

Institute of Transportation Studies
University of California at Berkeley

**The California Aviation System:
Current Status and Recent Trends**

**Mark M. Hansen
Geoffrey D. Gosling
Colin Rice**

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Preface and Acknowledgments

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Executive Summary

This report presents statistical information on aircraft activity and passenger and cargo traffic at California airports. Four main topics are considered: passenger enplanements, air travel origin and destination (O-D) patterns, aircraft operations, and air cargo. In each case, we present data for the state as a whole, major regions within the state, and major airports within each region. Most of the data are compiled on an annual basis for the years from 1980 to 1996.

Enplanement activity in California is heavily concentrated, with a handful of airports accounting for the vast majority of the state total. The concentration has increased between 1980 and 1996, during which time California's enplanement growth mirrored national trends. However, within the multiple airport systems of the San Francisco Bay Area and Southern California there is evidence of dispersion, as San Francisco International (SFO) and Los Angeles International (LAX) airports have lost market share to their smaller competitors.

Analysis of the O-D travel patterns of air passengers in the state reveals that the California intrastate and Northeast U.S. markets are the largest sources of California passenger traffic, while on a per-capita basis the state of Nevada and the Pacific region (including Hawaii, Guam and Pacific Territories) generate the most air travel in California. Analysis of recent trends shows that the Northwest (Alaska, Idaho, Montana, Oregon, Washington, and Wyoming), Mountain (Colorado and Utah), and Nevada regional markets are growing the most rapidly. There are marked airport-to-airport differences in the market composition of passenger traffic, with SFO and LAX dominating long-haul markets to the Northeast (Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia,) and Pacific regions, and the other airports far more competitive in short-haul markets such as Nevada and the Southwest (Arizona and New Mexico).

When aircraft operations (counting both take-offs and landings) are considered, several contrasts with the passenger traffic results are found. Operations are far less concentrated, reflecting the large amount of general aviation activity occurring outside California's largest urban areas. Also, while passenger traffic growth has been strong, the number of aircraft

operations has actually declined since 1980, both for California as a whole and for all of its major regions. Operations have increased at many of the state's largest airports, including LAX, SFO, Oakland, Sacramento Metro and San Diego International, but in all cases operations growth is considerably less than enplanement growth.

Between 1980 and 1996, the average annual growth rate of air carrier operations at the commercial service airports in the four largest metropolitan areas was generally less than the average annual growth rate of enplaned passengers. Air carrier operations increased at a significantly greater rate than enplaned passengers at only one airport (Long Beach Municipal), and grew at about the same rate as enplaned passengers at two others (Oakland International and Orange County airports). The state's two largest airports, Los Angeles International and San Francisco International, had the greatest increase in passengers per operation, with air carrier aircraft operations increasing at less than a third the average annual growth rate of enplaned passengers at Los Angeles International and somewhat less than half the growth rate of enplaned passengers at San Francisco International.

The growth of air cargo at the ten top cargo airports in California has been very fast. The combined growth rate of the ten airports during the six years from 1991 to 1996 is 57.6 percent, with an average annual growth rate of almost 10 percent. Seven out of the ten airports experienced a growth rate higher than 50 percent during the period. In particular, air cargo at Orange County, Oakland and Sacramento Metro airports grew 952 percent, 189 percent, and 121 percent, respectively. The average annual growth rate for Orange County Airport during the period was over 150 percent. At the regional level, the air cargo traffic in all four major regions of the state grew over 50 percent in the six years, while that in the two smaller of those regions grew faster than that in the two largest.

As of September 1998, there were 257 public-use airports in California, of which 230 were publicly owned. The California Aviation System Plan Inventory Element classifies airports into a number of *Functional Categories*, based on the services provided by each airport and the role that it plays in the aviation system. This system follows FAA practice of classifying air carrier airports as either Commercial or Primary, based on the level of enplanements, and general aviation airports as either General Aviation or Reliever, depending on whether the airport is eligible to receive funding as a reliever airport under the FAA Airport Improvement Program.

Within these categories, airports are classified by the California functional classification as Metropolitan, Regional, Community or Limited Use airports. As of September 1998, there were 28 Commercial or Primary airports in the state, 18 Metropolitan airports, 68 Regional airports, 103 Community airports, and 38 Limited Use airports. There were also two joint use military airports with commercial air service.

1. Introduction

This report is intended to provide an overview of the current state of the California aviation system and recent trends in the evolution of the system. The aviation system is critical to the economy of the state, and forms an essential element of the transportation system, particularly for longer distance travel and freight movement. At the same time, rising traffic levels at the major airports in the state are threatening to overwhelm their capacity, while changes in the pattern of general aviation activity pose significant problems for the viability of the large number of smaller airports.

However, the scale and complexity of the aviation system in California make it difficult to comprehend. The supply of data on the system is virtually endless. The challenge is to synthesize these data to identify key trends and forces shaping the evolution of the system. The objective of this report is to provide both a high level picture of the current state of the system and the nature of the underlying trends, as well as a source of more detailed data on specific aspects of the system.

