population base to have an inertia of its own, and has risen out of the recession of the early 1990s in good standing. For example, local authorities point out that St. Louis is now ranked sixth nationwide according to its number of *Fortune* 100 company headquarters, eighth in terms of *Fortune* 500 headquarters, and among the top ten U.S. cities for international companies [49]. St. Louis industries are not noted anywhere in air cargo trade literature as strong customers for either domestic or international air service, however, indicating that whatever cargo needs exist among the metropolitan region's target industries are already being met.

Home-Based Carrier Blues

St. Louis' Lambert Field has been dominated historically by two airline tenants. TWA and Ozark Airlines both had strong operations in St. Louis before and immediately following deregulation, and TWA continued to utilize Lambert as a major domestic hub along with New York's JFK as its primary international gateway after absorbing Ozark in 1986.

For decades, St. Louis' air service fortune unquestionably has been tied to the health of TWA, the only carrier that has provided nonstop overseas service from the city. Western Air Express, the carrier's predecessor, operated the first air mail service between St. Louis and Chicago when initial air routes were handed out by the U.S. Post Office. TWA was an early leader over the Atlantic as well, operating its first international service with a Lockheed Constellation on the New York-Gander-Shannon-Paris route in February, 1946. One year later, the carrier inaugurated the first-ever direct all-cargo service over the Atlantic. Although it only operated London Gatwick nonstop service four times a week in 1980, the carrier fed traffic from St. Louis to New York for its transatlantic service and thereby limited the city's nonstop overseas access. TWA was still one of the four major U.S. carriers at the time, and enjoyed more route authorities to Europe than any U.S. carrier other than Pan Am [50]. (In 1980, immediately following deregulation, the Big Four in the U.S. airline industry were: United, American, TWA, and Eastern. Pan Am, having just acquired National Airlines to provide its network of international routes with domestic feed, was close behind.) St. Louis was among the earliest interior gateways other than Chicago to enjoy nonstop overseas service, thanks to TWA's strength. However, TWA squandered its early lead among U.S. carriers in European service.

Lambert International Airport's director characterizes the airport and city's relationship with the airline as a "marriage," and marriages are meant to last through good and bad times [51]. Able to survive quite nicely as one of the protected grandfathers of the U.S. airline industry under Civil Aeronautics Board regulation, TWA struggled in the new competitive environment of the 1980s. The acquisition of its strongest competitor at St. Louis, Ozark, was one attempt to stay strong. The carrier also put off purchasing expensive new aircraft while other carriers were expanding their fleets in the 1980s, until TWA was left with the oldest, least-efficient fleet in the industry. By 1991, a cash shortage led the carrier, through the avarice of Carl Icahn, to sell its Heathrow route authorities from Los Angeles, Chicago, Boston, and New York to American

Airlines for $445 million [52]. TWA then filed for bankruptcy within a year. Throughout this tumultuous period in the carrier's history, other carriers' were establishing international service as quickly as possible at their hub cities, leaving St. Louis to lose its early edge over its regional competitors.

Airport Leadership and Support beyond the Airport

The airport director, Colonel Leonard Griggs, Jr., and his staff have not sat quietly by as the airline industry has spun on around Lambert St. Louis International Airport. Rather, airport management has moved decisively with a series of airport improvement plans since the 1977 FAA decision to keep the existing airport just twenty minutes west of downtown instead of building a new facility to serve the metropolitan region farther away from the city in Illinois. In the mid-1980s, the city launched a five-year, $248 million airfield and terminal expansion to accommodate the initial rise in traffic after deregulation [53]. Later, it helped fund a subway link between the airport and downtown St. Louis. By the mid-1990s, another expansion proposal with a price tag of $1.8 billion was on its way to approval. Director Griggs is very pragmatic and outspoken about the airport's relation to the carrier, but also stresses the airport's more important tie: to the fortunes of St. Louis. He emphasizes that the airport's emergence as one of the fastest growing in the world (in terms of passenger traffic) is tied to the national economic recovery, TWA's improved situation, and the build-up of Southwest Airlines' presence at the airport [51]. To Director Griggs, the goal of all improvements must be to maximize the economic benefits of the facility for St. Louis—and the 1996 expansion plan will improve its tenants' ability to do business there and thus keep the air service and jobs in St. Louis.

Expansion plans have been hampered by the not-in-my-backyard attitudes of St. Louis' surrounding communities. Although the proposal calls for home buy-out programs and noise-proofing features, homeowners in the suburbs near the airport have opposed the effort. As a result, no decision on whether or not to move forward with the improvements had been reached nearly two years after the approval process began in 1995.

Nowhere in the industry press surrounding expansion efforts in the 1980s or 1990s have cargo facilities been featured prominently. Emphasis now lies on meeting the needs of TWA and Southwest Airlines for their flow traffic, with the understanding that the enhanced service the city

enjoys by being a connection facility is itself an economic benefit. Additionally, the airport has worked to support new international service by supporting TWA's applications for first Paris (expanded authority granted in 1995) and more recently Tokyo/Osaka (filed in 1996, decision pending increased route authorities awarded to U.S. carriers after 1997 negotiations). Director Griggs asserts that the airport will support the efforts of any carrier, incumbent or new, wishing to serve St. Louis [51].

The airport authority, which is tied to the city rather than a regional or state government, has been assertive about gathering support for new service from beyond the local community. A national coalition for a more competitive environment for U.S.-Japan air service, ACCESS U.S.-Japan, was formed in the early 1990s to garner widespread support for a liberalized air service agreement with Japan from within and beyond the aviation industry. Since a new route between St. Louis and Japan would increase the one-stop service options from much of the southeastern United States and give nonstop action to a market of over 2.5 million people, St. Louis was an appropriate cause for the broad-based group to take up. In 1996, the coalition director filed jointly with leaders of St. Louis and Griggs in support of TWA's Japan application, a clear sign the St. Louis community leaders are being assertive about pitching their city and its facilities.

Conclusion: An Improving Outlook

The fact remains that TWA is not the powerhouse it once was, ranking only seventh among major U.S. carriers by the mid-1990s. However, the carrier has come a long way since its financial reorganization after emerging from bankruptcy. New aircraft, new leadership, and international service reorganization all combine to make the carrier more likely to be able to improve overseas service at St. Louis. With Memphis, Chicago, and the cargo service centers reachable from St. Louis eastward along Interstate 70, however, St. Louis is not likely ever to attract nonstop all-cargo service. Given the geographic and industrial hand the city has been dealt, the airport authority seems to have appropriate ambitions for facilities development. As for local passenger service at Lambert, the strength of Southwest Airlines, itself an increasingly important presence in the domestic industry, has the benefit of keeping the larger carrier competitive on costs and fares—important tangible benefits to the flying public. Due to the dim

prognosis for cargo, the Lambert leadership is wise to pin its hopes on meeting the passenger traffic needs of its major tenant carriers.

WASHINGTON-BALTIMORE

The study period situations of the remaining two case studies were more complex than those of Portland and St. Louis. Both the Washington-Baltimore and Minneapolis-St. Paul cases analyzed below reveal mismatches between changes in the cities' air cargo service supply and demand standings. Washington-Baltimore's service supply and demand mix represents a larger and more complex market than that of Minneapolis-St. Paul. The Washington-Baltimore region's air service market, like so many aspects of the region's economy, is heavily influenced by federal government operations and political interests as well as the competing agendas of multiple local jurisdictions.

The Washington-Baltimore market enjoyed five-fold growth in total overseas flights (from 21 to 133 weekly departures), and gained 19 new overseas destinations (26 in 1995 up from 7 in 1980) (Figure 6.3). Cargo growth at Dulles International Airport in suburban Virginia averaged 17 percent annually between 1983 and 1992—a reflection of the airport's low starting point as well as its stupendous improvement. The region received its first freighter service in 1993 with Air France's short-lived all-cargo service between Dulles and Paris [54]. Overall, the metropolitan region's overseas cargo service rank jumped five places to eighth in 1995, the greatest rank improvement among the U.S. metropolitan regions examined in this study.

But Washington-Baltimore did not fare as well in airborne export-producing industry employment during the same period. The region lost over 25,000 target industry jobs, slipping from 11th to 20th in the nation. The 33 cities and counties spanning Maryland, Virginia, West Virginia, and the District of Columbia itself were hit especially hard by automation and reorganization in the telecommunications industry in the early 1980s, as evidenced by the net decline of 80 percent in the Communications Equipment sector (a loss of an estimated 24,000 jobs in that sector alone).

The complexity of the Washington-Baltimore case is borne of the region's multiple airports and airport governance structures in addition to its numerous jurisdictions and sheer size (over seven million people in 1995, or slightly less than the other three case study regions'

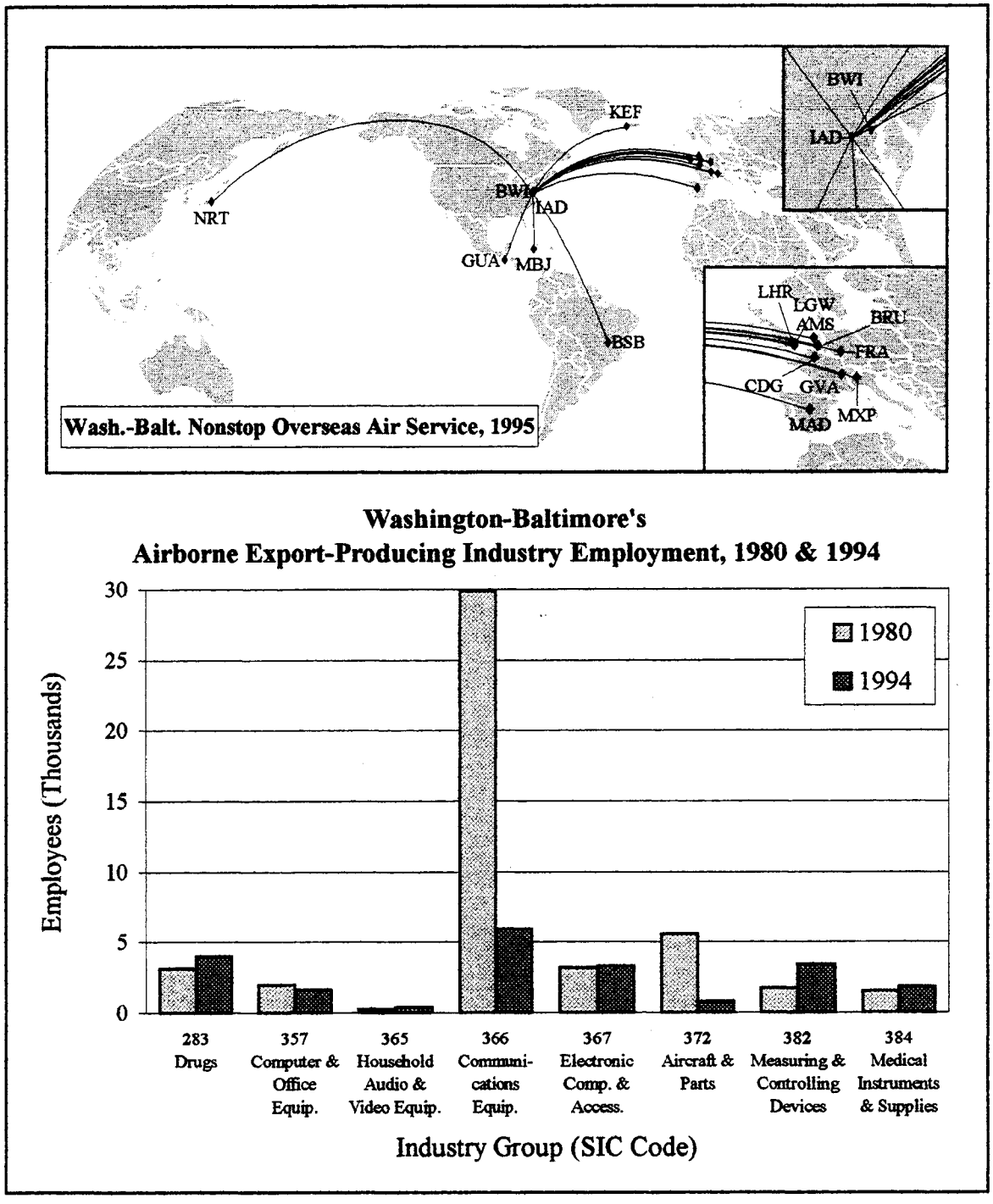


Figure 6.3. Washington-Baltimore's Nonstop Service and Target Industry Employment Growth. Washington's Dulles International Airport (IAD) gained over one hundred new weekly nonstop overseas flights by 1995, and Baltimore's BWI enjoyed modest overseas service expansion as well. The Washington-Baltimore metropolitan region is nearly three times the size of Portland, yet employment in its airborne export-producing industry sectors had shrunk to a similar size as Portland's rapidly expanding workforce in 1995. SOURCES: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; and U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.

populations combined). Three major airports serve the region: Baltimore Washington International Airport (BWI), Dulles International Airport (Dulles), and National Airport (National). Both BWI and Dulles can and do sustain overseas service, but National is relegated to routes under 1,250 miles in length both by law and by facilities constraints. Four principal factors combine to influence the disparity between the Washington-Baltimore region's strong service and weak cargo production standings: (1) local competition for service and geographic situation vis-à-vis other well-served cities on the eastern seaboard; (2) primary role as a government rather than manufacturing center; (3) importance as an international destination without the burden of hub activity; and (4) myriad political and service interests and authorities combined to influence the disparity between Washington's strong service and weak cargo production standings.

Competition within the Market, Competition with Other Markets

Service distribution within the metropolitan region is an issue in the Washington-Baltimore case study because of competing international airports (BWI and Dulles) and the availability of a third, more convenient airport (National) with good connections to other gateways. (Other metropolitan regions with multiple international airports include Miami, New York, and San Francisco.) National cannot be ignored because of its superior access from downtown Washington and special status as the closely monitored pet of members of the U.S. Congress. Frequent flights available on multiple carriers to the New York area's international airports, as well as to Atlanta, Miami, Boston, Detroit, and Chicago make National a viable alternative for passengers wedded to particular carriers and their frequent flier programs and/or resistant to spending the extra time on the ground needed to reach Dulles or BWI from downtown Washington.

National Airport dates from the early 1940s and is located just across the Potomac River from downtown Washington in Arlington, Virginia. Metrorail access to the airport has been in place since the subway's construction in the 1970s and recently received a boost from construction of a new terminal around a new, more convenient Metrorail station. For passengers, the airport is a clear choice. For cargo, the congestion and costs associated with flying into a veritable center-city location are disadvantages. Although highway access from Interstate 395, the George Washington Memorial Parkway, and U.S. Route 1 is available, the road system that

surrounds National is often heavily congested. Airport expansion is constrained by the dense infrastructure and natural features (i.e., the Potomac) that surround the facility; as a result, the Metropolitan Washington Airports Authority (MWAA) has emphasized the need to improve rather than enlarge the current facility with future projects.

Unlike National's location nestled well within the Washington Beltway, the city's dominant international airport on the border of Fairfax and Loudon counties in Virginia is 13 miles from the legendary freeway and 26 miles from the downtown it loosely encircles. Space is not nearly as restrictive at this 35-year old facility, which was planned from the outset to accommodate long-range jet aircraft. Dulles' three independent runways can each accommodate transoceanic service, and the two 11,500-ft runways enable nonstop service to Asia. The facility's single greatest drawback is its location: auto access via a privately-funded toll road with two toll-free dedicated lanes makes the journey often pleasant and relatively less-congested than other parts of the region's highway system, but does not lessen the considerable distance that passengers must travel to get to the terminal. The same distance that makes the airport inconvenient for passengers, however, makes Dulles advantageous for cargo service. Dedicated lanes on the access road ensure that airport traffic is free from congestion due to unrelated intra-urban travel.

Both Dulles and National airports are clearly focused on the nation's capital as a traffic base. BWI, on the other hand, lies between Baltimore (nine miles) and Washington (30 miles), along Interstate 95. Baltimore and Washington are connected by several traffic arteries including I-95, the Baltimore-Washington Parkway, and U.S. Route 1; BWI is accessible directly from each of these freeways as well as the Baltimore Beltway. The airport is clearly the first choice for Baltimore, but the facility falls in the shadow of Dulles and National. BWI has only one runway longer than 10,000 feet (the minimum length required for transatlantic flights from the region). In addition, it suffers from seemingly continuous construction and congestion on the freeways between the airport and downtown Washington. Today, the facility's greatest strength is its emergence as a low-cost alternative for the region's passengers with the advent of Southwest Airlines.

The location of the Washington-Baltimore metropolitan region near good ports and the Atlantic coast has long made the area a logical first step for immigrants from Europe and, more

recently, South America. As part of the original thirteen colonies, the mid-Atlantic region included in the Washington-Baltimore case study area has strong historical ties to the United Kingdom and other European nations. Jobs in Baltimore's shipyards drew immigrants from Eastern Europe during the 19th century; today, Salvadorians flock to the same (though more scarce) jobs and stimulate air service by visiting their homelands or sending for other relatives to join them. These cultural ties lend themselves to travel between the mid-Atlantic United States and these historically significant world regions.

As the seat of the U.S. government and "The Capital of the Free World," Washington continuously attracts foreigners and Americans alike not just as tourists, but also as employees of government and government-related enterprises for short-term assignments and permanent relocation. Nations around the world seek access to the power and resources of the government agencies and other organizations based in Washington, which translates into a desire for nonstop service to the region. The international orientation of government functions and transience of the area further stimulate the air traffic market.