The presentation of the data is organized by region within the state, as well as by individual airport. The sheer number of airports in California require some level of aggregation to comprehend the overall pattern of activity. The regional approach also reflects the role of regional transportation planning agencies in establishing policies and allocating funding for other elements of the transportation system. If the aviation system is to be properly integrated into a comprehensive, multi-modal transportation planning process, then effective aviation system planning must occur at the regional as well as the state level.

The remainder of this report is divided into four chapters. Chapter 2 examines trends in the passenger traffic at California airports. The following chapter expands on this by addressing the pattern of the underlying travel, and how the level of traffic in each market is changing over time. Chapter 4 explores the recent trends in aircraft operations at both regional and airport levels. Chapter 5 addresses trends in air cargo traffic at the top ten cargo airports in California. References for the data sources used in generating these statistics are listed at the end of the report.

It is recognized that the information presented in this report addresses only some of the many aspects of the aviation system that are likely to be of interest to planners, policy makers, and others. It is also recognized that to remain relevant to the needs of the state, the information contained in this report will need to be updated on a regular basis. The hope is that updates of this document will be published periodically, with future editions incorporating more recent data and addressing other aspects of the state aviation system, as time and resources permit.

2. Passenger Traffic

This chapter examines recent trends in enplaned passengers, also known as enplanements, at California airports. An enplanement occurs when a passenger boards a commercial flight, whether at the beginning of the journey or in making a connection from an earlier flight. (A passenger who reboards the same flight after deplaning at a stop is not counted, however.) The volume of enplanements is a direct indicator of the level of commercial passenger activity, and is used to track growth over time as well as in making comparisons across airports.

Enplanement data were compiled from the *Terminal Area Forecasts* (TAF) published by the Federal Aviation Administration. The TAF data base contains annual data on enplanements and operations for all U.S. commercial airports beginning in 1976, and can be accessed by the general public through the Worldwide Web. There are some 206 California airports included in the TAF data base for the year 1996, of which 39 had some enplanement activity.

Perhaps the most striking observation arising from these data is the extreme concentration of enplanement activity in the California airport system. The top enplanement airport, Los Angeles International, accounts for over one third of the state total. Well over half of California enplanements occurred at Los Angeles International (LAX) or San Francisco International (SFO) airports, and over 98 percent at one of the top 10 airports. Only 16 airports, which are listed in Table 2-1, had more than 100,000 enplanements in 1996. Enplanement activity is also disproportionately concentrated in California's largest urban regions. The Southern California, San Francisco Bay Area, San Diego, and Sacramento metropolitan regions together account for 96 percent of California enplanements (as shown in Figure 2-1), compared with 82 percent of the state's population.

Multiple airport regions play a major role in the state's commercial airport system. As shown in Table 2-2, the two largest urban areas in the State are served by multiple airports—six in the case of Southern California and three in the case of the San Francisco Bay Area. In these regions, which accounted for 85 percent of California enplanements in 1996, travelers have significant choices of what airport to use, and airlines of what airports to serve. While probably

desirable from a consumer's standpoint, this "footlooseness" can increase the complexity and uncertainty of airport planning.

Figure 2-2 and Table 2-3 show the recent trends in the airport enplanement levels for California as a whole and for its major regions. Growth in California enplanements has been quite strong, averaging 4.5 percent per year since 1980. This growth rate slightly outstrips the 4.4 percent annual rate of national enplanement growth. In fact, this slight difference reflects the near cancellation of two larger and opposing forces. First, California's population has grown at 1.9 percent annually since 1980, well over the national population growth rate of 1.0 percent. Conversely, the state's enplanements per capita have grown more slowly than that for the nation as a whole: 2.6 percent annually as compared to 3.3 percent. Thus, California's average annual enplanement growth rate of 4.5 percent can be decomposed into three components: 4.4 percent that reflects national growth in passenger enplanements, an additional 0.9 percent deriving from higher than national population growth, and a negative component of 0.8 percent reflecting lower growth in enplanements per capita than for the nation as a whole.

California's four large urban regions account for virtually all of the enplanement growth (as shown in Table 2-4). San Diego and Sacramento have experienced the highest growth rates—6.5 and 5.7 percent respectively—while those for Southern California and the San Francisco Bay Area have been slightly less. In contrast, enplanements for the rest of the state have declined slightly from 1980 to 1996. This lack of growth probably derives from the declining Federal commitment to support small community air service in the face of airline deregulation and budgetary pressures. The effect of deregulation is evident in the years just after 1980, when enplanements at airports outside the four major regions dropped dramatically.

Although San Diego and Sacramento have been gaining ground, the San Francisco Bay Area and Southern California continue to account for by far the largest number of enplanements. As shown in Table 2-3, these regions have maintained stable enplanement shares since 1980—Southern California at just under one-half, and the Bay Area at around one-third. These regions' shares of California's population have likewise remained fairly stable, although the Bay Area's share has declined slightly. Table 2-3 also reveals an interesting contrast between the regions. While Southern California's shares of enplanements and population are roughly equal, the Bay Area has a much larger enplanement share than population share: 35 percent versus 21 percent in

1996. One possible explanation is that more users of Bay Area airports reside outside the region. Included within this group are visitors to the region, residents of surrounding regions who use Bay Area airports for their air travel needs, and passengers from outside the region who connect through these airports.

While both the Bay Area and Southern California are multiple airport regions, both also feature a single dominant airport. As shown in Figures 2-3 and 2-4, the vast majority of enplanements in the Southern California region use LAX, while SFO plays a similar, albeit slightly less dominant, role in the Bay Area. However, Tables 2-5 and 2-6 reveal that the most rapid traffic growth has been at the secondary airports. In Southern California, both Ontario (ONT) and Orange County (SNA) airports have seen enplanements grow at over 7 percent annually, twice the rate at LAX. A similar story is seen in the Bay Area, where annual passenger traffic growth rates at Oakland and San Jose have averaged 9.9 and 7.5 percent, respectively, in contrast to 3.5 percent at SFO. Likely causes of these trends include the shifting patterns of regional development and capacity constraints at LAX and SFO. In addition, traffic growth in these regions may encourage greater dispersion of activity among airports, as traffic volumes in more markets cross thresholds at which services from more than one airport can be supported. The role of low cost carriers such as Southwest, who have chosen to launch their services out of secondary airports, has also been important.

Table 2-7 and Figure 2-5 show enplanement trends for airports outside California's largest urban areas. Table 2-7 shows that only two airports have experienced positive enplanement growth between 1980 and 1996. However, the enplanement data shows evidence of instability and fluctuation, with enplanement levels changing dramatically—sometimes rising and sometimes falling—from year-to-year. The fluctuations show how the decisions of individual airlines to expand and contract services affect traffic at smaller airports.

To summarize this section, analysis of enplanement data reveals several important features about the state of the California aviation system. The system is heavily concentrated, with a small number of airports and regions accounting for the vast majority of traffic. The concentration has increased since 1980. During this period, California's overall traffic growth has just about kept pace with that in the rest of the U.S., even as its population growth has exceeded national trends. Multiple airport systems in Southern California and the Bay Area

continue to dominate California's commercial airport landscape, and there is evidence of dispersion within these systems as LAX and SFO lose regional market share to secondary airports such as Ontario and Oakland. At airports outside California's largest metropolitan areas, enplanement growth since 1980 has been weak, and in several cases negative, while year-to-year fluctuations have been more pronounced.

Table 2-1

California Airports Handling Greater than 100,000 Total Passengers 1996

Airport	Code
Bakersfield Municipal	BFL
Burbank/Glendale/ Pasadena	BUR
Fresno Air Terminal	FAT
Los Angeles International	LAX
Long Beach Municipal	LGB
Monterey Peninsula	MRY
Ontario International	ONT
Oakland International	OAK
Palm Springs Regional	PSP
San Diego International/Lindbergh	SAN
Santa Barbara Municipal	SBA
San Luis Obispo	SBP
San Jose International	SJC
San Francisco International	SFO
Sacramento Metropolitan	SMF
Orange County/John Wayne	SNA

Source: Federal Aviation Administration, *Terminal Area Forecast*

Table 2-2

California Airports with over 100,000 Enplanements in 1996, by Region

Southern California	Bay Area	San Diego	Sacramento	Rest of State
BUR	OAK	SAN	SMF	BFL
LAX	SFO			FAT
LGB	SJC			MRY
ONT				SBA
SNA				SBP
PSP				

Table 2-3

Comparison of Enplanement Shares of Southern California and San Francisco Bay Area

	1980	1990	1996	Average Growth 1980-1996
United States				
Population (000)	226,542	248,718	265,293	1.0%
Enplanements (000)	309,914	495,617	613,649	4.4%
California				
Population (000)	23,667	29,758	31,878	1.9%
Enplanements (000)	38,556	60,021	78,165	4.5%
% of U.S. Population	10.4%	12.0%	12.0%	
% of U.S. Enplanements	12.4%	12.1%	12.7%	
Los Angeles CMSA				
Population (000)	11,498	14,532	15,495	1.9%
% of state Population	48.6%	48.8%	48.6%	
% of total Enplanements	50.2%	49.4%	48.4%	
San Francisco CMSA				
Population (000)	5,368	6,250	6,605	1.3%
% of state Population	22.7%	21.0%	20.7%	
% of total Enplanements	34.2%	34.6%	35.3%	

Source: U.S. Department of Commerce, *Statistical Abstract of the United States*; Federal Aviation Administration, *Terminal Area Forecast*

Table 2-4
California Enplanements by Region
 (Thousands)

Year	Southern California	Bay Area	San Diego	Sacramento	Rest of State	Total
1980	19,638	13,193	2,756	1,228	1,741	38,556
1981	18,895	11,565	2,450	1,054	1,154	35,118
1982	19,231	12,519	2,565	1,131	1,122	36,568
1983	20,581	14,450	3,113	1,269	1,349	40,762
1984	21,355	15,006	3,573	1,292	1,433	42,659
1985	24,367	16,545	4,000	1,411	1,249	47,572
1986	26,755	17,977	4,480	1,631	1,745	52,588
1987	29,410	19,462	4,989	1,896	1,823	57,580
1988	29,394	19,639	5,328	1,839	1,547	57,747
1989	30,011	20,093	5,467	1,853	1,673	59,097
1990	30,110	20,760	5,488	1,807	1,856	60,021
1991	31,042	21,643	5,617	2,176	2,867	63,345
1992	32,060	22,584	5,968	2,629	2,038	65,279
1993	32,335	22,528	5,883	2,639	1,842	65,227
1994	34,523	24,266	6,296	2,829	1,609	69,523
1995	36,015	25,944	6,626	3,308	1,507	73,400
1996	38,231	27,913	6,841	3,461	1,719	78,165
Average Growth	4.3%	4.8%	5.8%	6.7%	-0.1%	4.5%