The number of international destinations with service to Washington-Baltimore airports is larger and more varied than one might expect for a metropolitan region so close to the major New York-area gateways at JFK and Newark. Rivalry between New York and Washington is similar to those between Seattle and Portland and Chicago and Minneapolis-St. Paul. However, the unique combination of international ties, a large population base, and government interests has made the Washington-Baltimore metropolitan region more successful as an international gateway alternative to its traditional rival than the other cases.

Local Businesses of People and Power, Not Airborne Export Products

The international ties that the Washington-Baltimore region enjoys are based more on people, their communications, and power than on manufactured products. The region's largest business is government, and government ties forge the international passenger service demand. What that means for cargo service users is the existence of more overseas shipping options than the regional economy might otherwise sustain.

Despite the dismal performance of employment in the Communications Equipment and Aircraft Parts sectors during the study period, the Washington-Baltimore region seems to

represent an excellent opportunity for airborne export-production development because of its superior air service options. Airport authorities and a major local interest group have targeted cargo services as high priorities for development in recognition of that sector's development (see below). Additionally, Fairfax County and other communities have joined together with state officials to promote the concept of "Silicon Dominion," a play on the state's heritage as the Old Dominion of the British government and Silicon Valley's explosion as a technological center in the 1980s.

The Silicon Dominion concept arose out of a 1984 Virginia General Assembly mandate to create a non-profit organization to enhance technology transfer ties between state universities and private corporations and promote Virginia's competitiveness among other states and foreign countries. Virginia's Center for Innovative Technology (CIT) focuses on several industries identified in this study as airborne export-producers, including computer technology and biomedical products. The organization has its headquarters in Herndon, Virginia—a Fairfax County suburb close to Dulles. The Dulles Access Road corridor between the airport and the Washington Beltway has been one of the area's strongest areas of new growth in the 1990s, although there is no evidence that clearly identifies CIT as the reason behind this development.

The Washington-Baltimore region is heavily populated and developed. While these features support overseas air service, they also contribute to the cost pressure on economic resources. Land and labor are especially costly in such built-up areas with high costs of living, and can act as barriers to new establishments seeking to utilize the cargo service available at Dulles and BWI. For these reasons, efforts like CIT are particularly important for attracting new businesses that might otherwise be discouraged by the high costs of doing business in the area.

International Appeal, If Not an International Network

Dulles, and to a lesser degree BWI, have succeeded in attracting new overseas air service to the area since 1980. The increased foreign carrier presence in particular speaks to the desirability of Washington-Baltimore as a U.S. destination; serving the U.S. capital is a matter of pride as well as economics for foreign flag carriers. The unique attractive-ness of Washington-Baltimore as a destination yields a greater variety as well as a greater quantity of service options for travelers and shippers in the metropolitan region: in 1995, foreign carriers with direct or

nonstop service at Dulles and/or BWI included Tranbrazil, Air France, Saudi Arabian Airlines, Lufthansa, TACA International, Swissair, Icelandic, Air Jamaica, British Airways, All Nippon Airways, Japan Air Lines, and Korean Airlines. In 1980, the only carrier based overseas operating at any of airports in the region was British Airways.

An advantage for the metropolitan region has been the lack of a dominant home-based international carrier at Dulles or BWI that might have threatened the viability of additional service. Indeed, United Airlines now uses Dulles as its primary East Coast international gateway with nonstop service to Amsterdam, Brussels, Frankfurt, London-Heathrow, Madrid, Milan, and Zurich, but the carrier's home and major hub are at Chicago's O'Hare International. (Amsterdam, Brussels, Frankfurt, and Zurich service by United and other carriers represent route authorities made possible by Open Skies agreements with each country's respective government. These agreements have greatly reduced the administrative and political barriers to operating such service from second-tier gateways like Washington-Baltimore.) A recent trade magazine article touting the strengths of the carrier did not mention its operations at Dulles, instead emphasizing gateway activities at Los Angeles, San Francisco, and potentially Denver [55]. The distribution of United's international routes among several cities in its expansive and organized network is an advantage to the Washington-Baltimore market, as are the carrier's strong international alliances.

Among the major outcomes of trade agreement liberalization and industry shuffling in the 1980s and early 1990s are multi-carrier alliances among U.S. and foreign airlines. Beyond code-sharing, these alliances provide cooperative opportunities for marketing, frequent flier programs, and even yield management where antitrust immunity is also granted. United's marriage to Lufthansa at the start of what has grown into the Star Alliance (United, Lufthansa, SAS, Thai Airways, Air Canada, and most recently Varig) has further strengthened foreign air service at Dulles. Likewise, the devolution of the USAir/British Airways alliance in 1997 contributed to the decline of USAirways' (formerly USAir) operations at BWI and enabled Southwest to increase its presence in the market. Besides one daily British Airways flight to London, BWI's only service to overseas destinations other than the Caribbean are charters.

Expanded overseas passenger service has enabled cargo traffic to grow at Dulles since 1980, but dedicated all-cargo service is not available. For widebody freighter service, New York remains the premier gateway to Europe and Asia, while Miami (accessible via I-95) is the best

option for cargo service to Latin America. Both BWI and Dulles advertise regularly in trade publications to attract new shippers as they vie for mid-Atlantic cargo business.

Multiple Airports, Multiple Authorities, Multiple Interests

All airports arguably face conflicting interests in their surrounding communities. Differences are bound to arise among, but are not limited to: (1) air carriers that want to protect their competitive positions, (2) nearby neighborhoods whose residents protest airport expansion because of its threat to their property values and community livability, (3) environmental activists, and (4) businesses that seek improved service for the economic opportunities that usually accompany it. The situation in the Washington-Baltimore region is further complicated by the number and varying power of government jurisdictions and their political interests. Governance of the three major facilities in the Washington-Baltimore area is divided between MWAA (Dulles and National) and the Maryland Aviation Administration (BWI).

The Maryland Aviation Administration owns and operates BWI, serving a role common among airport authorities nationwide (U.S. airports are generally owned and administered by state and/or local agencies). In contrast, MWAA's governing council comprises representatives appointed by the District of Columbia, Maryland, and Virginia in addition to several Presidential appointees. A 1986 federal law mandated this system and formed MWAA to assume control of National and Dulles. Prior to MWAA, the FAA had jurisdiction over what were the only federally owned and operated commercial airports in the country—but the agency was ill-suited to manage (and unsuccessful at managing) individual airports.

Congress did not readily relinquish federal control over the airports from which its members regularly fly home to their constituencies. Elizabeth Dole, then Secretary of Transportation, was the major champion for removing control of National and Dulles from federal power as part of the Republican agenda to reduce government, but the issue faced considerable resistance at the Capitol. The legislation that eventually passed was packed with peace offerings for individual House and Senate members. For example, the extension of the airport's maximum flight distance (the perimeter rule) from 1,000 to 1,250 feet allowed Texas-based Continental and American to serve National from Houston and Dallas respectively with nonstop service for the first time. The limit extension was very handy for Senator Lloyd Bentsen and the Speaker of the

House Jim Wright, who suddenly were able to fly nonstop from convenient National to their home cities: Houston and Dallas. Also, BWI received significant federal airport improvement funds after a 76-hour filibuster by Senator Paul Sarbanes (D-Md.), who feared (correctly) that BWI's importance would diminish next to a stronger National and Dulles [56].

Indeed, development at both National and Dulles "took off" once freed from the mantle of inefficient federal control. But in the late 1980s, the airports gained a new and economically powerful advocate with formation of a new non-profit organization made up of individuals and, even more importantly, companies, seeking to promote the airports and attract new international service at Dulles. The Washington Airports Task Force became a model for communities elsewhere in the United States as a non-government voice to which air carriers seemed to listen. It undertook to stimulate local interest in cargo service, particularly, through outreach efforts for the mid-Atlantic region's shippers and forwarders that included publication of a Washington Dulles Air Cargo Directory and other promotional materials. Much of the international service initiated at Dulles, including the Air France freighter service in the early 1990s, was actively cultivated by the Task Force. The organization has continuously lobbied MWAA for new and improved cargo facilities at Dulles, including the construction of a third new international building now underway. In addition, the Task Force has continuously sought opportunities to keep improved air service to the region in the public eye through cooperation with Virginia's Center for Innovative Technology and constant publicity of its actions.

The Washington-Baltimore metropolitan region's airport governance situation makes it a more complex case than the other case studies examined thus far. The federal government's presence in the region is a unique asset due to the wider attention (and often money) it brings to air service. The surrounding area's population size and international orientation enabled Dulles and BWI together to emerge as a strong international gateway in the 1980s, despite New York's relatively close proximity. Additionally, the Washington Airports Task Force effectively "sold" Dulles to the airline industry—a strategy that many state and local airport authorities are reluctant to take on themselves.

MINNEAPOLIS-ST. PAUL

Minneapolis-St. Paul represents the large group of cities nationwide identified in Chapter 6 for which airborne export-producing industry employment ranks rose while overseas service ranks declined during the study period. More metropolitan regions experienced service rank declines than increases, since the number of cities with overseas service increased by ten between 1980 and 1995. With just one daily nonstop overseas flight in 1980 (Northwest Airlines to London's Gatwick Airport), Minneapolis-St. Paul International Airport (MSP) ranked 14th. Its rank had dropped to 18th by 1995, although its actual nonstop overseas service had risen from one to three daily flights.

Meanwhile, as the relative level of air service slipped, target industry employment was on the rise. The Minneapolis-St. Paul metropolitan region experienced a net gain of nearly 2,000 jobs in airborne export-producing industries, or four percent target industry job growth. This gain, during a period when all metropolitan regions combined experienced a net loss of over twenty percent in target industry employment, moved Minneapolis-St. Paul into the top ten U.S. metropolitan regions (Figure 6.4).

Overseas air service did grow at MSP, but the airport's share of all overseas service available to and from U.S. cities rose by less than a quarter of a percentage point. Conversely, its share of nationwide target industry employment rose by over two percentage points during the study period—a dramatic shift in its place within the U.S. urban hierarchy defined by target industry employment. The exports being produced by this larger target industry labor force, however, must have left the United States via other gateways, since expansion at MSP was slight between 1980 and 1995.

The early availability of overseas service at MSP can be attributed to the presence of Twin Cities-based Northwest Airlines, yet the lack of overseas service expansion commensurate with the metropolitan region's airborne export-producing industry employment growth is also attributable to the carrier's dominant position in its home market. Like St. Louis, Minneapolis-St. Paul's air service fortunes are tightly bound to the health of its major incumbent carrier. Unlike St. Louis, however, Minneapolis-St. Paul's location at the periphery of the United States' populated core makes the metropolitan region more vulnerable to the failure of that airline, a fact that strengthens Northwest Airlines' bargaining position with local authorities in everything from state loans to

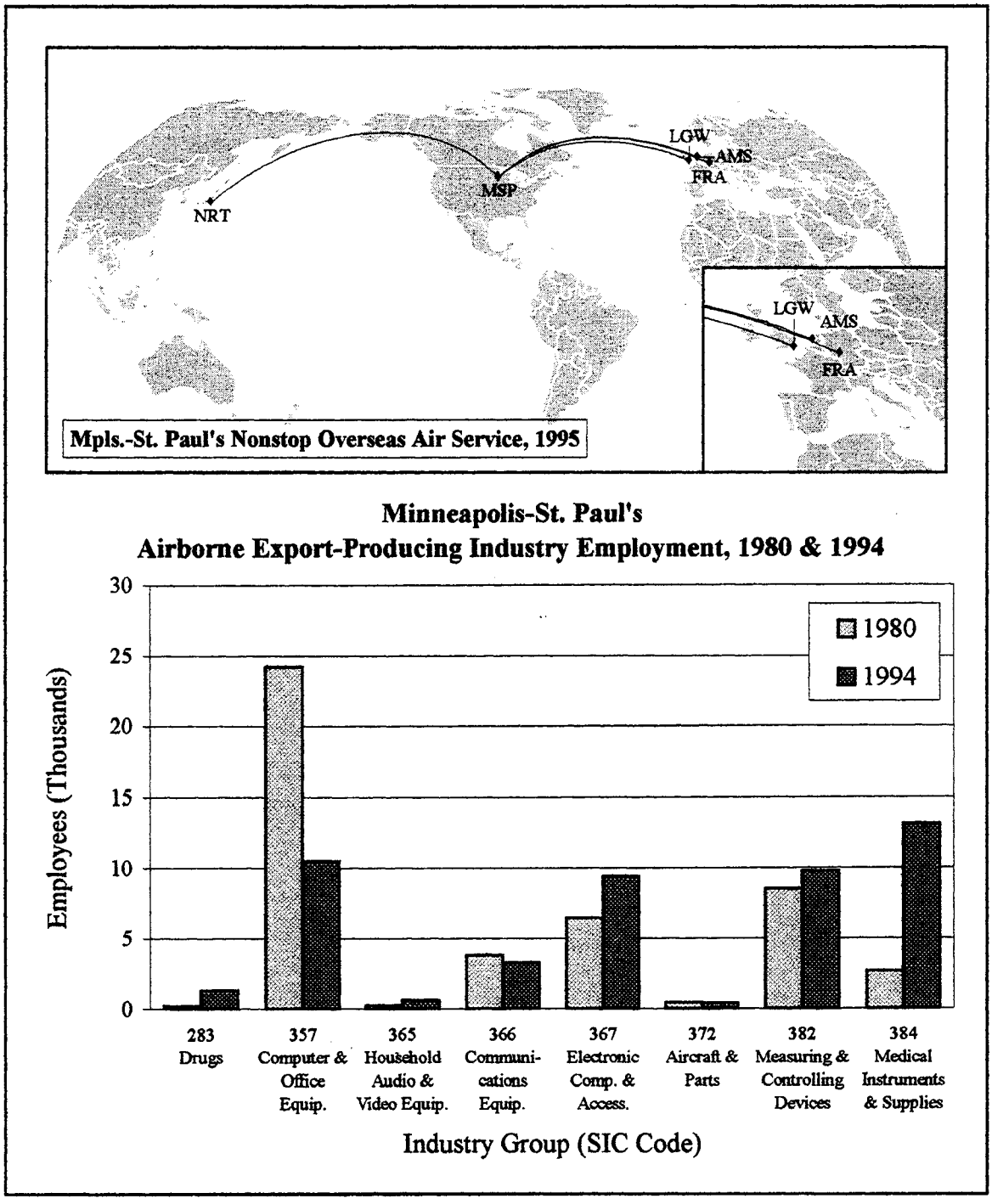


Figure 6.4. Minneapolis-St. Paul's Nonstop Service and Target Industry Employment Growth. Minneapolis-St. Paul's nonstop overseas route network is expansive, with service to both Asia and Europe. Employment losses in the computer/office equipment sector were more than offset by increases in the drugs, electronic components, and especially medical technology industry groups. SOURCES: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; and U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.

airport operations. Historical inertia, in part, has kept passenger service at MSP stronger than might be expected for a metropolitan region with a medium-sized population of under three million people. Despite the strength of the local economy and airborne export-producing industries, however, the Twin Cities will continue to find it difficult to establish a cargo catchment area competitive with those of other cities because of its peripheral location in the geography of domestic airline routes, its proximity to Chicago, the stranglehold that the incumbent airline has on it, and the hesitant stance of local authorities.

America's "North Coast Gateway" in the Shadow of Chicago

St. Paul and Minneapolis were established in the mid-19th century as gateways between the growing United States and the unsettled (by Europeans) West. Just a half-century later, however, the Twin Cities' situation was no longer on the western edge of a geographically expanding country, but rather on the northern edge of a developing nation's sparsely-populated midsection, near the even less populated midsection of Canada. It was not until the middle of the 20th century that Minneapolis-St. Paul again enjoyed a transportation advantage that gave the metropolitan area a gateway city role; this time it was utilization of the great circle routing to reach Asia from the central United States.

Minneapolis-St. Paul's proximity to Asia and even Europe is much closer than one might think, since great circle routes are hard to envision on two-dimensional maps. Northwest Airlines began capitalizing on the Twin Cities' geographic situation relative to Asia with its 1947 route to Japan, and then expanded Asian service throughout the 1950s. In 1969, Northwest, Pan Am, and Western Airlines all applied to the U.S. government for route authority to serve Scandinavia from MSP. The carriers had come to appreciate that MSP via an "over-the-top" route was just 300 miles farther from Scandinavia than is a congested East Coast airport like JFK [57]. By 1995, scheduled nonstop travel times between MSP and London were only one to two hours longer than those between JFK and London.

The converse of MSP's advantageous proximity to Asia and Europe is its peripheral location with regard to the domestic population. While the Twin Cities support and depend on an expansive hinterland that spans the Northern Plains and the Upper Midwest, these are some of the country's least-populated areas [58]. Chicago, one of the three largest metropolitan areas in the

country and a long-standing transportation nexus, lies between MSP and the population concentrations on the East Coast and in the Southeast. Fewer population centers that are able to sustain regular jet service lie within a one and a half hour flight radius from MSP than from virtually any other major U.S. carrier's hub (e.g., St. Louis or Cincinnati). MSP would be a convenient stop on some lucrative coast-to-coast routes, but high-yield business travelers in these markets would prefer nonstop service to a mid-continental stop.

The Minneapolis-St. Paul metropolitan region is therefore more vulnerable to the whims and strategies of its dominant home-based carrier than other hub cities because it is at a geographic disadvantage. The combined population base of the Twin Cities and the regions that feed MSP is probably not large enough to attract a new carrier to erect a nonstop network from the ground up in Minneapolis-St. Paul if a major vacancy were to develop. Rather than geography, it is historical inertia and the corporate investments already made in labor, infrastructure, and a route network that make the Twin Cities a profitable base for Northwest Airlines—and give the metropolitan region better air service than it might otherwise enjoy.

The Right Kinds of Business Ship Out, but Who Orders In?

The Minneapolis-St. Paul area's economy performed well during the study period, with airborne export-producing industries often leading the way. Employment in five of the eight target industry groups examined in this study rose between 1980 and 1995: drugs, household audio and video equipment, electronic components and accessories, measuring and controlling devices, and medical instruments and supplies (Figure 6.4). Strong performances by companies like Minnesota Mining and Manufacturing (3M) and Medtronic, which together earned over $4 billion in annual revenue in 1996 alone, led medical-related production [59]. The Twin Cities metropolitan region is home to not only the University of Minnesota's research and teaching hospital facilities, but also several other major hospital systems. The internationally-respected Mayo Clinic in Rochester adds to the region's reputation as a "medical alley" and provides opportunities for agglomeration economies in the medical-related high-tech industries. Improvements in combined target industry employment offset declines that were led by the Control Data Corporation's demise in the computer and office equipment sector.

High-tech industries that produce goods most likely to be exported by air find the Twin Cities metropolitan region an advantageous one for doing business. Although state and local taxes are relatively high, the products of these tax bills are evident in the high standard of living supported by and public services provided by those tax dollars [60]. As in Portland, Twin Cities employers appreciate the region's excellent surface transportation infrastructure that allows relatively easy movement of goods and people compared with more congested metropolitan areas. The public and higher education systems are strong, and provide the region with a highly-skilled, well-trained labor force. The consistently high quality-of-life ratings Minneapolis and St. Paul enjoy demonstrate the desirability of the area to the workers needed by local target industry firms.

Target industry strengths in the Minneapolis-St. Paul metropolitan region indicate that production of airborne exports increased, despite constrained overseas air service growth relative to other regions. What remains unclear, however, is how much leakage from the MSP catchment area occurs due to insufficient international cargo service at the airport. Although there is widespread agreement among local airport officials, shippers, and forwarders that a high proportion of local products are trucked to Chicago or other more substantial cargo gateways for export, it has not been documented in a manner that is likely to help draw additional cargo service into the area. (As discussed at length in Chapter 4, no comprehensive data on the domestic portion of export and import flows are available. Mid-sized markets like Minneapolis-St. Paul cannot demonstrate the leakage from their markets to other gateways without documenting the information themselves from surveys.) Once again, the region's geographic situation and demographic profile come into play. The Twin Cities' peripheral location vis-à-vis other U.S. production and population centers as well as the relatively small size of its population base make it a difficult sell as both a consumptive and a productive region.

Local leaders must convince prospective carriers that the Twin Cities market can generate sufficient demand for inbound international air cargo traffic to fill flights returning from much-needed outbound trips. Companies in the transportation business need to either make enough money on one-way traffic so they can afford to operate return trips without additional revenue, or have enough traffic in both directions to support the outbound and inbound service. This back-haul issue is one reason why air service supply does not seem to be keeping up with demand

based on this study's findings, but an equally important factor in cargo service's constrained growth at MSP is Northwest Airline's dominance within the local market.

A Home-Based Carrier Brings Good and Bad

Minneapolis-St. Paul has long enjoyed a wealth of mixed- and all-cargo service that is especially notable given the location and size of the metropolitan region. Domestic nonstop passenger service availability was strong even before deregulation, and the deregulation era led both Northwest and Republic Airlines to organize hub-and-spoke networks around MSP, yielding still more service for the local community. In terms of international service in 1980, MSP was doing better than indicated by its single daily nonstop overseas flight (to London) counted for this study: the Twin Cities already enjoyed a wide range of direct mixed-cargo and all-cargo flights to European and Asian destinations, making it the only case study metropolitan region with freighter aircraft service to Europe at the time. (Appendix K lists the direct service available at each case study metropolitan region in detail. The large number of overseas destinations reported to have direct service from MSP is due in part to Northwest's maintenance of its widebody aircraft Minneapolis; the airline's schedule is therefore organized around bringing the planes in for periodic checks.) Passenger feed behind the MSP gateway bolstered international service demand at the airport, as Northwest joined other major carriers in flowing traffic from smaller spoke origins in its route network over a few hubs. In 1995, Federal Express was also serving MSP with direct all-cargo service to Asia via Anchorage, the only air carrier other than Northwest and KLM (its alliance partner) to provide overseas service at MSP until 1998.

The dominant position of Northwest at MSP makes it a difficult market for new entrants on both the passenger and cargo sides. Icelandic Airlines, scheduled to inaugurate nonstop service between MSP and Rekjavik in the spring of 1998, is the first foreign carrier (other than Air Canada) that the Metropolitan Airports Commission (MAC) has successfully lured in to serve the Twin Cities. The service will be operated with a Boeing 757 airplane—a narrow-body aircraft that is likely to only slightly increase MSP's cargo capacity. Until the entrance of Icelandic in the European market, the lack of competitors has given Northwest little reason to improve its service at its captive home market.

Northwest operates three major domestic hubs, at MSP, Detroit (DTW), and Memphis (MEM). Until 1996, the carrier concentrated its international activities at DTW, with some nonstop service from MSP and traditional coastal gateways (Los Angeles, San Francisco, Seattle, and Boston) as well. Minneapolis-St. Paul and the MAC are faced with the challenge of demonstrating the metropolitan region's value as an originating and terminating market for overseas cargo service among many other cities vying for the carrier's limited resources—although competing cities often do not appreciate how limited an airline's resources may be. The Twin Cities leadership must show (and not just talk about) more than an ability to fill aircraft with people and cargo, but also that serving MSP will earn a carrier more money than serving other competing places. It is not enough to plead for more lift: shippers that want more service must organize and provide evidence that their business will support additional service.

There are good and bad sides to Northwest's role at MSP, just as with TWA's role at St. Louis and Delta's role at Portland. The traffic generated by Northwest's hub activity at MSP enables the metropolitan region to have exceptional nonstop service for a small metropolitan area on the geographic fringe of populated North America. Downsides, however, include the lack of nonstop carrier options for domestic and overseas service, the high costs associated with service at any major carrier hub due to the lack of price-lowering competition common at these places, and the ability of Northwest to scare away potential service providers. The MAC, therefore, is left in a quandary: it must protect the service the airport already has by handling NWA with kid gloves, yet it also must look out for the best interests of the community by continuously striving to broaden the carrier and service options available for both passengers and cargo shippers. The considerable strengths of the region's economy and airborne export-producing industries make MSP an attractive service option; to date, unfortunately, the Minneapolis-St. Paul metropolitan region's advantages have remained fairly well-hidden to outsiders.

Selling a Reluctant Minnesota to the World

Air service development at MSP faces hurdles associated with the local and regional political climate, despite the often-hampered efforts of MAC officials and the Twin Cities Airport Task Force, an organization made up of public and private sector representatives. First, regional and state leadership have failed to consider, much less agree upon, how MSP fits into the Twin

Cities metropolitan region's future. In part, this stems from the absence of a long-term vision and concrete plan for cultivating the area's competitive advantage among other U.S. cities: it is not that the airport in particular has been overlooked, but no such plan has been adopted [61]. Governor Arne Carlson is among those public figures who describe MSP as one of the "engines" of the economy, yet his administration has not led the metropolitan region or state in developing such a plan [62].

Second, local communities are divided over the future of MSP itself. Existing factions separated further in the wake of the long "dual-track" planning process that eventually led to a decision to improve the existing MSP rather than start from scratch at a new site in Dakota County, south of St. Paul. The state legislature mandated the unwieldy dual-track process, calling for simultaneous planning for existing facility expansion while also researching, selecting a site for, and designing a new airport. However, legislators representing noise-ridden South and Southwest Minneapolis and its contiguous, wealthy suburbs responded to the decision by pointing fingers at the MAC and accusing the agency of withholding information [63].

"NIMBY" attitudes prevail in these neighborhoods, where residents have high propensities to travel yet would rather have the jets necessary for good passenger service fly over other people's neighborhoods. (NIMBY" refers to the "not-in-my-backyard" phenomenon in which people want the benefits of an industry without being exposed to the disamenities inherent in its operation (e.g., noise, pollution, traffic).) Airport noise has been a contentious issue in the Twin Cities because of the airport's location close to densely-populated urban areas since even before airline deregulation accelerated already-increasing aircraft activity. The battle over whether or not to build a new airport opened old wounds and encouraged further discord on the issue. In addition, the dual-track process soured legislature-MAC relations, depleted MAC employee morale, and drained public attention and MAC resources away from improving the prospects for better air service at MSP.

The MAC and MSP are best known among aviation professionals nationwide for the noise controversy and its associated lawsuits, and the efficacy with which personnel handle harsh winter weather conditions. Despite the dedicated efforts of a few individuals to promote the airport, the MAC as an institution does not emphasize aviation marketing among the many duties associated with running MSP and other Twin Cities area airports. Indeed, the impression given by many

members of the Commission is that sales and promotion are not appropriate for a government entity (such as the MAC) to perform, in sharp contrast to Portland, Baltimore, and even St. Louis. Official airport promotion efforts beyond the Twin Cities themselves have been limited to a largely one-man effort, that of Deputy Director for Public Affairs J. Robert Stassen.

Stassen was instrumental in starting an organization that has grown into the Twin Cities Airport Task Force, modeled after the successful Washington group discussed above. (At varying times in its brief history, the organization has assumed the name "Global Access Task Force" and "Global Access Development Association" as well.) Representatives from public and private interests across the metropolitan region and state began meeting regularly in 1994 in an attempt to suggest, encourage, and support air service (and particularly international air service) improvements at MSP. The group has repeatedly recognized the need to both educate the public about the airport's importance to the regional economy and promote the region to potential service providers and business partners from outside the area. The organization's effectiveness, however, has been plagued by its ties to the MAC and its lack of resources.

The Twin Cities Airports Task Force has been dependent upon the MAC for administrative and even financial support since its inception. This link undermines the Task Force's credibility as an independent, free-thinking body. Standing alone as a group of representatives from beyond the airport will greatly increase the potential impact of the Task Force's actions. Unfortunately, the Task Force has lacked the funds, expertise, and personnel necessary to launch an effective, large-scale membership drive. In 1995, one Task Force member made a considerable contribution out of his own pocket as start-up money for the organization, but a continuous source of funding is desperately needed for its long-term viability. The Task Force's Marketing Committee volunteered countless hours to put promotional material together for the group, but has had limited success getting its message heard due to the lack of both financial and time resources. Several dedicated individuals have worked selflessly for the organization, but a broader and more focused effort will be necessary if the Twin Cities Airports Task Force is to realize its goals.

The Minneapolis-St. Paul metropolitan region has done quite well for itself as the headquarters and a major domestic hub of Northwest Airlines. In particular, MSP enjoyed international service earlier than most U.S. airports with similar market sizes because of

Northwest's presence. However, actions taken by the carrier in its best interests do not necessarily concur with the best interests of the metropolitan region in today's environment of competition among cities for service. The task of asserting the many strengths of the Twin Cities to prospective carriers and business interests unfamiliar with the region should be a primary concern of the MAC and the broader political leadership of the state. The Twin Cities Airport Task Force has worked admirably to fill the void left by the inaction of the powers that be. Ultimately, however, part-time volunteers from an organization lacking permanent staff and resources cannot effectively do a job alone that requires a broad-based effort to define the Twin Cities' competitive advantage among its rivals.

SUMMARY: DIFFERENT AIR CARGO SOLUTIONS FOR DIFFERENT MARKETS

Each city's site is unchangeable, yet its relative location varies according to accessibility. Access between places is afforded by transportation technology and the interplay of forces that control its development and implementation. These forces may or may not be within the influence of the local place and its powers, as demonstrated by the case studies analyzed above. For example, there is nothing that Washington can do to changes its proximity to New York, just as Portland cannot change the distances between it and Seattle or San Francisco, Minneapolis-St. Paul cannot alter its location eight hours by truck from Chicago, and St. Louis will always be in the center of a group of cities at least as large and economically strong as itself. And these relationships between mid-sized cities and their dominant competitors will inherently influence their attempts to develop their own overseas cargo service markets.

A mixture of luck, pragmatism, and hard work is equally important in determining the success of cities like those discussed in this chapter. Indeed, fortuitous timing among (1) aircraft technology that still prohibited nonstop service from the southeastern United States to Asia, (2) new route authorities granted by the Japanese for U.S.-Japan service, (3) Delta's first forays into overseas service, and (4) Portland's spectacular growth as an attractive metropolitan area and center for high-tech (and cargo-using) industry development all combined to put Oregon's largest city on the overseas cargo service map during the study period. But the Port of Portland, like St. Louis, has understood the vulnerable positions in which today's competitive airline industry places U.S. cities. These authorities, like the Washington Airports Task Force, then focused their efforts

on both supporting incumbent carriers and attracting new service through assertive promotional activities tailored to each local economy's industry strengths.

Minneapolis-St. Paul attempted similar tactics with plans for airport improvements like the new International Arrivals Facility (opened in 1996) and cargo facility upgrades, and eventually successful efforts to bring Icelandair to serve MSP. However, the MAC's efforts have been ill-focused and sporadic. The MAC administration has lacked support from the appointed Commission. There is a love-hate relationship between the community and Northwest Airlines that is further hindered by Northwest's own poor public relations efforts and bickering among Twin Cities leaders and state legislators. Further, local and statewide attention that should have been turned to the development of a long-term plan for identifying and promoting the competitive advantage of MSP and the Twin Cities was instead distracted by the dual-track planning process.

Portland, St. Louis, Washington-Baltimore, and Minneapolis-St. Paul represent different types of overseas cargo service market performance, as identified by this study. In some cases, strong local leadership and airport authority initiative have recognized and capitalized on regional strengths in their efforts to promote better air service for their communities. Additionally, these cities recognize their limitations and are pragmatic about their positions within the networks of international air service and within the U.S. urban hierarchy. Metropolitan regions like Portland and Washington-Baltimore, in particular, that both have addressed those issues within their influence and developed long-range plans carefully attuned to concurrent airline industry and regulatory environment changes have been most successful. Other metropolitan regions could profit from their examples.

CHAPTER SEVEN
CONCLUSIONS

The term "globalization" is increasingly a prominent feature of contemporary discourse; it may be found in everything from television commercials to political essays and academic research. The complexities of globalization, inherent in its very nature, do not lend themselves to easy empirical examination, however. Our geographical analysis of U.S. markets for overseas air cargo service provides concrete evidence of the increasing global ties that are becoming more important to a growing number of U.S. cities

Specifically, we examined the geographic patterns of overseas air cargo service availability, or supply, among 64 U.S. metropolitan regions in 1980 and the mid-1990s, analyzing the changing number of gateway cities and their competition for dominance. We then identified industries for whose export activities air cargo service is most critical, and documented employment in eight of these target industry groups to indicate demand for overseas air cargo service. For both the supply and demand analyses, we used net changes and share changes to evaluate individual metropolitan regions' success in both actual and relative terms. We compared the supply and demand indicator rank changes during the study period for each city in the final nationwide section of the study, and classified the metropolitan regions based on (1) where growth or decline in service and service-using industries was commensurate and (2) where mismatches occurred.

From our classification of U.S. markets for overseas air cargo service, we identified Portland, Oregon; St. Louis; Washington-Baltimore; and Minneapolis-St. Paul as case study metropolitan regions. The influences of (1) location; (2) local economic conditions; (3) airline networks, carrier health, and industry changes; and (4) leadership on and off the airport are evident from each of these cities' stories during the study period, and bring the broader trends discussed earlier down to earth. In all, each step of the study has yielded new findings with wide-ranging implications for practitioners and academicians alike.

FINDINGS

Our first research task addressed overseas air cargo service supply at U.S. airports. We determined how best to measure international air cargo service availability at the airport level, documented that service availability (or lack thereof) among 71 U.S. airports, and analyzed trends in nationwide and individual markets. The overwhelming expansion in the amount of all- and mixed-cargo service available between U.S. cities and overseas points is clear, and not surprising given the technological, industry, and regulatory changes discussed. Moreover, our service documentation shows a localized trend away from traditional gateway airports; more cities had a piece of the overseas air cargo service pie in 1995 than did in 1980—and the pie itself was larger. The nationwide scope and inclusion of all potential service gateways in the analysis was crucial to eliciting and demonstrating these trends.

The second and more complicated task in this study involved assessing demand for overseas cargo service at U.S. cities. We determined, for the first time, which specific industries use and rely most heavily on air transportation for their export activities. First, we identified the most air-eligible products based on the weight, value, and percentage value of airborne exports according to the Standard International Trade Classification (SITC) in which 1995 trade date are organized. We then matched those products with their respective Standard Industrial Classification (SIC) industry groups. Low-weight, high-value products associated with high-tech sectors prevailed among airborne exports, but other categories with particular economic or physical perishability also appeared. For example, specialized industrial machinery and fish were among the highest weight group, and the high percentage value category included raw materials such as silver ore as well as biological and chemical substances.