Source: Federal Aviation Administration, *Terminal Area Forecast*

Table 2-5
Enplanements for Southern California Airports
 (Thousands)

Year	LAX	ONT	SNA	BUR	LGB	PSP	Total
1980	15,957	1,055	1,176	1,053	101	267	19,638
1981	15,717	1,090	1,151	869	52	243	18,895
1982	15,690	967	1,229	975	161	209	19,231
1983	15,979	1,206	1,318	1,425	409	244	20,581
1984	16,349	1,448	1,389	1,365	531	273	21,355
1985	18,694	1,733	1,538	1,505	540	357	24,367
1986	20,428	2,020	1,911	1,486	564	346	26,755
1987	22,399	2,238	2,190	1,574	608	401	29,410
1988	22,342	2,375	2,201	1,512	573	391	29,394
1989	22,749	2,623	2,232	1,343	662	402	30,011
1990	22,276	2,670	2,291	1,729	693	451	30,110
1991	22,575	2,873	2,636	1,843	650	465	31,042
1992	23,335	3,044	2,861	1,901	446	473	32,060
1993	23,466	3,043	2,993	2,063	313	457	32,335
1994	24,932	3,225	3,253	2,372	261	480	34,523
1995	26,147	3,234	3,521	2,471	185	457	36,015
1996	28,247	3,189	3,577	2,465	204	549	38,231
Average Growth	3.6%	7.2%	7.2%	5.5%	4.5%	4.6%	4.3%

Source: Federal Aviation Administration, *Terminal Area Forecast*

Table 2-6
Enplanements for Bay Area Airports
(Thousands)

Year	SFO	SJC	OAK	Total
1980	10,594	1,544	1,055	13,193
1981	9,161	1,314	1,090	11,565
1982	9,710	1,378	1,431	12,519
1983	11,273	1,710	1,467	14,450
1984	11,490	1,880	1,636	15,006
1985	12,233	2,180	2,132	16,545
1986	13,272	2,783	1,922	17,977
1987	14,647	2,836	1,979	19,462
1988	14,892	2,818	1,929	19,639
1989	14,782	3,217	2,094	20,093
1990	14,694	3,345	2,721	20,760
1991	15,187	3,443	3,013	21,643
1992	15,936	3,512	3,136	22,584
1993	15,639	3,304	3,585	22,528
1994	16,396	3,986	3,884	24,266
1995	16,887	4,336	4,721	25,944
1996	18,325	4,779	4,809	27,913
Average Growth	3.5%	7.3%	9.9%	4.8%

Source: Federal Aviation Administration, *Terminal Area Forecast*

Table 2-7
Enplanements Other California Airports
 (Thousands)

Year	Fresno	Santa Barbara	Monterey	Bakersfield	San Luis Obispo	Other
1980	499	226	241	127	100	592
1981	335	166	193	52	34	354
1982	354	202	203	71	32	236
1983	419	218	186	79	45	379
1984	454	319	215	90	59	281
1985	412	329	193	135	53	109
1986	421	274	228	124	53	618
1987	483	327	275	133	66	525
1988	405	296	232	119	65	439
1989	424	310	249	125	60	495
1990	461	309	240	138	82	653
1991	576	330	280	176	93	726
1992	558	314	290	144	109	599
1993	515	277	243	134	114	557
1994	500	269	209	114	106	446
1995	458	262	213	111	120	378
1996	512	302	224	107	124	490
Average Growth	0.2%	1.8%	-0.5%	-1.1%	1.3%	-1.2%

Source: Federal Aviation Administration, *Terminal Area Forecast*

Figure 2-1 California Enplaned Passengers by Region, 1996

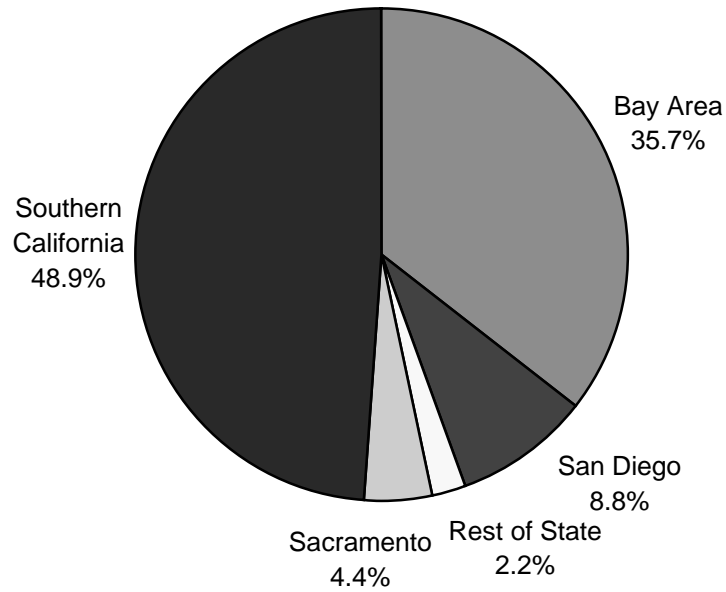


Figure 2-2 Trends in California Enplanements, by Region

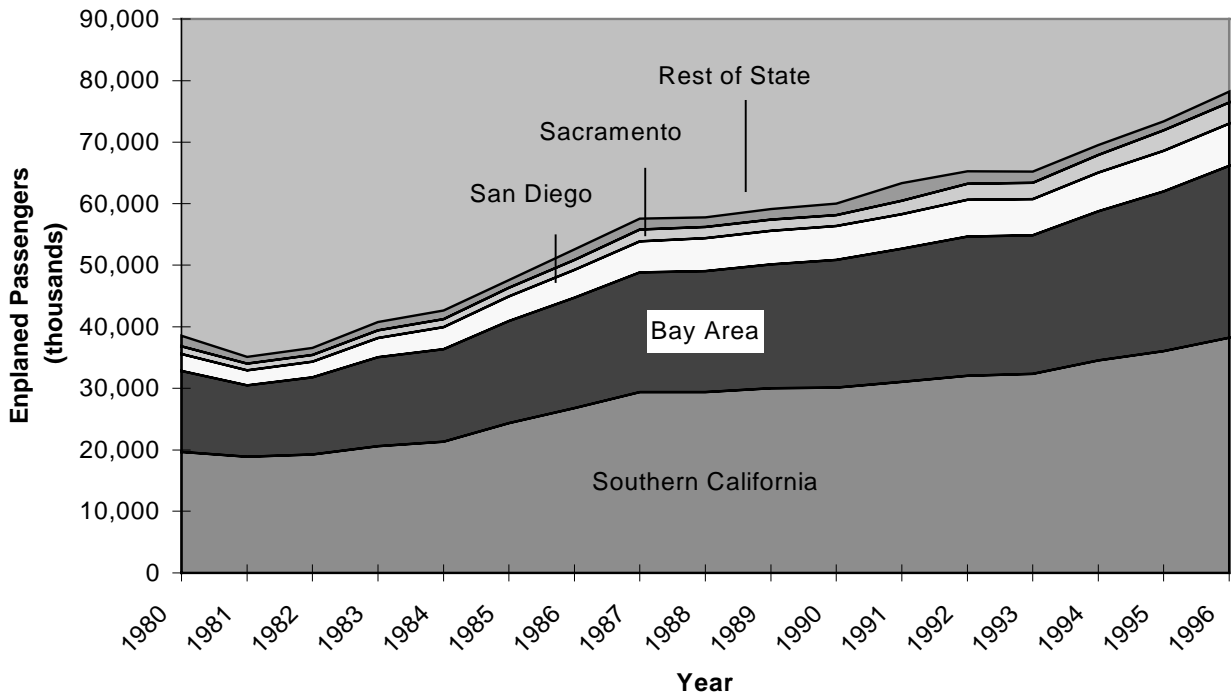