Once we had identified the eight industry groups (by three-digit SIC code) that are strong airborne export producers, we documented industry employment at each metropolitan region as an indicator of airborne export production demand locations in 1980 and the mid-1990s. Taken separately, regional strengths of individual target industry groups are clear: Seattle and Los Angeles continued to have high concentrations of aircraft parts production and all sectors involving computers and electronics thrived at San Francisco during the study period. Equally clear, however, is the over 20 percent loss of jobs in the eight target industry sectors combined. Although the total weight and value of U.S. airborne exports more than doubled during the study

period and the value of airborne exports accounted for nearly one-third of all U.S. exports by 1995, jobs in the sectors producing the exports most commonly shipped by air shrunk considerably. Traditional industrial centers in the Northeast, Chicago, and southern California were hit hardest by job losses. As was the case with supply, demand for air cargo service spread out from traditional centers. The total number of jobs associated with the industries that use air cargo service, however, shrunk even as demand for cargo space increased.

The third and final part of our nationwide investigation revealed where local supply and demand trends have and have not matched. We based our analysis on the changes in rank of each metropolitan region according to the amount of cargo service available and the number of jobs in target industry groups. The resulting matrix indicated that only four cities (Orlando, Atlanta, Philadelphia, and Portland) experienced improvements in their competitive positions relative to other metropolitan regions in terms of both service supply and demand. Conversely, a total of 22 cities among the 64 examined suffered declines in both their supply and demand ranks between 1980 and the mid-1990s. The high number is due in part to the inclusion of 33 places that had no nonstop overseas service in either year. The large number of cities without nonstop overseas service were included because they fell (1) among the 60 largest cities in the United States, or (2) within the FAA-designated large or medium hub community categories based on total aircraft activity. Since 1995, Phoenix has gained its first nonstop service to Europe, and a few other previously unserved metropolitan regions are likely to follow.

Three metropolitan regions stood out as opportunities for airborne export producers because of their gain in air service supply dominance without commensurate gains in target industry employment standing: Washington-Baltimore, Cincinnati, and Chicago. Twenty metropolitan regions enjoyed improvements in their standing according to service demand, but their ranks according to service availability slipped. The remaining metropolitan regions we considered in the aggregate market analysis were stable in at least supply or demand; the New York City metropolitan region held on its positions as the top overseas cargo service gateway in the nation and the second-ranked city in terms of target industry employment (behind Los Angeles).

We conducted the fourth research phase at a different scale, giving Portland, St. Louis, Washington-Baltimore, and Minneapolis-St. Paul individual consideration as representative cases

from the four corners of our overseas service market classification matrix. These cases exemplify how local characteristics and broader airline industry trends can influence a metropolitan region's potential as an overseas cargo service gateway. It also made clear that not all of the factors likely to shape local cargo market development are within the influence of local authorities. Cities with leaders who promote local strengths, undertake needed infrastructure improvements, and, most importantly, consider a long-term view of the metropolitan region's potential competitive advantage over its competitors seem to have the best prognosis for improved air cargo service. But leaders must make the best of these opportunities, since they cannot change their city's geographic situation and are unlikely to be able to succeed in rearranging airline networks so that their communities are in the center. The varying successes of Portland and the other case study metropolitan regions emphasize the importance of farsighted local leadership to reasonable and appropriate market development.

Throughout this study, the theme of interurban competitiveness appears repeatedly. Air service is just one of the bases upon which U.S. (and even foreign) cities compete for economic activity today. We made frequent comparisons between metropolitan regions, between markets, and among service providers and consumers to reiterate this theme. The need for individual places to promote themselves today to attract and keep employers, air service, sports teams, and any number of other economic activities is at once a cause and effect of interurban competition. Our study identifies the relative positions of U.S. cities based on overseas cargo service supply and demand indicators and also shows which cities are and are not keeping up with their own past standings. Not every city can be a major overseas air cargo service center; cities that understand their strengths and limitations and tailor their competitive advantage development schemes accordingly are those best poised to create and support a level of overseas cargo service appropriate for their local market.

IMPLICATIONS

Our study provides documentation and analysis of nationwide and industry-wide trends that local practitioners can use to inform decisions involving long-range, strategic planning for their communities. Additionally, we believe our study can inform and suggest new directions for

academic research through its synthesis of economic and transportation geography and by offering concrete evidence of the connections between local and global economic activity.

One example of local practitioners that might benefit from our study's findings are those with little knowledge of the air transportation system itself, but a desire to steer their communities towards economic activities that will support a competitive niche appropriate for local strengths and limitations. Too much preaching to the choir goes on among those airport professionals and service users who already know and appreciate the importance of air cargo activity to local economic activities. Local political and economic leaders must come to share this appreciation that air service, whether it be passenger or cargo, is just one of many bases upon which U.S. and even foreign cities compete today. We have moved from the competitive advantage of nations to the competitive advantage of cities, and our study demonstrates a need for leaders beyond the airport to identify where their communities can fit into the constantly changing competitive environment. There are different right answers for different cities; the key is understanding the community's air service needs. That understanding can be helped by analyses like mine that place individual U.S. cities in the context of their rivals for service.

Defining a city's broader strategy for finding its economic niche among other cities competing for jobs, service, and other activities cannot be left solely to airport authorities. Professional airport directors and operators, especially those in small and mid-sized cities, often lack the knowledge and resources to evaluate the long-term potential for the broader economic picture beyond air service, to assess and determine a vision for a metropolitan region's future. These are the cities for which long-term strategizing is the most important, yet where the necessary expertise and resources for such planning is scarcest.

Airport authorities, too, must actively seek rather than shun the involvement of local leadership beyond the airport. Airports depend on community support as much as communities depend upon airports, though neither faction is often appreciative of the nature of the dependence. Our study clearly shows that those cities where community support for airport planning and development is strong have the most positive outlooks for service development. True, some individual facilities may be at the mercy of air carriers. But it is not a one-way dependency. Carriers, likewise, need the traffic a market can provide. Authorities can take specific steps to not

only support their incumbent carriers, but also help draw in additional service providers where their service will benefit the community.

The final group of practitioners who can potentially benefit from our study's findings are those who provide and use overseas air cargo service. We have identified markets where the service rank improved while the target industry improvement rank did not, indicating the possible presence of excess capacity for the region. These are places where producers of exports that must be shipped by air might consider locating. Likewise, air cargo service providers might note the markets where service standing has not kept up with changes in airborne-export producing industry employment.

Academicians can build on our study's attempt to attach the concept of globalization to the ground through empirical analysis and specific examples of local ties to global economic processes. Worldwide economic exchanges are increasingly difficult to track, especially as government-instituted data collection has fallen out of favor (and out of funding). The method we developed in this study to compensate for a lack of data on commodity flows within the United States is a step in the right direction, but it is only a substitute for the kind of precision that enhanced and more thorough data collection would provide. There is a need for the collection and dissemination of data to keep pace with the rapidly changing economic flows among not just nations, but the places within them.

Our approach is a departure from past transportation geography literature that has tended to divorce supply from demand by considering the transportation system in question in splendid isolation. Especially as more transportation service and infrastructure have become market-driven, it is crucial to consider the forces shaping what is available. Transportation is inherently geographical because it involves movement across space and connections among places, but it is not enough to map where things go without explaining the complex economic and social systems at work in determining these patterns. Complex transportation networks (and their usage) mirror similar complexities in the economic and social systems that these networks serve. A plethora of research opportunities, some hinted at in this work, could also incorporate both the supply of and demand for transportation of various kinds in today's globalizing economy.

Several provocative research issues fell outside the scope of this study, yet provide intriguing research opportunities for future geographic inquiry. One example is the potential for

work that separates air cargo issues from those associated with passenger service. Although the two types of service are inextricably intertwined due to their shared usage of aircraft, airport, and personnel resources, they cater to distinct markets. Non-scheduled cargo service omitted from this study might be tracked through individual company data, which might also prove useful for a more detailed analysis of import flows via air cargo as well. Such micro-level research might also be used to evaluate our assumptions regarding the most likely products to be shipped by air. Waybill information from individual carriers or transportation facilities that includes not just the origin, destination, and routing of a shipment but also its content would sharpen our understanding of the nature of commodity flows, be they international or domestic. Finally, individual in-depth examinations based on specific places that have had volatile air service experiences demonstrated by our study could shed further light on the interplay of local and global economic forces. We believe this study is a strong first step down this research path, but considerable questions remain.

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APPENDIX A

METROPOLITAN REGION DEFINITIONS

METROPOLITAN REGION DEFINITIONS

The cities included in this study are among the sixty largest in the nation, are designated by the Federal Aviation Administration as "large" or "medium" hub communities, and/or are home to at least one airport with overseas air cargo service. Two publications, *Airport Activity Statistics of Certificated Route Air Carriers* (Federal Aviation Administration, 1995) and *City and County Data Book* (U.S. Bureau of the Census, 1994), provide these data. The study is based on the premise that not all U.S. cities have enjoyed improvements in overseas air cargo service and the economic benefits of employment in airborne export-producing industries, although both service and airborne exports nationwide grew dramatically between 1980 and the mid-1990s. To effectively compare these characteristics over time and determine where growth and decline in dominance occurred, a standard county-based definition for each metropolitan region in question must be established.

The U.S. Bureau of the Census and the Office of Management and Budget adopt and mandate federal government use of standard definitions to classify U.S. urban areas. Relying on the official definitions of a "metropolitan area" does not solve the geographic consistency problem, however, because definitional criteria applied by the Census Bureau change over time. Furthermore, whereas most metropolitan areas in the United States are composed of one or more counties, those in New England are not based on full counties, but rather on towns and cities. In fact, U.S. metropolitan areas themselves are composed of several types of sub-units: Consolidated Metropolitan Statistical Areas (CMSAs) consisting of two or more Primary Metropolitan Statistical Areas (PMSAs), stand-alone Metropolitan Statistical Areas (MSAs), and New England County Metropolitan Statistical Areas (NECMSAs)—according to the 1996 Census definitions [U.S. Bureau of the Census. (1996). *Metropolitan Areas and Components, 1996, with FIPS Codes* (Online). Available: http://www.census.gov/population/www/estimates/metrodef.html (1997, January 8)].

Metropolitan area definitions from 1996 provide a basis for the geographic areas employed in this study, but certain adaptations are required. Using the most recent definition available ensures that maximum catchment areas for service demand are considered. The areas

are designated to align with the service areas of each region's major airport(s). Totals for each of 18 CMSAs and 45 MSAs are calculated from the individual county data in U.S. Census *County Business Patterns* files from 1980 and 1994. In addition, the Fairbanks-North Star Borough in Alaska and Maui County in Hawaii are used for Fairbanks and Kahului respectively; these cities have some international air service but lack sufficient population for MSA designation. A final adjustment combines the Hartford CT MSA and Springfield MA MSA counties because Bradley Field (known as Hartford-Springfield International) serves both. (The Hartford, CT and Springfield, MA MSAs are contiguous. For this study, the Hartford-Springfield metropolitan region includes Hartford, Litchfield, Middlesex, New London, Tolland, and Windham counties in Connecticut, and Franklin, Hampden, and Hampshire counties in Massachusetts.) Throughout this study, the term "metropolitan region" refers to each of these 64 places (Figure A-1). Counties and major airports included in each metropolitan region are listed in Table A-1.

Two types of error are inherent in this system of aggregating county-level data to delimit metropolitan regions. First, New England metropolitan area totals are overcounted in some cases because parts of a single county are included in two different NECMSAs. Bristol County, Massachusetts, for example, is split between Providence and Boston according to Census definition, but using full-county CBP data prevents separating the county into two meaningful parts. The entire county's employment, for example, is therefore included in both metropolitan regions' totals. The second source of error results from the estimation of airborne export-producer employment in counties where total employment is small and actual figures are suppressed to preserve confidentiality. Estimates are defined systematically, but metropolitan regions with small employment counts in individual counties are disproportionately affected.

There is no foolproof method to alleviate these errors due to constraints inherent in the data sources used to identify airborne export-producer employment. Using a consistent county-based definition for each metropolitan region in both years standardizes at least one aspect of the process. Applying consistent estimation methods for suppressed employment data further reduces error.

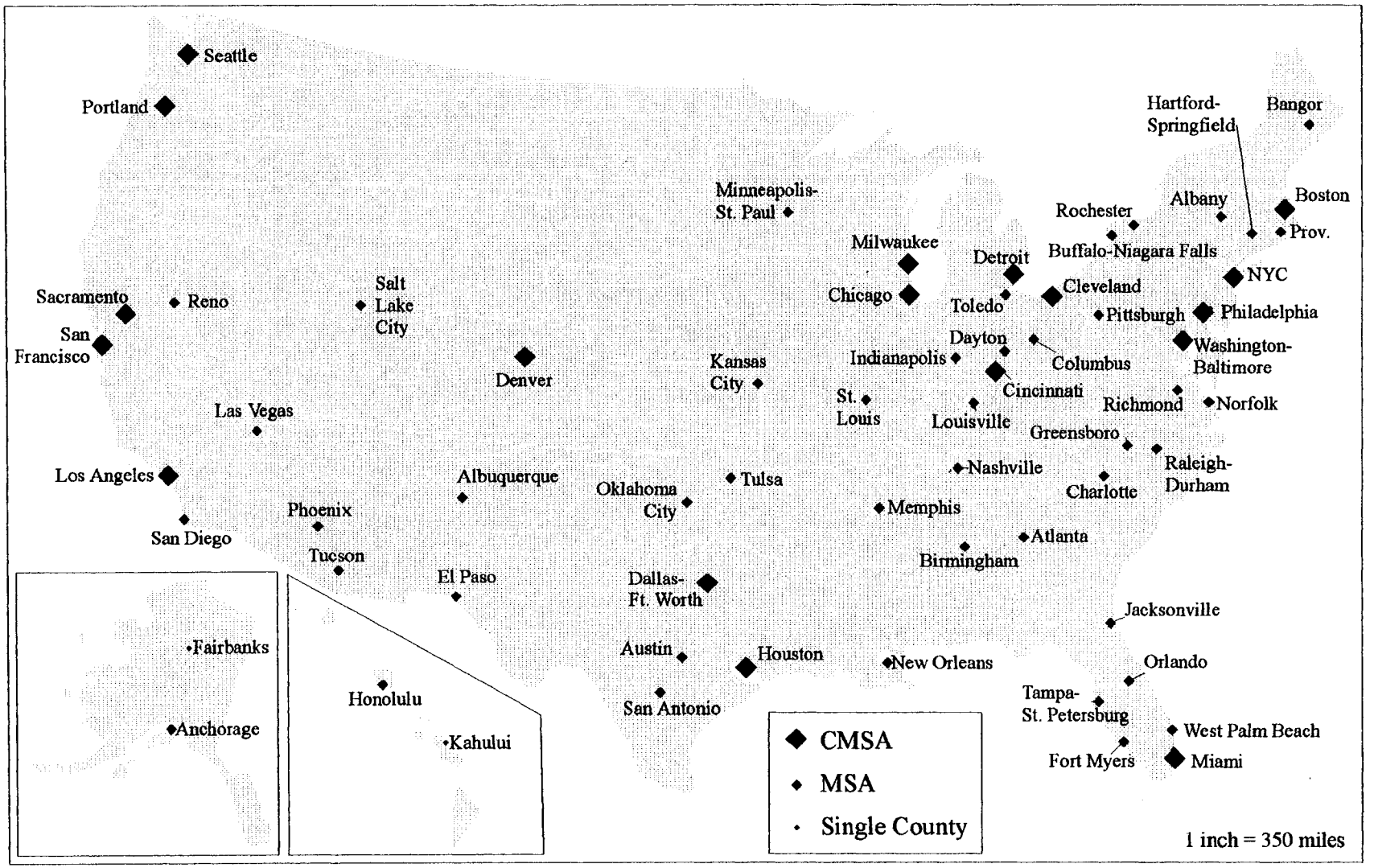

Figure A-1. The 64 Metropolitan Regions. Units examined include single counties and totals for counties in selected Census-designated Metropolitan Statistical Areas.

Table A-1. Metropolitan Region County Definitions and Major Airports

METROPOLITAN REGION, STATE(s), and Counties	MAJOR AIRPORT(S)
1. **ALBANY, New York:** Albany, Montgomery, Rensselaer, Saratoga, Schenectady, Schoharie	ALB
2. **ALBUQUERQUE,** New Mexico: Bernalillo, Sandoval	ABQ
3. **ANCHORAGE, Alaska:** Anchorage Borough	ANC
4. **ATLANTA, Georgia:** Bartow, Carroll, Cherokee, Clayton, Cobb, Coweta, De Kalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Newton, Paulding, Pickens, Rockdale,	ATL
5. **AUSTIN, Texas:** Caldwell, Hays, Travis, Williamson	AUS
6. **BANGOR, Maine:** Penobscot, Waldo	BGR
7. **BIRMINGHAM, Alabama:** Blount, Jefferson, Shelby, St. Clair	BHM
8. **BOSTON** **Connecticut:** *Windham* **Maine:** York **Massachusetts:** *Bristol,* Essex, *Hampshire,* Middlesex, Norfolk, Plymouth, Suffolk, **New Hampshire:** Hillsborough, Merrimack, Rockingham, Strafford	BOS
9. **BUFFALO-NIAGARA FALLS, New York:** Erie, Niagara	BUF
10. **CHARLOTTE** **North Carolina:** Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Union **South Carolina:** York	CLT
11. **CHICAGO** **Illinois:** Cook, De Kalb, Du Page, Grundy, Kane, Kankakee, Kendall, Lake, McHenry, Will **Indiana:** Lake, Porter **Wisconsin:** Kenosha	ORD
12. **CINCINNATI** **Indiana:** Dearborn, Ohio **Kentucky:** Boone, Campbell, Gallatin, Grant, Kenton, Pendleton **Ohio:** Brown, Butler, Clermont, Hamilton, Warren	CVG
13. **CLEVELAND, Ohio:** Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage,	CLE
14. **COLUMBUS, Ohio:** Fairfield, Franklin, Licking, Madison, Pickaway	CMH
15. **DALLAS-FT. WORTH, Texas:** Collin, Dallas, Denton, Ellis, Henderson, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall, Tarrant	DFW
16. **DAYTON, Ohio:** Clark, Greene, Miami, Montgomery	DAY
17. **DENVER, Colorado:** Adams, Arapahoe, Boulder, Denver, Douglas, Jefferson, Weld	DEN
18. **DETROIT, Michigan:** Genesee, Lapeer, Lenawee, Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, Wayne	DTW
19. **EL PASO, Texas:** El Paso	ELP
20. **FAIRBANKS, Alaska:** Fairbanks North Star Borough	FAI
21. **FORT MYERS, Florida:** Lee	FMY
22. **GREENSBORO, North Carolina:** Alamance, Davidson, Davie, Forsyth, Guilford,	GSO
23. **HARTFORD-SPRINGFIELD** **Connecticut:** Hartford, *Litchfield, Middlesex,* New London, Tolland, *Windham* **Massachusetts:** Franklin, Hampden, *Hampshire*	BDL

Note: *Italicized counties* are included in multiple metropolitan regions.

METROPOLITAN REGION, STATE(s), and Counties	MAJOR AIRPORT(S)
24. HONOLULU, Hawaii: Honolulu	HNL
25. HOUSTON, Texas: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty,	IAH
26. INDIANAPOLIS, Indiana: Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, Marion, Morgan, Shelby	IND
27. JACKSONVILLE, Florida: Clay, Duval, Nassau, St. Johns	JAX
28. KAHULUI, Hawaii: Maui	OGG
29. KANSAS CITY **Kansas:** Johnson, Leavenworth, Miami, Wyandotte **Missouri:** Cass, Clay, Clinton, Jackson, Lafayette, Platte, Ray	MCI
30. LAS VEGAS **Arizona:** Mohave **Nevada:** Clark, Nye	LAS
31. LOS ANGELES, California: Los Angeles, Orange, Riverside, San Bernardino, Ventura	LAX, ONT
32. LOUISVILLE **Indiana:** Clark, Floyd, Harrison, Scott **Kentucky:** Bullitt, Jefferson, Oldham	SDF
33. MEMPHIS **Alabama:** Crittenden **Mississippi:** De Soto **Tennessee:** Fayette, Shelby, Tipton	MEM
34. MIAMI, Florida: Broward, Dade	MIA, FLL
35. MILWAUKEE, Wisconsin: Milwaukee, Ozaukee, Racine, Washington, Waukesha	MKE
36. MINNEAPOLIS-ST. PAUL **Minnesota:** Anoka, Carver, Chisago, Dakota, Hennepin, Isanti, Ramsey, Scott, Sherburne, Washington, Wright **Wisconsin:** Pierce, St. Croix	MSP
37. NASHVILLE, Tennessee: Cheatham, Davidson, Dickson, Robertson, Rutherford, Sumner, Williamson, Wilson	BNA
38. NEW ORLEANS, Louisiana: Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Tammany	MSY
39. NEW YORK **Connecticut:** Fairfield, *Litchfield, Middlesex,* New Haven **New Jersey:** Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, Warren **New York:** Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester **Pennsylvania:** Pike	EWR, JFK, LGA
40. NORFOLK **North Carolina:** Currituck **Virginia:** Chesapeake City, Gloucester, Hampton City, Isle of Wight, James City, Mathews, Newport News City, Norfolk City, Poquoson City, Portsmouth City, Suffolk City, Virginia	ORF
41. OKLAHOMA CITY, Oklahoma: Canadian, Cleveland, Logan, McClain, Oklahoma,	OKC
42. ORLANDO, Florida: Lake, Orange, Osceola, Seminole	MCO

Note: *Italicized counties* are included in multiple metropolitan regions.

METROPOLITAN REGION, STATE(s), and Counties	MAJOR AIRPORT(S)
43. PHILADELPHIA **Delaware:** New Castle **Maryland:** Cecil **New Jersey:** Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Salem **Pennsylvania:** Bucks, Chester, Delaware, Montgomery, Philadelphia	PHL
44. PHOENIX, Arizona: Maricopa, Pinal	PHX
45. PITTSBURGH, Pennsylvania: Allegheny, Beaver, Butler, Fayette, Washington,	PIT
46. PORTLAND **Oregon:** Clackamas, Columbia, Marion, Multnomah, Polk, Washington, Yamhill **Washington:** Clark	PDX
47. PROVIDENCE **Massachusetts:** *Bristol* **Rhode Island:** Bristol, Kent, Newport, Providence, Washington	PVD
48. RALEIGH-DURHAM, North Carolina: Chatham, Durham, Franklin, Johnston, Orange,	RDU
49. RENO, Nevada: Washoe	RNO
50. RICHMOND, Virginia: Charles City, Chesterfield, Colonial Heights City, Dinwiddie, Goochland, Hanover, Henrico, Hopewell City, New Kent, Petersburg City, Powhatan, Prince George, Richmond City	RIC
51. ROCHESTER, New York: Genesee, Livingston, Monroe, Ontario, Orleans, Wayne	ROC
52. SACRAMENTO, California: El Dorado, Placer, Sacramento, Yolo	SMF
53. SALT LAKE CITY, Utah: Davis, Salt Lake, Weber	SLC
54. SAN ANTONIO, Texas: Bexar, Comal, Guadalupe, Wilson	SAN
55. SAN DIEGO, California: San Diego	SAN
56. SAN FRANCISCO, California: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, Sonoma	OAK, SFO, SJC
57. SEATTLE, Washington: Island, King, Kitsap, Pierce, Snohomish, Thurston	SEA
58. ST. LOUIS **Illinois:** Clinton, Jersey, Madison, Monroe, St. Clair **Missouri:** Franklin, Jefferson, Lincoln, St. Charles, St. Louis, St. Louis City, Warren	STL
59. TAMPA-ST. PETERSBURG, Florida: Hernando, Hillsborough, Pasco, Pinellas	TPA
60. TOLEDO, Ohio: Fulton, Lucas, Wood	TOL
61. TUCSON, Arizona: Pima	TUS
62. TULSA, Oklahoma: Creek, Osage, Rogers, Tulsa, Wagoner	TUL
63. WASHINGTON-BALTIMORE **District of Columbia:** Washington, D.C. **Maryland:** Anne Arundel, Baltimore, Baltimore, City, Calvert, Carroll, Charles, Frederick, Harford, Howard, Montgomery, Prince George's, Queen Anne's, Washington **Virginia:** Alexandria City, Arlington, Clarke, Culpeper, Fairfax, Fairfax City, Falls Church City, Fauquier, Fredericksburg, King George, Loudoun, Manassas City, Manassas Park City, Prince William, Spotsylvania, Stafford, Warren **West Virginia:** Berkeley, Jefferson	BWI, IAD
64. WEST PALM BEACH, Florida: Palm Beach	PBI

Note: *Italicized counties* are included in multiple metropolitan regions.

APPENDIX B

WIDEBODY AND NARROW-BODY AIRCRAFT

WIDEBODY AND NARROW-BODY AIRCRAFT

Code	*Aircraft*
AB3	Airbus Industrie (All Series)
B11	BAC 111 (All Series)
B72	Boeing 720/720B
CL4	Canadair-Cl-44
CV8	Convair 880
CWC	Curtiss-Wright Commando-C-46
DC3	McDonnell Douglas DC3/C47-Dakota
DC6	McDonnell Douglas DC6 (All Series)
DC8	McDonnell Douglas DC8 (Series 50)
DC9	McDonnell Douglas DC9 (Series 10/20)
D1F	**McDonnell Douglas DC-10 Freighter**
D1M	**McDonnell Douglas DC10 (Mixed Configuration)**
D10	**McDonnell Douglas DC10 (All Series)**
D8F	McDonnell Douglas DC8 (Freighter)
D8M	McDonnell Douglas DC8 (Mixed Passenger/Freighter)
D8S	McDonnell Douglas DC8 (All 60/70 Series)
D9S	McDonnell Douglas DC9 (Series 30/40/50)
ILW	**Ilyushin Il-86**
IL4	Ilyushin IL-14
IL6	Ilyushin IL-62
IL9	**Ilyushin IL-96-300**
LOE	Lockheed L188 Electra
L10	**Lockheed L1011 (All Series)**
L15	**Lockheed L1011-500 Tristar**
M1F	**McDonnell Douglas MD-11 Freighter**
M1M	**McDonnell Douglas MD-11 Mixed Configuration**
M11	**McDonnell Douglas MD-11 Passenger**
PAG	Piper (All Series)
RFS	Road Feeder Service (Truck)
SWM	Swearingen Metro

Code	*Aircraft*
310	**Airbus Industrie A310 (All Series)**
312	**Airbus Industrie A310-200**
313	**Airbus Industrie A310-300**
319	Airbus Industrie A319
32S	Airbus Industrie (A319 & A320 Series)
320	Airbus Industrie A320-100/200
321	Airbus Industrie A321
330	**Airbus Industrie A330**
340	**Airbus Industrie A340 (All Series)**
342	**Airbus Industrie A340-200**
343	**Airbus Industrie A340-300**
70F	Boeing 707 (Freighter/All Series)
70M	Boeing 707 (Mixed Passenger/Freighter)
707	Boeing 707 (Passenger)
72f	Boeing 727 (Freighter/All Series)
72s	Boeing 727-200
727	Boeing 727 (Passenger/All Series)
73s	Boeing 737 (Series 200/200C/200QC)
737	Boeing 737 (Passenger/All Series)
74C	**Boeing 747-200B/200C Mixed Configuration**
74D	**Boeing 747-300 Mixed Configuration**
74E	**Boeing 747-400 Mixed Configuration**
74F	**Boeing 747-100F/200C/200F (Freighter)**
74I	**Boeing 747 SP**
74M	**Boeing 747 (Mixed Passenger/ Freighter)**
747	**Boeing 747 (Passenger/All Series)**
75F	Boeing 757-200PF Freighter
757	Boeing 757-200 Passenger
762	**Boeing 767-200/200ER**
763	**Boeing 767-300/300ER**
767	**Boeing 767 (All Series)**
777	Boeing 777

Aircraft listed in **bold type** are classified as widebody aircraft, and hold significantly more passengers and/or cargo than narrow-body aircraft. SOURCE: Official Airline Guides. (1995). *Worldwide Edition/Supplement Air Cargo Guide.* Oak Brook, IL: Reed Travel Group.

APPENDIX C

1980 FLIGHT FREQUENCY CONVERSION METHOD

1980 FLIGHT FREQUENCY CONVERSION METHOD

The electronic file of route data obtained for this study was limited to full-month totals for each flight with a distinctive flight number and/or origin and destination time. In this form, the frequencies are not comparable to weekly frequencies available in the print publication of OAG data in the monthly *Worldwide Edition Air Cargo Guide.* To make compatible comparisons, I established a conversion system based on the calendar days in September, 1980 and the monthly totals provided in the electronic data file.

Some monthly-to-weekly conversions are straightforward: 30 flights during the month corresponds simply to daily service (or 7 flights per week) because September has 30 days. A total of four flights during the month clearly translates into one flight per week, since their are only four full weeks in the month. Beyond these, however, totals require closer examination of the September 1980 calendar.

September, 1980 began on a Monday and ended on a Tuesday four weeks later (Figure C-1). Therefore, four Sundays, Wednesdays, Thursdays, Fridays, and Saturdays and five Mondays and Tuesdays fell during the month. Accordingly, a flight that operated four times during the month was most likely scheduled once a week on either every Sunday, Wednesday, Thursday, Friday, or Saturday during the month, while a flight that operated five times most likely operated weekly on Mondays or Tuesdays.

In instances where the totals are not easily broken into logical weekly schedules, it is assumed that the schedule changed during the month. Such changes are common due to fleet allocation needs, passenger or cargo market changes, or maintenance requirements. Details of schedule changes cannot be discerned from the monthly totals available. The estimates reflect an average over the month in cases where the flight schedule changed or the schedule pattern is not obvious from the total. All flights that operated at all during the month are counted; those flights that operated only once are estimated to have been scheduled weekly during at least one week in September, 1980.

Monthly Calendar

September 1980

Sun.	*Mon.*	*Tues.*	*Wed.*	*Thurs.*	*Fri.*	*Sat.*
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Frequency Conversions

Monthly Flight Frequency	Estimated Weekly Flight Frequency
1,2,3,4, or 5	1
6,7,8,9,10, or 11	2
12,13,14,15	3
16,17,18,19	4
20,21,22,23,24	5
25,26,27,28,29	6
30	7 (daily service)

Examples

8 flights during September

S	*M*	*T*	*W*	*R*	*F*	*S*
	1	2	**3**	**4**	5	6
7	8	9	**10**	**11**	12	13
14	15	16	**17**	**18**	19	20
21	22	23	**24**	**25**	26	27
28	29	30				

A total of eight flights over a period of four weeks (one month) splits evenly into two flights per week. Shown here is one of several possible scheduling combinations: flights on Wednesdays and Thursdays only.

26 flights during September

S	*M*	*T*	*W*	*R*	*F*	*S*
	1	**2**	**3**	**4**	**5**	6
7	**8**	**9**	**10**	**11**	**12**	13
14	**15**	**16**	**17**	**18**	**19**	20
21	**22**	**23**	**24**	**25**	**26**	27
28	**29**	**30**				

To account for a total of 26 flights during the month, both days of the week with five occurrences and some combination of four calendar days with four occurrences during the month had scheduled service. Shown here is service scheduled 6 days per week (every day except Saturday).

Figure C-1. Monthly to Weekly Flight Frequency Conversions. Converting 1980 total flight frequencies for the month of September to weekly flight frequency estimates allows comparison with 1995 frequencies. These estimates were applied systematically to all 1980 monthly totals.

APPENDIX D

1980 AND 1995 SERVICE DATA

1980 AND 1995 SERVICE DATA

Origin	Destinations served		Total all-cargo flights		Total mixed-cargo flights		Nonstop all-cargo flights		Nonstop mixed-cargo flights		All-cargo service index		Mixed-cargo service index	
	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995
Airports with overseas service in both 1980 and 1995														
ANC	17	14	46	162	79	12	22	97	57	9	10.33	21.27	4.37	0.30
ATL	5	29	-	10	33	213	-	3	32	140	-	0.66	2.45	4.69
BDL	1	1	-	-	7	7	-	-	-	-	-	-	-	-
BOS	16	18	17	2	93	155	7	1	80	111	3.29	0.22	6.13	3.72
BWI	1	5	-	-	3	35	-	-	-	21	-	-	-	0.70
DFW	5	10	2	6	21	85	-	3	7	63	-	0.66	0.54	2.11
DTW	5	11	-	3	26	89	-	2	-	66	-	0.44	-	2.21
EWR	2	27	-	42	11	159	-	7	7	117	-	1.54	0.54	3.92
HNL	14	21	8	11	196	234	1	2	115	193	0.47	0.44	8.82	6.46
IAD	6	23	-	-	38	171	-	-	21	107	-	-	1.61	3.58
IAH	13	15	5	9	42	88	1	2	26	48	0.47	0.44	1.99	1.61
JFK	94	104	209	143	722	1,033	87	36	442	725	40.85	7.89	33.90	24.28
LAX	43	57	36	80	291	763	4	4	82	357	1.88	0.88	6.29	11.96
MIA	61	79	109	347	386	569	74	219	276	411	34.74	48.03	21.17	13.76
MSP	10	9	4	8	43	43	-	-	7	23	-	-	0.54	0.77
MSY	9	7	-	-	87	26	-	-	22	4	-	-	1.69	0.13
ORD	27	44	59	48	98	280	13	18	54	217	6.10	3.95	4.14	7.27
PHL	2	11	-	13	12	68	-	9	2	28	-	1.97	0.15	0.94
SEA	10	17	21	13	41	91	3	4	28	59	1.41	0.88	2.15	1.98
SFO	20	30	18	55	144	314	-	10	40	171	-	2.19	3.07	5.73
STL	1	4	-	-	4	31	-	-	4	10	-	-	0.31	0.33
TPA	2	2	-	-	2	2	-	-	1	2	-	-	0.08	0.07
Airports that had overseas service in 1980, but had none by 1995														
BGR	4	-	2	-	2	-	1	-	1	-	0.47	-	0.08	-
CLE	3	-	-	-	4	-	-	-	-	-	-	-	-	-
LAS	1	-	-	-	7	-	-	-	-	-	-	-	-	-
LGA	1	-	-	-	1	-	-	-	-	-	-	-	-	-
Airports that had no overseas service in 1980, but gained service by 1995														
BNA	-	1	-	-	-	7	-	-	-	7	-	-	-	0.23
CLT	-	2	-	-	-	14	-	-	-	7	-	-	-	0.23
CVG	-	4	-	-	-	28	-	-	-	28	-	-	-	0.94
DEN	-	1	-	-	-	7	-	-	-	-	-	-	-	-
FAI	-	2	-	7	-	-	-	7	-	-	-	1.54	-	-
FLL	-	3	-	4	-	1	-	2	-	1	-	0.44	-	0.03
FMY	-	1	-	-	-	2	-	-	-	-	-	-	-	-
IND	-	4	-	11	-	-	-	-	-	-	-	-	-	-
MCO	-	13	-	-	-	65	-	-	-	22	-	-	-	0.74
MEM	-	12	-	56	-	4	-	12	-	4	-	2.63	-	0.13
OAK	-	2	-	-	-	2	-	-	-	2	-	-	-	0.07
PDX	-	5	-	-	-	31	-	-	-	20	-	-	-	0.67
PIT	-	2	-	14	-	-	-	14	-	-	-	3.07	-	-
RDU	-	1	-	-	-	7	-	-	-	7	-	-	-	0.23
SAN	-	1	-	-	-	7	-	-	-	-	-	-	-	-
SDF	-	2	-	7	-	-	-	4	-	-	-	0.88	-	-
SJC	-	1	-	-	-	6	-	-	-	6	-	-	-	0.20
TOTALS							213	456	1,304	2,986	100	100	100	100

SOURCES: Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file compiled by BACK Information Services). Oak Brook, IL: Reed Travel Group; Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group.