Figure 2-3 Trends in Southern California Enplanements, by Airport

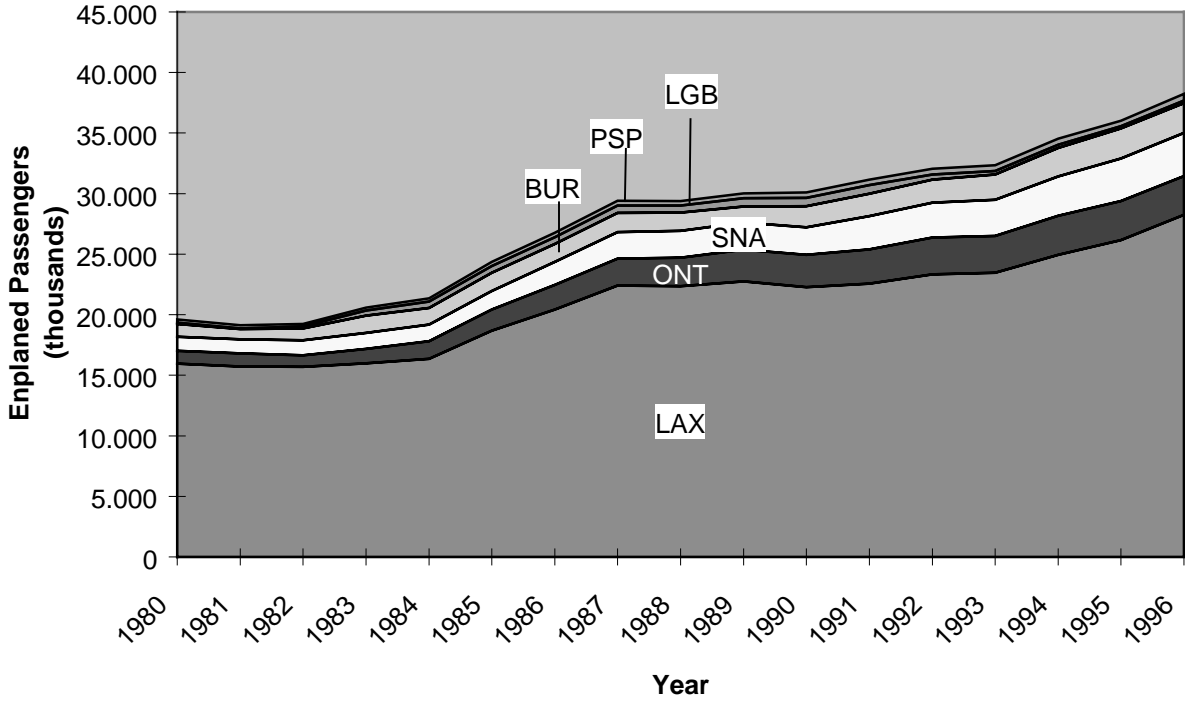


Figure 2-4 Trends in Bay Area Enplanements, by Airport

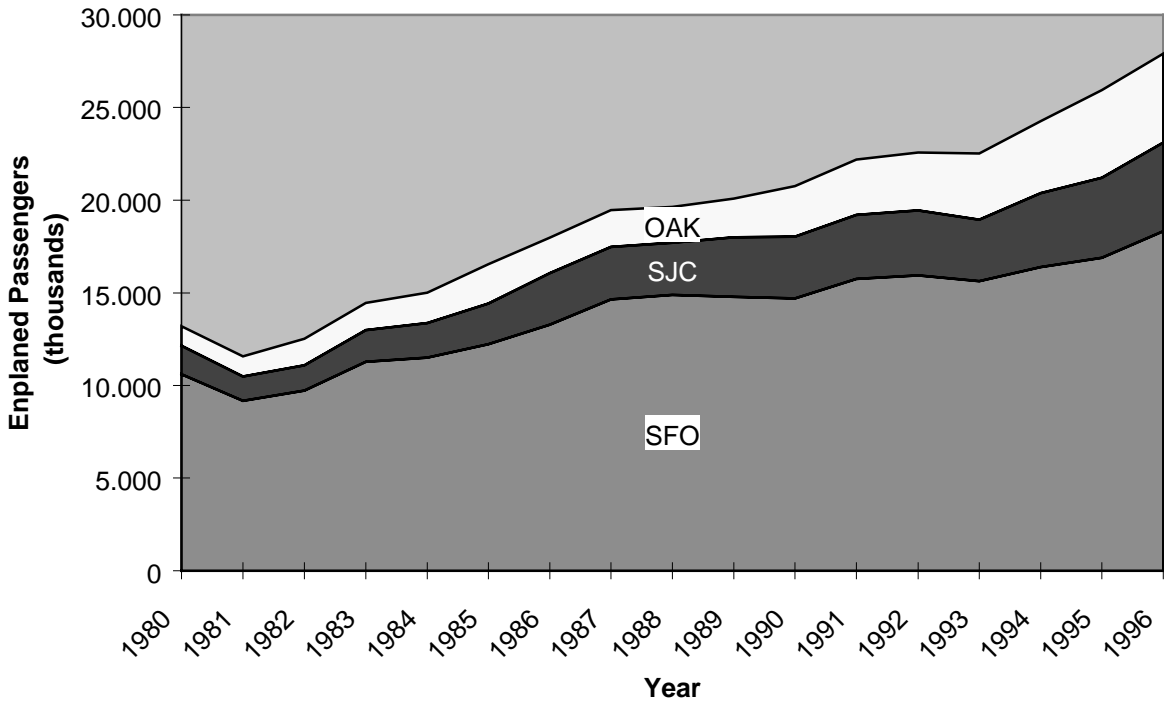
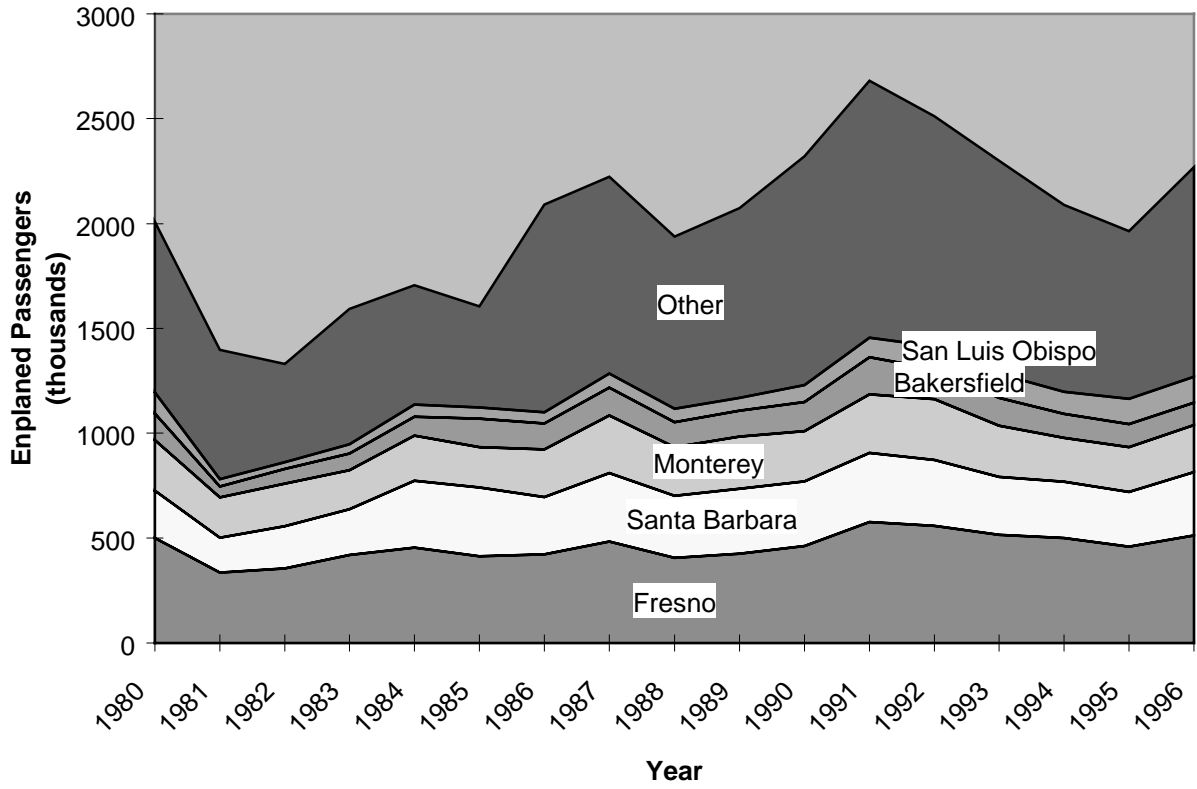