APPENDIX E

U.S. AIRPORT CODES

U.S. AIRPORT CODES

Airport Code	City (Airport Name)
ABQ	ALBUQUERQUE, NM
ALB	ALBANY, NY
ANC	ANCHORAGE (INT'L), AK
ATL	ATLANTA, GA
AUS	AUSTIN, TX
BDL	HARTFORD, CT-SPRINGFIELD, MA
BGR	BANGOR, ME
BHM	BIRMINGHAM, AL
BNA	NASHVILLE, TN
BOS	BOSTON (INT'L), MA
BUF	BUFFALO, NY
BWI	BALTIMORE (INT'L), MD
CLE	CLEVELAND (INT'L), OH
CLT	CHARLOTTE, NC
CMH	COLUMBUS (INT'L), OH
CVG	CINCINNATI (INT'L), OH
DAY	DAYTON (INT'L), OH
DEN	DENVER (INT'L), CO
DFW	DALLAS-FT.WORTH (INT'L), TX
DTW	DETROIT (METRO WAYNE), MI
ELP	EL PASO, TX
EWR	NY NY-NEWARK, NJ
FAI	FAIRBANKS, AK
FLL	FT. LAUDERDALE (INT'L), FL
FMY	FORT MYERS, FL
GSO	GREENSBORO-HIGH POINT-WINSTON SALEM, NC
HNL	HONOLULU, OAHU, HI
IAD	WASHINGTON (DULLES), DC
IAH	HOUSTON (INT'L), TX
IND	INDIANAPOLIS, IN
JAX	JACKSONVILLE, FL
JFK	NY (JOHN F. KENNEDY), NY
LAS	LAS VEGAS (INT'L), NV
LAX	LOS ANGELES (INT'L), CA
LGA	NY (LA GUARDIA), NY
MCI	KANSAS CITY (INT'L), MO
MCO	ORLANDO (INT'L), FL
MEM	MEMPHIS, TN
MIA	MIAMI (INT'L), FL
MKE	MILWAUKEE, WI
MSP	MINNEAPOLIS-ST. PAUL, MN
MSY	NEW ORLEANS, LA
OAK	OAKLAND, CA
OGG	KAHULUI, MAUI, HI
OKC	OK CITY, OK
ONT	ONTARIO, CA
ORD	CHICAGO (O'HARE), IL
ORF	NORFOLK-VIRGINIA BEACH-WILLIAMSBURG, VA
PBI	WEST PALM BEACH, FL
PDX	PORTLAND, OR
PHL	PHILADELPHIA PA-WILMINGTONTON, DE
PHX	PHOENIX (INT'L), AZ
PIT	PITTSBURGH (INT'L), PA
PVD	PROVIDENCE, RI
RDU	RALEIGH-DURHAM, NC
RIC	RICHMOND-WILLIAMSBURG, VA
RNO	RENO, NV
ROC	ROCHESTER, NY
SAN	SAN DIEGO (LINDBERG), CA
SAT	SAN ANTONIO, TX
SDF	LOUISVILLE, KY
SEA	SEATTLE, WA
SFO	SAN FRANCISCO, CA
SJC	SAN JOSE, CA
SLC	SALT LAKE CITY, UT
SMF	SACRAMENTO (METRO), CA
STL	ST. LOUIS (INT'L), MO
TOL	TOLEDO, OH
TPA	TAMPA-ST. PETERSBURG, FL
TUL	TULSA, OK
TUS	TUCSON, AZ

APPENDIX F

METROPOLITAN REGION
WEEKLY SERVICE SHARES

METROPOLITAN REGION
WEEKLY SERVICE SHARES

Metropolitan Region	WEEKLY NONSTOP OVERSEAS FLIGHTS			PERCENTAGE OF WEEKLY NATIONAL TOTAL		
	1980	1995	Change	1980	1995	Change
Albany	-	-	-	-	-	-
Albuquerque	-	-	-	-	-	-
Anchorage	79	106	27	5.21	3.07	-2.14
Atlanta	32	143	111	2.11	4.14	2.03
Austin	-	-	-	-	-	-
Bangor	2	-	-2	0.13	-	-0.13
Birmingham	-	-	-	-	-	-
Boston	87	112	25	5.74	3.25	-2.49
Buffalo	-	-	-	-	-	-
Charlotte	-	7	7	-	0.20	0.20
Chicago	67	235	168	4.42	6.81	2.39
Cincinnati	-	28	28	-	0.81	0.81
Cleveland	-	-	-	-	-	-
Columbus	-	-	-	-	-	-
Dallas-Ft. Worth	7	66	59	0.46	1.91	1.45
Dayton	-	-	-	-	-	-
Denver	-	-	-	-	-	-
Detroit	-	68	68	-	1.97	1.97
El Paso	-	-	-	-	-	-
Fairbanks	-	7	7	-	0.20	0.20
Fort Myers	-	-	-	-	-	-
Greensboro	-	-	-	-	-	-
Hartford	-	-	-	-	-	-
Honolulu	116	195	79	7.65	5.65	-2.00
Houston	27	50	23	1.78	1.45	-0.33
Indianapolis	-	-	-	-	-	-
Jacksonville	-	-	-	-	-	-
Kahului	-	-	-	-	-	-
Kansas City	-	-	-	-	-	-
Las Vegas	-	-	-	-	-	-
Los Angeles	86	361	275	5.67	10.46	4.79
Louisville	-	4	4	-	0.12	0.12

Metropolitan Region	WEEKLY NONSTOP OVERSEAS FLIGHTS			PERCENTAGE OF WEEKLY NATIONAL TOTAL		
	1980	1995	Change	1980	1995	Change
Memphis	-	16	16	-	0.46	0.46
Miami	350	633	283	23.07	18.34	-4.73
Milwaukee	-	-	-	-	-	-
Mpls.-St. Paul	7	23	16	0.46	0.67	0.21
Nashville	-	7	7	-	0.20	0.20
New Orleans	22	4	-18	1.45	0.12	-1.33
New York	536	885	349	35.33	25.64	-9.69
Norfolk	-	-	-	-	-	-
Oklahoma City	-	-	-	-	-	-
Orlando	-	22	22	-	0.64	0.64
Philadelphia	2	37	35	0.13	1.07	0.94
Phoenix	-	-	-	-	-	-
Pittsburgh	-	14	14	-	0.41	0.41
Portland	-	24	24	-	0.70	0.70
Providence	-	-	-	-	-	-
Raleigh-Durham	-	7	7	-	0.20	0.20
Reno	-	-	-	-	-	-
Richmond	-	-	-	-	-	-
Rochester	-	-	-	-	-	-
Sacramento	-	-	-	-	-	-
Salt Lake City	-	-	-	-	-	-
San Antonio	-	-	-	-	-	-
San Diego	-	-	-	-	-	-
San Francisco	40	189	149	2.64	5.48	2.84
Seattle	31	63	32	2.04	1.83	-0.22
St. Louis	4	10	6	0.26	0.29	0.03
Tampa	1	2	1	0.07	0.06	-0.01
Toledo	-	-	-	-	-	-
Tucson	-	-	-	-	-	-
Tulsa	-	-	-	-	-	-
Washington-Balt.	21	133	112	1.38	3.85	2.47
W. Palm Beach	-	-	-	-	-	-
TOTAL	1,517	3,451		100	100	

SOURCES: (1) Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services). Oak Brook, IL: Reed Travel Group; (2) Official Airline Guides. (September,1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group.

APPENDIX G

EMPLOYMENT SIZE CLASS ESTIMATES

EMPLOYMENT SIZE CLASS ESTIMATES

Suppression Code	Employment Class Size Range	Estimate Used
	Total number of full- and part-time employees	
A	0-19	10
B	20-99	60
C	100-249	175
E	250-499	375
F	500-999	750
G	1,000-2,499	1,750
H	2,500-4,999	3,750
I	5,000-9,999	7,500
J	10,000-24,999	17,500
K	25,000-49,999	37,500
L	50,000-99,999	75,000
M	100,000 or more	N/A

SOURCES: U.S. Bureau of the Census (1995). *County Business Patterns on CD-ROM Technical Documentation.* Washington: U.S. Department of Commerce; and U.S. Bureau of the Census (1981). *County Business Patterns, 1974-1980 Technical Documentation* / prepared by Data Access and Use Staff, Data User Services Division, Bureau of the Census, Washington: The Bureau.

APPENDIX H

LEADING AIRBORNE EXPORT-PRODUCING INDUSTRIES, 1995

Table H-1. Airborne Exports by Weight, 1995

S.I.C. Code	*Description*	*Value of Airborne Exports*	*Value of All Exports*	*Percent*	*Weight of Airborne Exports*
		Thousands of Dollars			*Thousands of Kilograms*
3571	Electronic computers	24,801,485	29,489,878	84.1	**127,361**
3714	Motor vehicle parts & accessories	1,354,785	26,363,003	5.1	**72,052**
3577	Computer peripheral equipment, n.e.c.	2,759,449	4,760,501	58.0	**40,062**
3312	Blast furnaces & steel mills	108,905	4,887,962	2.2	**36,298**
2869	Industrial organic chemicals, n.e.c.	806,861	12,363,451	6.5	**33,206**
3533	Oil & gas field machinery	1,379,671	4,211,045	32.8	**32,952**
3357	Nonferrous wiredrawing & insulating	876,623	3,018,973	29.0	**32,887**
2011	Meat packing plants	194,234	6,335,022	3.1	**31,804**
3663	Radio & TV communications equipment	5,975,817	7,112,696	84.0	**31,304**
9800	Goods returned to Canada after processing in the U.S.	291,985	1,660,649	17.6	**30,835**
0912	Finfish	143,897	2,058,648	7.0	**29,996**
3679	Electronic components, n.e.c.	3,746,678	6,071,196	61.7	**29,052**
3674	Semiconductors & related devices	28,364,289	33,030,654	85.9	**28,893**
2731	Book publishing	575,734	1,845,928	31.2	**27,786**
3569	General industrial machinery, n.e.c.	1,460,275	4,503,411	32.4	**27,554**
3861	Photographic equipment & supplies	1,459,587	4,572,868	31.9	**27,052**
3544	Special dies, tools, jigs & fixtures	542,646	1,586,920	34.2	**26,857**

SOURCE: U.S. Bureau of the Census (1996). *U.S. Exports and Imports of Merchandise on CD-ROM,* December 1995. Washington: The Bureau.

Table H-2. Airborne Exports by Value, 1995

S.I.C. Code	*Description*	*Value of Airborne Exports*	*Value of All Exports*	*Percent*	*Weight of Airborne Exports*
		Thousands of Dollars			*Thousands of Kilograms*
3674	Semiconductors & related devices	**28,364,289**	33,030,654	85.9	28,893
3571	Electronic computers	**24,801,485**	29,489,878	84.1	127,361
3728	Aircraft parts & equipment, n.e.c.	**8,472,740**	10,423,089	81.3	24,511
3663	Radio & TV communications equipment	**5,975,817**	7,112,696	84.0	31,304
3724	Aircraft engines & engine parts	**5,786,115**	6,469,039	89.4	16,251
3339	Primary nonferrous metals, n.e.c.	**4,816,205**	5,799,964	83.0	7,851
3661	Telephone & telegraph apparatus	**4,589,554**	6,066,303	75.7	25,713
3559	Special industry machines, n.e.c.	**4,475,466**	5,512,919	81.2	20,173
3572	Computer storage devices	**4,339,485**	5,150,348	84.3	22,848
3679	Electronic components & accessories	**3,746,678**	6,071,196	61.7	29,052
3825	Instruments to measure electricity	**3,572,554**	4,378,312	81.6	13,113

SOURCE: U.S. Bureau of the Census (1996). *U.S. Exports and Imports of Merchandise on CD-ROM,* December 1995. Washington: The Bureau.

Table H-3. Airborne Exports by Percentage Value, 1995

S.I.C. Code	*Description*	*Value of Airborne Exports* (Thousands of Dollars)	*Value of All Exports* (Thousands of Dollars)	*Percent*	*Weight of Airborne Exports* (Thousands of Kilograms)
3915	Jewelers' materials & lapidary work	2,454,313	2,515,842	**97.6**	474
3911	Jewelery, precious metal	829,296	878,085	**94.4**	791
1044	Silver ores	238	259	**92.2**	23
3724	Aircraft engines & engine parts	5,786,115	6,469,039	**89.4**	16,251
0272	Horses & other equines	251,919	286,371	**88.0**	2,791
3674	Semiconductors & related devices	28,364,289	33,030,654	**85.9**	28,893
3826	Analytical instruments	2,230,533	2,607,190	**85.6**	12,458
3572	Computer storage devices	4,339,485	5,150,348	**84.3**	22,848
3571	Electronic computers	24,801,485	29,489,878	**84.1**	127,361
2835	Diagnostic substances	1,502,527	1,786,720	**84.1**	15,439
3663	Radio & TV communications equipment	5,975,817	7,112,696	**84.0**	31,304
3845	Electromedical equipment	2,718,464	3,247,663	**83.7**	15,671
3339	Primary nonferrous metals, n.e.c.	4,816,205	5,799,964	**83.0**	7,851
3851	Opthalmic goods	530,677	646,346	**82.1**	4,404
3827	Optical instruments & lenses	953,073	1,163,356	**81.9**	4,926
3825	Instruments to measure electricity	3,572,554	4,378,312	**81.6**	13,113
3728	Aircraft parts & equipment, n.e.c.	8,472,740	10,423,089	**81.3**	24,511
3559	Special industry machinery, n.e.c.	4,475,466	5,512,919	**81.2**	20,173
2836	Biological products except diagnostic	1,263,520	1,565,595	**80.7**	8,687

SOURCE: U.S. Bureau of the Census (1996). *U.S. Exports and Imports of Merchandise on CD-ROM,* December 1995. Washington: The Bureau.