Figure 2-5 Enplanement Trends at Other California Airports



3. Air Travel Patterns

This chapter examines the geographic pattern of air travel by passengers flying to and from California airports. While the number of enplaned passengers at an airport is a useful measure of overall air travel activity, it provides no information on where those passengers are coming from or going. This chapter will present such data, first for California as a whole, and then for the state's two largest airports: Los Angeles International and San Francisco International.

The data provided in this chapter were obtained from the ODPlus database, a product of Data Base Products, Incorporated. The ODPlus database contains data from a 10 percent sample of domestic ticket coupons provided by air carriers and compiled by the U.S. Department of Transportation. The data analyzed here are based on all sample coupons of air travelers who originate or terminate their travel within California.

The analysis presented in this chapter only considers air travel within the U.S. This accounted for some 87 percent of all passenger enplanements in 1996. Analysis of international travel patterns requires the integration of several data sources, due to the role of foreign flag airlines in these markets, and has been deferred for a subsequent study.

California Air Travel Patterns

California air travel in domestic markets involves hundreds of destinations within and outside the state. To obtain an overall view of these travel patterns, it is useful to aggregate the origins and destinations regionally within the U.S. Eleven regions were defined: California, Midwest, Mountain, Nevada, North Central, Northeast, Northwest, Pacific, South Central, Southeast, and Southwest. The states and territories included in each region are shown in Table 3-1.

Figure 3-1 and Table 3-2 show the distribution of California air traffic by regional market. As shown in Figure 3-1, 18 percent of California's air travelers are traveling within California, making it the largest regional market. The second largest is the Northeast (15 percent), followed by the Northwest (12 percent). Below this is a tier consisting of six

regions each of whose share is in the 6 to 9 percent range. The North Central and Pacific markets have the lowest shares.

A different perspective on these data is obtained by normalizing market sizes by the resident population of each region, as shown in Figure 3-3. Nevada emerges as the destination with the highest travel “density”, reflecting its importance as a leisure destination for California travelers, as well as its sparse population. Similar conditions cause the Pacific region (which includes Hawaii) to be the second most dense market on the basis of resident population. The Southwest, Northwest, and Mountain regions occupy the next tier. These regions are less important than the first two as tourist destinations, but are fairly close to California. After these comes California intrastate travel. It may seem somewhat surprising that the intrastate market does not rank higher in air travel per capita, but it must be remembered that the vast majority of intrastate trips use modes other than air because of the short distances involved. The five remaining regions, all with travel densities less than 0.5 annual trips per resident, are the ones that are more distant from California.

These statistics provide an interesting perspective on the supposed “bi-coastal” nature of domestic air travel to and from California. Figure 3-1 reveals that in total, about one third of California domestic air trips involves travel in West Coast markets (the California, Northwest, and Pacific regions), and about a quarter of the trips are to and from the East Coast (the Northeast and Southeast regions). The remaining 40 percent are distributed over the interior regions of the U.S. On the other hand, Figure 3-2 shows that when the populations of the regions are considered, travel origins and destinations in the central regions of the country generate just as much travel as those on the East Coast. In other words, air travel is bi-coastal only because the population of the country is.

Figure 3-3 and Table 3-2 show trends in California O-D traffic during the period from 1993 to 1996, both in terms of the absolute growth and percentage growth. The Northwest region shows the strongest growth by either measure. Traffic between California and the Mountain states and Nevada also increased sharply in both absolute and percentage terms. The intrastate market and the Northeast grew strongly in absolute terms, but less so on a percentage basis. In general, the disparity in growth rates among the regional markets is notable. Plainly,

growth in California air travel over this period has been accompanied by a significant redistribution of activity.