APPENDIX I

METROPOLITAN REGION
TARGET INDUSTRY EMPLOYMENT

Table I-1. Metropolitan Region Target Industry Employment, 1980

Metropolitan Region (MR)	Industry Group Employment, 1980								Total Jobs	As % MR
	Drugs 283	Computer & Office Equip. 357	Household Audio & Video Equip. 365	Communi-cations Equip. 366	Electronic Components & Accessories 367	Aircraft & Parts 372	Measuring & Controlling Devices 382	Medical Instruments & Supplies 384		
Albany	760	60	-	550	420	-	890	295	**2,975**	**0.14**
Albuquerque	60	750	60	2,465	298	1,810	60	10	**5,513**	**0.26**
Anchorage	-	-	-	10	-	10	-	-	**20**	**0.00**
Atlanta	426	608	50	3,271	626	17,855	200	586	**23,622**	**1.09**
Austin	235	7,520	60	1,770	3,945	-	713	175	**14,418**	**0.67**
Bangor	-	-	-	60	60	-	10	10	**140**	**0.01**
Birmingham	60	60	60	175	10	1,750	206	53	**2,374**	**0.11**
Boston	1,516	35,323	3,695	40,448	33,886	10,570	20,852	8,149	**154,439**	**7.16**
Buffalo	1,306	175	10	760	836	181	479	1,967	**5,714**	**0.26**
Charlotte	525	420	20	70	2,205	175	90	750	**4,255**	**0.20**
Chicago	12,106	8,105	11,519	43,847	24,115	1,063	14,650	7,996	**123,401**	**5.72**
Cincinnati	1,770	845	98	1,905	815	18,260	715	1,197	**25,605**	**1.19**
Cleveland	403	939	233	1,155	1,452	11,248	5,735	1,648	**22,813**	**1.06**
Columbus	465	732	10	7,675	1,130	1,760	3,094	323	**15,189**	**0.70**
Dallas-Ft. Worth	925	5,340	1,708	32,563	19,748	46,438	1,865	1,070	**109,657**	**5.08**
Dayton	60	1,760	-	820	1,518	3,359	541	20	**8,078**	**0.37**
Denver	616	8,792	51	5,984	2,202	2,530	2,315	3,802	**26,292**	**1.22**
Detroit	2,922	7,082	325	1,642	1,330	1,187	1,852	1,157	**17,497**	**0.81**
El Paso	-	375	-	1,750	65	-	60	15	**2,265**	**0.10**
Fairbanks	-	-	-	-	-	-	-	-	**-**	**-**
Fort Myers	-	60	-	-	189	10	60	375	**694**	**0.03**
Greensboro	445	60	-	8,260	1,500	-	10	30	**10,305**	**0.48**
Hartford	3,870	5,822	195	2,225	5,764	49,384	3,121	2,979	**73,360**	**3.40**
Honolulu	10	60	175	-	60	-	-	10	**315**	**0.01**
Houston	815	4,213	54	3,489	3,880	395	2,056	431	**15,333**	**0.71**
Indianapolis	7,560	435	2,195	7,560	629	17,337	1,500	352	**37,568**	**1.74**
Jacksonville	10	-	-	10	60	235	10	175	**500**	**0.02**
Kahului	-	-	-	-	-	-	-	-	**-**	**-**
Kansas City	2,685	40	150	6,070	8,812	70	221	1,278	**19,326**	**0.90**
Las Vegas	10	10	10	175	20	-	-	20	**245**	**0.01**
Los Angeles	9,695	37,343	8,817	73,846	55,922	118,783	17,436	13,937	**335,779**	**15.56**
Louisville	60	-	60	235	375	20	-	191	**941**	**0.04**

Metropolitan Region (MR)	Industry Group Employment, 1980								Total Jobs	As % MR
	Drugs 283	Computer & Office Equip. 357	Household Audio & Video Equip. 365	Communi-cations Equip. 366	Electronic Components & Accessories 367	Aircraft & Parts 372	Measuring & Controlling Devices 382	Medical Instruments & Supplies 384		
Memphis	1,750	10	750	60	26	10	28	945	**3,579**	**0.17**
Miami	1,542	3,672	363	10,587	1,759	1,795	441	711	**20,870**	**0.97**
Milwaukee	610	1,770	375	4,155	2,056	20	1,040	1,568	**11,594**	**0.54**
Mpls.-St. Paul	183	24,190	235	3,760	6,448	430	8,494	2,714	**46,454**	**2.15**
Nashville	235	70	496	1,510	212	1,750	185	9	**4,467**	**0.21**
New Orleans	130	20	10	60	20	10	-	120	**370**	**0.02**
New York	43,379	32,173	5,749	59,532	62,673	67,725	19,016	20,426	**310,673**	**14.40**
Norfolk	120	-	3,760	305	570	-	235	215	**5,205**	**0.24**
Oklahoma City	241	3,820	810	7,500	620	1,750	375	337	**15,453**	**0.72**
Orlando	185	998	120	4,908	3,106	20	325	286	**9,948**	**0.46**
Philadelphia	12,172	7,790	2,246	11,398	8,216	9,468	13,408	2,648	**67,346**	**3.12**
Phoenix	375	11,463	953	7,792	20,400	7,500	476	750	**49,709**	**2.30**
Pittsburgh	385	1,770	-	4,560	1,845	70	2,109	3,417	**14,156**	**0.66**
Portland	339	1,810	116	1,110	1,665	1,750	190	975	**7,955**	**0.37**
Providence	120	1,174	175	3,570	4,519	60	1,483	2,476	**13,577**	**0.63**
Raleigh-Durham	1,125	8,310	1,760	3,810	3,443	10	1,870	395	**20,723**	**0.96**
Reno	-	175	10	750	103	175	60	23	**1,296**	**0.06**
Richmond	1,750	20	-	1,810	-	10	10	120	**3,720**	**0.17**
Rochester	1,393	2,185	185	4,447	3,925	375	4,082	1,750	**18,342**	**0.85**
Sacramento	60	350	760	148	100	70	70	70	**1,628**	**0.08**
Salt Lake City	862	4,492	70	2,965	1,069	245	175	3,810	**13,688**	**0.63**
San Antonio	385	7,500	1,816	20	175	1,750	10	81	**11,737**	**0.54**
San Diego	124	7,016	1,750	8,767	6,276	13,468	4,368	1,524	**43,293**	**2.01**
San Francisco	5,636	62,094	734	29,314	66,241	680	18,141	3,116	**185,956**	**8.62**
Seattle	43	1,215	360	3,846	1,017	71,164	2,288	505	**80,438**	**3.73**
St. Louis	3,430	175	70	5,570	976	24,064	1,298	1,400	**36,983**	**1.71**
Tampa	120	60	185	9,418	3,444	185	294	834	**14,540**	**0.67**
Toledo	-	375	-	60	90	810	72	1,025	**2,432**	**0.11**
Tucson	60	3,750	60	60	1,969	1,750	10	175	**7,834**	**0.36**
Tulsa	10	1,750	60	1,897	743	7,560	504	267	**12,791**	**0.59**
Washington	3,105	1,974	234	29,836	3,151	5,570	1,751	1,512	**47,133**	**2.18**
West Palm Beach	10	3,750	60	312	3,249	7,500	37	60	**14,978**	**0.69**
MR Total (1000)	**129**	**323**	**54**	**473**	**382**	**532**	**162**	**103**	**2,158**	***100.00***
U.S. Total (1000)	**169**	**385**	**87**	**576**	**511**	**582**	**227**	**137**	**2,673**	
MR as % of U.S.	77	84	62	82	75	91	71	75	**81**	

SOURCE: U.S. Bureau of the Census (1981). *County Business Patterns 1980 Machine Readable Data Files.* Washington: The Bureau.

Table I-2. Metropolitan Region Target Industry Employment, 1994

Metropolitan Region,(MR)	Industry Group Employment, 1994								Total Jobs	As % MR
	Drugs 283	Computer & Office Equip. 357	Household Audio & Video Equip. 365	Communi-cations Equip. 366	Electronic Components & Accessories 367	Aircraft & Parts 372	Measuring & Controlling Devices 382	Medical Instruments & Supplies 384		
Albany	205	10	10	-	445	-	380	417	**1,467**	**0.09**
Albuquerque	60	750	71	175	5,500	1,750	750	925	**9,981**	**0.58**
Anchorage	-	-	-	-	-	60	10	10	**80**	**0.00**
Atlanta	612	2,326	1,890	5,002	2,712	17,680	1,505	3,167	**34,894**	**2.03**
Austin	1,925	3,041	60	1,352	25,873	185	1,362	1,662	**35,460**	**2.06**
Bangor	-	-	-	60	10	-	10	-	**80**	**0.00**
Birmingham	60	185	20	-	30	1,750	60	61	**2,166**	**0.13**
Boston	6,068	13,440	1,679	17,455	35,026	7,670	24,123	18,368	**123,829**	**7.20**
Buffalo	1,522	175	60	218	1,006	375	754	2,022	**6,132**	**0.36**
Charlotte	631	385	175	70	5,136	235	682	1,052	**8,366**	**0.49**
Chicago	19,718	4,860	2,142	15,770	17,045	1,029	9,675	9,038	**79,277**	**4.61**
Cincinnati	983	360	195	1,588	1,296	18,225	1,838	3,623	**28,108**	**1.63**
Cleveland	807	630	70	1,582	2,161	3,252	5,477	5,143	**19,122**	**1.11**
Columbus	888	445	375	3,820	956	60	1,929	601	**9,074**	**0.53**
Dallas-Ft. Worth	4,143	3,502	751	10,305	19,237	35,715	5,057	4,259	**82,969**	**4.82**
Dayton	185	80	-	10	1,825	2,069	2,145	405	**6,719**	**0.39**
Denver	1,998	8,704	189	2,860	2,386	255	3,458	6,662	**26,512**	**1.54**
Detroit	1,597	1,628	305	881	3,363	1,130	6,984	1,962	**17,850**	**1.04**
El Paso	10	60	-	-	581	10	365	910	**1,936**	**0.11**
Fairbanks	-	-	-	-	-	-	-	-	**-**	**-**
Fort Myers	60	10	-	10	226	10	60	375	**751**	**0.04**
Greensboro	505	120	770	882	3,708	60	140	1,620	**7,805**	**0.45**
Hartford	3,870	1,107	215	566	4,411	26,770	3,612	2,433	**42,984**	**2.50**
Honolulu	10	10	10	175	-	-	10	10	**225**	**0.01**
Houston	345	4,051	10	363	3,125	337	4,220	3,492	**15,943**	**0.93**
Indianapolis	3,750	289	1,185	185	1,424	4,345	1,005	900	**13,083**	**0.76**
Jacksonville	20	62	60	60	96	395	20	935	**1,648**	**0.10**
Kahului	-	-	-	-	-	10	-	-	**10**	**0.00**
Kansas City	2,510	340	30	820	1,930	250	664	856	**7,400**	**0.43**
Las Vegas	70	171	-	10	120	120	385	91	**967**	**0.06**
Los Angeles	14,233	15,133	5,242	9,664	40,236	67,961	16,948	23,249	**192,666**	**11.20**
Louisville	131	30	375	235	820	60	265	331	**2,247**	**0.13**

Metropolitan Region (MR)	Industry Group Employment, 1994								Total Jobs	As % MR
	Drugs 283	Computer & Office Equip. 357	Household Audio & Video Equip. 365	Communi-cations Equip. 366	Electronic Components & Accessories 367	Aircraft & Parts 372	Measuring & Controlling Devices 382	Medical Instruments & Supplies 384		
Memphis	1,750	750	760	236	95	60	109	2,046	**5,806**	**0.34**
Miami	2,341	957	122	4,378	1,691	1,694	4,142	4,284	**19,609**	**1.14**
Milwaukee	967	196	70	235	2,581	130	3,008	4,852	**12,039**	**0.70**
Mpls.-St. Paul	1,357	10,454	612	3,281	9,352	382	9,740	13,129	**48,307**	**2.81**
Nashville	855	205	1,034	116	450	1,760	505	140	**5,065**	**0.29**
New Orleans	57	60	10	130	235	-	565	60	**1,117**	**0.06**
New York	45,462	15,103	2,403	11,443	33,285	37,423	21,824	23,049	**189,992**	**11.05**
Norfolk	60	1,820	-	341	1,005	385	279	205	**4,095**	**0.24**
Oklahoma City	370	2,773	375	3,760	959	395	175	455	**9,262**	**0.54**
Orlando	30	3,500	10	2,172	2,360	760	621	760	**10,213**	**0.59**
Philadelphia	11,121	3,204	1,055	5,566	5,618	8,388	10,833	5,565	**51,350**	**2.99**
Phoenix	1,750	1,530	375	3,750	22,829	17,500	2,669	750	**51,153**	**2.97**
Pittsburgh	175	517	375	473	2,659	70	4,601	3,070	**11,940**	**0.69**
Portland	547	5,904	860	1,403	9,791	1,985	5,777	2,199	**28,466**	**1.66**
Providence	295	902	10	1,770	3,643	10	2,055	4,521	**13,206**	**0.77**
Raleigh-Durham	3,346	19,270	70	5,328	3,515	90	1,490	803	**33,912**	**1.97**
Reno	60	60	10	60	99	10	60	111	**470**	**0.03**
Richmond	1,810	20	-	20	1,895	-	10	495	**4,250**	**0.25**
Rochester	1,810	1,259	20	3,521	2,949	235	2,577	792	**13,163**	**0.77**
Sacramento	395	1,880	250	137	2,772	130	457	277	**6,298**	**0.37**
Salt Lake City	820	1,923	301	978	1,962	770	185	7,522	**14,461**	**0.84**
San Antonio	538	175	48	363	1,025	1,750	188	170	**4,257**	**0.25**
San Diego	2,447	6,068	2,455	2,895	8,642	10,109	3,912	7,441	**43,969**	**2.56**
San Francisco	9,432	36,489	771	24,654	63,323	763	19,890	13,741	**169,063**	**9.83**
Seattle	820	1,719	945	1,763	3,764	76,925	3,298	4,588	**93,822**	**5.46**
St. Louis	3,214	565	195	329	2,454	18,270	1,478	3,861	**30,366**	**1.77**
Tampa	1,135	1,071	385	5,097	5,636	419	1,810	2,503	**18,056**	**1.05**
Toledo	60	265	20	60	311	10	235	666	**1,627**	**0.09**
Tucson	-	375	60	60	1,770	750	457	750	**4,222**	**0.25**
Tulsa	115	60	10	375	498	3,251	1,527	207	**6,043**	**0.35**
Washington	3,977	1,638	399	5,920	3,267	770	3,404	1,797	**21,172**	**1.23**
West Palm Beach	101	107	60	3,750	1,276	7,500	350	209	**13,353**	**0.78**
MR Total (1000)	**164**	**183**	**30**	**168**	**382**	**384**	**202**	**206**	**1,720**	***100.00***
U.S. Total (1000)	**200**	**224**	**50**	**221**	**523**	**440**	**252**	**272**	**2,182**	
MR as % of U.S.	82	82	60	76	73	87	80	76	**79**	

SOURCE: U.S. Bureau of the Census (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau.

Table I-3. Changes in Metropolitan Region Target Industry Employment, 1980 - 1994

Metropolitan Region (MR)	Net Industry Group Employment Change, 1980 - 1994								Net Job Loss or Growth	% MR Total, Change
	Drugs 283	Computer & Office Equip. 357	Household Audio & Video Equip. 365	Communi-cations Equip. 366	Electronic Components & Accessories 367	Aircraft & Parts 372	Measuring & Controlling Devices 382	Medical Instruments & Supplies 384		
Albany	-555	-50	10	-550	25	-	-510	122	**-1,508**	**-0.05**
Albuquerque	-	-	11	-2,290	5,202	-60	690	915	**4,468**	**0.32**
Anchorage	-	-	-	-10	-	50	10	10	**60**	**0.00**
Atlanta	186	1,718	1,840	1,731	2,086	-175	1,305	2,581	**11,272**	**0.93**
Austin	1,690	-4,479	-	-418	21,928	185	649	1,487	**21,042**	**1.39**
Bangor	-	-	-	-	-50	-	-	-10	**-60**	**0.00**
Birmingham	-	125	-40	-175	20	-	-146	8	**-208**	**0.02**
Boston	4,552	-21,883	-2,016	-22,993	1,140	-2,900	3,271	10,219	**-30,610**	**0.04**
Buffalo	216	-	50	-542	170	194	275	55	**418**	**0.09**
Charlotte	106	-35	155	-	2,931	60	592	302	**4,111**	**0.29**
Chicago	7,612	-3,245	-9,377	-28,077	-7,070	-34	-4,975	1,042	**-44,124**	**-1.11**
Cincinnati	-787	-485	97	-317	481	-35	1,123	2,426	**2,503**	**0.45**
Cleveland	404	-309	-163	427	709	-7,996	-258	3,495	**-3,691**	**0.05**
Columbus	423	-287	365	-3,855	-174	-1,700	-1,165	278	**-6,115**	**-0.18**
Dallas-Ft. Worth	3,218	-1,838	-957	-22,258	-511	-10,723	3,192	3,189	**-26,688**	**-0.26**
Dayton	125	-1,680	-	-810	307	-1,290	1,604	385	**-1,359**	**0.02**
Denver	1,382	-88	138	-3,124	184	-2,275	1,143	2,860	**220**	**0.32**
Detroit	-1,325	-5,454	-20	-761	2,033	-57	5,132	805	**353**	**0.23**
El Paso	10	-315	-	-1,750	516	10	305	895	**-329**	**0.01**
Fairbanks	-	-	-	-	-	-	-	-	**-**	**0.00**
Fort Myers	60	-50	-	10	37	-	-	-	**57**	**0.01**
Greensboro	60	60	770	-7,378	2,208	60	130	1,590	**-2,500**	**-0.02**
Hartford	-	-4,715	20	-1,659	-1,353	-22,614	491	-546	**-30,376**	**-0.90**
Honolulu	-	-50	-165	175	-60	-	10	0	**-90**	**0.00**
Houston	-470	-162	-44	-3,126	-755	-58	2,164	3,061	**610**	**0.22**
Indianapolis	-3,810	-146	-1,010	-7,375	795	-12,992	-495	548	**-24,485**	**-0.98**
Jacksonville	10	62	60	50	36	160	10	760	**1,148**	**0.07**
Kahului	-	-	-	-	-	10	-	-	**10**	**0.00**
Kansas City	-175	300	-120	-5,250	-6,882	180	443	-422	**-11,926**	**-0.47**
Las Vegas	60	161	-10	-165	100	120	385	71	**722**	**0.04**
Los Angeles	4,538	-22,210	-3,575	-64,182	-15,686	-50,822	-488	9,312	**-143,113**	**-4.36**
Louisville	71	30	315	-	445	40	265	140	**1,306**	**0.09**

Metropolitan Region (MR)	Net Industry Group Employment Change, 1980 - 1994								Net Job Loss or Growth	% MR Total, Change
	Drugs 283	Computer & Office Equip. 357	Household Audio & Video Equip. 365	Communi-cations Equip. 366	Electronic Components & Accessories 367	Aircraft & Parts 372	Measuring & Controlling Devices 382	Medical Instruments & Supplies 384		
Memphis	-	740	10	176	69	50	81	1,101	**2,227**	**0.17**
Miami	799	-2,715	-241	-6,209	-68	-101	3,701	3,573	**-1,261**	**0.17**
Milwaukee	357	-1,574	-305	-3,920	525	110	1,968	3,284	**445**	**0.16**
Mpls.-St. Paul	1,174	-13,736	377	-479	2,904	-48	1,246	10,415	**1,853**	**0.66**
Nashville	620	135	538	-1,394	238	10	320	131	**598**	**0.09**
New Orleans	-73	40	-	70	215	-10	565	-60	**747**	**0.05**
New York	2,083	-17,070	-3,346	-48,089	-29,388	-30,302	2,808	2,623	**-120,681**	**-3.35**
Norfolk	-60	1,820	-3,760	36	435	385	44	-10	**-1,110**	**0.00**
Oklahoma City	129	-1,047	-435	-3,740	339	-1,355	-200	118	**-6,191**	**-0.18**
Orlando	-155	2,502	-110	-2,736	-746	740	296	474	**265**	**0.13**
Philadelphia	-1,051	-4,586	-1,191	-5,832	-2,598	-1,080	-2,575	2,917	**-15,996**	**-0.14**
Phoenix	1,375	-9,933	-578	-4,042	2,429	10,000	2,193	-	**1,444**	**0.67**
Pittsburgh	-210	-1,253	375	-4,087	814	-	2,492	-347	**-2,216**	**0.04**
Portland	208	4,094	744	293	8,126	235	5,587	1,224	**20,511**	**1.29**
Providence	175	-272	-165	-1,800	-876	-50	572	2,045	**-371**	**0.14**
Raleigh-Durham	2,221	10,960	-1,690	1,518	72	80	-380	408	**13,189**	**1.01**
Reno	60	-115	-	-690	-4	-165	-	88	**-826**	**-0.03**
Richmond	60	-	-	-1,790	1,895	-10	-	375	**530**	**0.07**
Rochester	417	-926	-165	-926	-976	-140	-1,505	-958	**-5,179**	**-0.08**
Sacramento	335	1,530	-510	-11	2,672	60	387	207	**4,670**	**0.29**
Salt Lake City	-42	-2,569	231	-1,987	893	525	10	3,712	**773**	**0.21**
San Antonio	153	-7,325	-1,768	343	850	-	178	89	**-7,480**	**-0.30**
San Diego	2,323	-948	705	-5,872	2,366	-3,359	-456	5,917	**676**	**0.5**
San Francisco	3,796	-25,605	37	-4,660	-2,918	83	1,749	10,625	**-16,893**	**1.2**
Seattle	777	504	585	-2,083	2,747	5,761	1,010	4,083	**13,384**	**1.73**
St. Louis	-216	390	125	-5,241	1,478	-5,794	180	2,461	**-6,617**	**0.05**
Tampa	1,015	1,011	200	-4,321	2,192	234	1,516	1,669	**3,516**	**0.38**
Toledo	60	-110	20	-	221	-800	163	-359	**-805**	**-0.02**
Tucson	-60	-3,375	-	-	-199	-1,000	447	575	**-3,612**	**-0.12**
Tulsa	105	-1,690	-50	-1,522	-245	-4,309	1,023	-60	**-6,748**	**-0.24**
Washington	872	-336	165	-23,916	116	-4,800	1,653	285	**-25,961**	**-0.95**
West Palm Beach	91	-3,643	-	3,438	-1,973	-	313	149	**-1,625**	**0.08**
MR Net Chg. (1000)	**35**	**-140**	**-24**	**-304**	**-**	**-148**	**41**	**102**	**-438**	
U.S. Net Chg. (1000)	**32**	**-161**	**-37**	**-355**	**13**	**-142**	**24**	**135**	**-492**	

SOURCES: U.S. Bureau of the Census (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau; U.S. Bureau of the Census (1981). *County Business Patterns 1980 Machine Readable Data Files.* Washington: The Bureau.

APPENDIX J

METROPOLITAN REGION SERVICE DEMAND AND SUPPLY RANKS

METROPOLITAN REGION
SERVICE DEMAND AND SUPPLY RANKS

Metropolitan Region	EMPLOYMENT 1980 Rank	EMPLOYMENT 1980 Target Industry Jobs	EMPLOYMENT 1994 Rank	EMPLOYMENT 1994 Target Industry Jobs	EMPLOYMENT Change Rank	SERVICE 1980 Rank	SERVICE 1980 Weekly Nonstop Overseas Flights	SERVICE 1995 Rank	SERVICE 1995 Weekly Nonstop Overseas Flights	SERVICE Change Rank
Albany	*49*	2,975	*55*	1,467	-	*20*	0	*30*	0	-
Albuquerque	*43*	5,513	*34*	9,981	+	*20*	0	*30*	0	-
Anchorage	*62*	20	*61*	80	+	*6*	79	*10*	106	-
Atlanta	*18*	23,622	*14*	34,894	+	*9*	32	*7*	143	+
Austin	*30*	14,418	*13*	35,460	+	*20*	0	*30*	0	-
Bangor	*61*	140	*61*	80	***0***	*17*	2	*30*	0	-
Birmingham	*51*	2,374	*51*	2,166	***0***	*20*	0	*30*	0	-
Boston	*4*	154,439	*4*	123,829	***0***	*4*	87	*9*	112	-
Buffalo	*42*	5,714	*42*	6,132	***0***	*20*	0	*30*	0	-
Charlotte	*46*	4,255	*37*	8,366	+	*20*	0	*23*	7	-
Chicago	*5*	123,401	*7*	79,277	-	*7*	67	*4*	235	+
Cincinnati	*17*	25,605	*18*	28,108	-	*20*	0	*16*	28	+
Cleveland	*19*	22,813	*22*	19,122	-	*20*	0	*30*	0	-
Columbus	*27*	15,189	*36*	9,074	-	*20*	0	*30*	0	-
Dallas-Ft. Worth	*6*	109,657	*6*	82,969	***0***	*14*	7	*12*	66	+
Dayton	*39*	8,078	*40*	6,719	-	*20*	0	*30*	0	-
Denver	*16*	26,292	*19*	26,512	-	*20*	0	*30*	0	-
Detroit	*24*	17,497	*24*	17,850	***0***	*20*	0	*11*	68	+
El Paso	*52*	2,265	*52*	1,936	***0***	*20*	0	*30*	0	-
Fairbanks	*63*	0	*64*	0	-	*20*	0	*23*	7	-
Fort Myers	*56*	694	*58*	751	-	*20*	0	*30*	0	-
Greensboro	*37*	10,305	*38*	7,805	-	*20*	0	*30*	0	-
Hartford	*8*	73,360	*12*	42,984	-	*20*	0	*30*	0	-
Honolulu	*59*	315	*60*	225	-	*3*	116	*5*	195	-
Houston	*26*	15,333	*25*	15,943	+	*11*	27	*14*	50	-
Indianapolis	*14*	37,568	*30*	13,083	-	*20*	0	*30*	0	-
Jacksonville	*57*	500	*53*	1,648	+	*20*	0	*30*	0	-
Kahului	*63*	0	*63*	10	***0***	*20*	0	*30*	0	-
Kansas City	*22*	19,326	*39*	7,400	-	*20*	0	*30*	0	-
Las Vegas	*60*	245	*57*	967	+	*20*	0	*30*	0	-
Los Angeles	*1*	335,779	*1*	192,666	***0***	*5*	86	*3*	361	+
Louisville	*55*	941	*50*	2,247	+	*20*	0	*27*	4	-

NOTE: "+" indicates improvement in overall rank, "-" indicates decline in overall rank, and "***0***" indicat a stable rank

Metropolitan Region	EMPLOYMENT 1980 Rank	EMPLOYMENT 1980 Target Industry Jobs	EMPLOYMENT 1994 Rank	EMPLOYMENT 1994 Target Industry Jobs	EMPLOYMENT Change Rank	SERVICE 1980 Rank	SERVICE 1980 Weekly Nonstop Overseas Flights	SERVICE 1995 Rank	SERVICE 1995 Weekly Nonstop Overseas Flights	SERVICE Change Rank
Memphis	*48*	3,579	*44*	5,806	+	*20*	0	*20*	16	***0***
Miami	*20*	20,870	*21*	19,609	-	*2*	350	*2*	633	***0***
Milwaukee	*36*	11,594	*31*	12,039	+	*20*	0	*30*	0	-
Mpls.-St. Paul	*12*	46,454	*10*	48,307	+	*14*	7	*18*	23	-
Nashville	*45*	4,467	*45*	5,065	***0***	*20*	0	*23*	7	-
New Orleans	*58*	370	*56*	1,117	+	*12*	22	*27*	4	-
New York	*2*	310,673	*2*	189,992	***0***	*1*	536	*1*	885	***0***
Norfolk	*44*	5,205	*49*	4,095	-	*20*	0	*30*	0	-
Oklahoma City	*25*	15,453	*35*	9,262	-	*20*	0	*30*	0	-
Orlando	*38*	9,948	*33*	10,213	+	*20*	0	*19*	22	+
Philadelphia	*9*	67,346	*8*	51,350	+	*17*	2	*15*	37	+
Phoenix	*10*	49,709	*9*	51,153	+	*20*	0	*30*	0	-
Pittsburgh	*31*	14,156	*32*	11,940	-	*20*	0	*21*	14	-
Portland	*40*	7,955	*17*	28,466	+	*20*	0	*17*	24	+
Providence	*33*	13,577	*28*	13,206	+	*20*	0	*30*	0	-
Raleigh-Durham	*21*	20,723	*15*	33,912	+	*20*	0	*23*	7	-
Reno	*54*	1,296	*59*	470	-	*20*	0	*30*	0	-
Richmond	*47*	3,720	*47*	4,250	***0***	*20*	0	*30*	0	-
Rochester	*23*	18,342	*29*	13,163	-	*20*	0	*30*	0	-
Sacramento	*53*	1,628	*41*	6,298	+	*20*	0	*30*	0	-
Salt Lake City	*32*	13,688	*26*	14,461	+	*20*	0	*30*	0	-
San Antonio	*35*	11,737	*46*	4,257	-	*20*	0	*30*	0	-
San Diego	*13*	43,293	*11*	43,969	+	*20*	0	*30*	0	-
San Francisco	*3*	185,956	*3*	169,063	***0***	*8*	40	*6*	189	+
Seattle	*7*	80,438	*5*	93,822	+	*10*	31	*13*	63	-
St. Louis	*15*	36,983	*16*	30,366	-	*16*	4	*22*	10	-
Tampa	*29*	14,540	*23*	18,056	+	*19*	1	*29*	2	-
Toledo	*50*	2,432	*54*	1,627	-	*20*	0	*30*	0	-
Tucson	*41*	7,834	*48*	4,222	-	*20*	0	*30*	0	-
Tulsa	*34*	12,791	*43*	6,043	-	*20*	0	*30*	0	-
Washington	*11*	47,133	*20*	21,172	-	*13*	21	*8*	133	+
W. Palm Beach	*28*	14,978	*27*	13,353	+	*20*	0	*30*	0	-

NOTE: "+" indicates improvement in overall rank, "-" indicates decline in overall rank, and "***0***" indica a stable rank

SOURCES: (1) U.S. Bureau of the Census. (1981). *County Business Patterns 1980, Machine Readable Data Files.* Washington: The Bureau; (2) U.S. Bureau of the Census. (1995). *County Business Patterns 1994 on CD-ROM.* Washington: The Bureau; (3) Official Airline Guides. September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services). Oak Brook, IL: Reed Travel Group; (3) Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group.

APPENDIX K

CASE STUDY METROPOLITAN REGION
OVERSEAS ROUTE PROFILES, 1980 AND 1995

Table K-1. Overseas Service from Portland International Airport, 1980 & 1995

1980			
Destination	**Air Carrier**	**Stops**	**Flights per week**
-	-	-	-

1995			
Destination	**Air Carrier**	**Stops**	**Flights per Week**
BKK-Bangkok	Delta	Seoul	4
FRA-Frankfurt	TWA	Seattle, New York	7
NGO-Nagoya	Delta	-	7
NRT-Tokyo-Narita	Delta	-	7
SEL-Seoul	Delta	-	6
TPE-Taipei	Delta	-	4

SOURCES: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services.). Oak Brook, IL: Reed Travel Group.

Table K.-2. Overseas Service from St. Louis, 1980 & 1995

1980			
Destination	**Air Carrier**	**Stops**	**Flights per week**
LGW-London-Gatwick	British Caledonian	-	4

1995			
Destination	**Air Carrier**	**Stops**	**Flights per Week**
CDG-Paris-Charles de Gaulle	TWA	-	3
FCO-Rome	TWA	New York	7
FRA-Frankfurt	TWA	New York	6
LGW-London-Gatwick	TWA	-	7
TLV-Tel Aviv	TWA	Paris	3

SOURCES: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services.). Oak Brook, IL: Reed Travel Group.

Table K-3. Overseas Service from Washington-Baltimore Metropolitan Region Airports, 1980 & 1995

1980

Destination	Air Carrier	Stops	Flights per Week
CDG-Paris-Charles de Gaulle	TWA	-	7
LGW-London-Gatwick*	World Airways	Boston	3
LHR-London-Heathrow	Pan Am	-	7
	British Airways	-	7
MNL-Manila	Northwest Airlines	Chicago, Anchorage, Tokyo	2
	" "	Chicago, Tokyo, Osaka	1
	" "	Chicago, Tokyo	1
NRT-Tokyo-Narita	Northwest Airlines	Chicago	5
	" "	Chicago, Anchorage	2
OKA-Osaka	Northwest Airlines	Chicago, Tokyo	1
SEL-Seoul	Northwest Airlines	Chicago, Tokyo	2

1995

Destination	Air Carrier	Stops	Flights per Week
AMS-Amsterdam	Northwest/KLM	-	3
	United Airlines	-	7
BRU-Brussels	United Airlines	-	7
BSB-Brasilia	Transbrasil S/A	-	3
CDG-Paris-Charles de Gaulle	Air France	-	7
DHA-Dhahran	Saudi Arabian Airlines	New York, Riyadh	2
FRA-Frankfurt	United Airlines	-	7
	Lufthansa	-	7
	Delta	-	7
FCO-Rome	United Airlines	Milan	7
GRU-Sao Paulo	Transbrasil S/A	Brasilia	3
GUA-Guatemala City	TACA International	-	12
GVA-Geneva	Delta/Swissair	-	5
JED-Jeddah	Saudi Arabian Airlines	New York	1
KEF-Reykjavik*	Icelandic Air	-	7
KIN-Kingston*	Air Jamaica	Montego Bay	7
LGW-London-Gatwick*	British Airways	-	7
LHR-London-Heathrow	British Airways	-	14
	United Airlines	-	7
LUX-Luxembourg*	Icelandic Air	Reykjavik	7
MAD-Madrid	United Airlines	-	7
MBJ-Montego Bay*	Air Jamaica	-	7
MXP-Milan	United Airlines	-	7
NRT-Tokyo-Narita	All Nippon Airways	-	3
	Japan Air Lines	-	2
RUH-Riyadh	Saudi Arabian Airlines	New York	2
	" "	New York, Jeddah	1
SAL-San Salvador	TACA International	Guatemala City	7
SEL-Seoul	Korean Air Lines	New York	3
SVO-Moscow	Delta	Frankfurt	7
VIE-Vienna	Delta/Austrian Airlines	Geneva	5
ZRH-Zurich	United Airlines	-	7
	Swissair	Boston	2

* Service operates from Baltimore-Washington International Airport (BWI). All other service operates from Dulles (IAD).

SOURCES: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services.). Oak Brook, IL: Reed Travel Group.

Table K-4. Overseas Service from Minneapolis-St. Paul International Airport (MSP), 1980 & 1995

1980			
Destination	**Air Carrier**	**Stops**	**Flights per week**
AMS-Amsterdam	Northwest Airlines	*Chicago, New York, Boston Glasgow*	*2*
ARN-Stockholm	Northwest Airlines	Detroit, New York, Copenhagen	3
	" "	Detroit, New York, Oslo	2
CPH-Copenhagen	Northwest Airlines	Detroit, New York	3
	Northwest Airlines	Boston, Glasgow	2
GEN-Oslo	Northwest Airlines	Detroit, New York	2
HAM-Hamburg	Northwest Airlines	London	2
LGW-London-Gatwick	Northwest Airlines	-	7
NRT-Tokyo-Narita	Northwest Airlines	Honolulu	7
PIK-Glasgow	Northwest Airlines	Boston	2
	" "	Boston, Shannon	2
	" "	*Chicago, New York, Boston*	*2*
SEL-Seoul	Northwest Airlines	Honolulu, Tokyo	7
SNN-Shannon	Northwest Airlines	Boston	2

1995			
Destination	**Air Carrier**	**Stops**	**Flights per Week**
AMS-Amsterdam	Northwest/KLM	-	14
FRA-Frankfurt	Northwest	-	1
	" "	Detroit	6
HKG-Hong Kong	Northwest	*Anchorage, Tokyo*	*1*
	Federal Express	*Anchorage, Tokyo*	*1*
KIX-Osaka	Federal Express	*Anchorage*	*1*
KUA-Kuala Lumpur	Federal Express	*Anchorage, Osaka, Subic Bay*	*1*
LGW-London-Gatwick	Northwest	-	7
NRT-Tokyo-Narita	Northwest	-	1
	" "	Seattle	7
	" "	*Anchorage*	*1*
	" "	*Houston, Los Angeles, Anchorage*	*1*
PEN-Pennang	Federal Express	*Anchorage, Osaka, Subic Bay,*	*1*
SIN-Singapore	Northwest	*Houston, Los Angeles, Anchorage, Tokyo*	*1*
	Northwest	Seattle, Tokyo	7

NOTE: *Italicized text* indicates all-cargo service.

SOURCES: Official Airline Guides. (September, 1995). *Worldwide Edition Air Cargo Guide.* Oak Brook, IL: Reed Travel Group; Official Airline Guides. (September, 1980). *Worldwide Edition Air Cargo Guide* (electronic data file prepared by BACK Information Services.). Oak Brook, IL: Reed Travel Group.