Airport Variation in Air Travel Patterns

In order to show how air travel patterns vary among California airports, the domestic O-D traffic statistics for LAX, SFO, and all other airports in the state are summarized in Table 3-3 and Figure 3-4. Of 96 million domestic one-way air trips to or from California in 1996, a third used LAX, a fifth used SFO, and the remainder some other airport. The shares vary substantially across the different regional markets, however. The other- airports in the state in total have larger shares in the shorter-haul markets, such as the Northwest (61 percent), Southwest (57 percent), and Nevada (56 percent), but low shares in long-haul services to the Pacific (5 percent) and Northeast (28 percent). Additional differences are seen between LAX and SFO. The SFO shares of traffic to the Southwest and Nevada are much less than those for LAX, while it has higher shares of the traffic in the Northeast and Northwest markets.

The Top 50 California O-D Markets

Finally, considering individual markets, Table 3-4 presents the top 50 California airport O-D markets. All together, the top 50 markets account for 43 percent of California air travel. LAX-Las Vegas, with over 2 million passengers in 1996, is the largest by a considerable margin. To put this traffic level in perspective, at 100 passengers per flight, this market would require over 25 flights per day in each direction. There are nine other markets with over 1 million passengers, of which eight involve LAX. Seven of the top ten markets are comparatively short-haul, the three exceptions being between LAX and New York Kennedy, Chicago O'Hare and Honolulu International airports.

The next 40 markets had between 492 and 968 thousand passengers. All but four of the markets involve an airport in either the San Francisco Bay Area or Southern California, and no airport outside the state's four largest urban areas is represented on the list. Fourteen of the markets are intrastate. Of the 14 out-of-state destinations, those with the most airport pairs in the top 50 markets are Las Vegas (six), Seattle (five), Portland (four), and Phoenix (three).

Table 3-1
States and Territories Grouped by Region

Region	States and Territories	Resident Population 1996
		(000)
California	California	31,858
Midwest	Illinois, Indiana, Michigan, Ohio, Wisconsin,	43,713
Mountain	Colorado, Utah	5,834
Nevada	Nevada	1,601
North Central	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota	18,470
Northeast	Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia	66,309
Northwest	Alaska, Idaho, Montana, Oregon, Washington, Wyoming	11,866
Pacific	Hawaii, Guam, Pacific Territories	1,387
South Central	Arkansas, Louisiana, Oklahoma, Texas,	29,233
Southeast	Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Puerto Rico	52,749
Southwest	Arizona, New Mexico	6,145

Source: U.S. Department of Commerce, *Statistical Abstract of the United States*

Table 3-2
California O-D Traffic by Regional Market, 1993-1996
(Thousands)

Region	1993	1994	1995	1996	Absolute Growth 1993-1996	Per Cent Growth 1993-1996
California	13.919	15.539	16.763	17.010	3.091	22,21%
Midwest	7.261	7.521	7.798	8.374	1.113	15,32%
Mountain	4.137	5.128	5.371	6.026	1.888	45,65%
Nevada	5.897	7.258	7.329	7.938	2.041	34,61%
North Central	3.588	3.691	3.884	4.309	722	20,12%
Northeast	13.123	13.122	13.991	14.412	1.289	9,82%
Northwest	7.156	8.823	10.346	11.390	4.234	59,16%
Pacific	3.185	3.303	3.323	3.416	231	7,25%
South Central	6.490	6.811	6.840	7.234	743	11,45%
Southeast	7.236	7.260	7.643	8.342	1.106	15,29%
Southwest	6.632	7.234	7.375	7.712	1.080	16,29%

Source: Data Base Products, *ODPlus*

Table 3-3

California Origin and Destination Traffic by Regional Market and Airport, 1996

(Thousands)

Region	California	LAX	SFO	Other	LAX Share	SFO Share	Other Share
California	17.010	6.080	4.989	5.942	35,7%	29,3%	34,9%
Midwest	8.374	2.793	2.092	3.489	33,3%	25,0%	41,7%
Mountain	6.026	1.942	1.104	2.980	32,2%	18,3%	49,4%
Nevada	7.938	2.499	997	4.442	31,5%	12,6%	56,0%
North Central	4.309	1.218	812	2.279	28,3%	18,9%	52,9%
Northeast	14.412	5.725	4.681	4.006	39,7%	32,5%	27,8%
Northwest	11.390	2.443	1.991	6.956	21,4%	17,5%	61,1%
Pacific	3.416	1.907	1.314	195	55,8%	38,5%	5,7%
South Central	7.234	2.206	1.219	3.808	30,5%	16,9%	52,6%
Southeast	8.342	3.059	1.934	3.349	36,7%	23,2%	40,1%
Southwest	7.712	2.405	899	4.409	31,2%	11,7%	57,2%
<i>Total</i>	96.163	32.277	22.033	41.854	33,6%	22,9%	43,5%

Source: Data Base Products, *ODPlus*

Table 3-4

Top 50 California O-D Markets, 1996

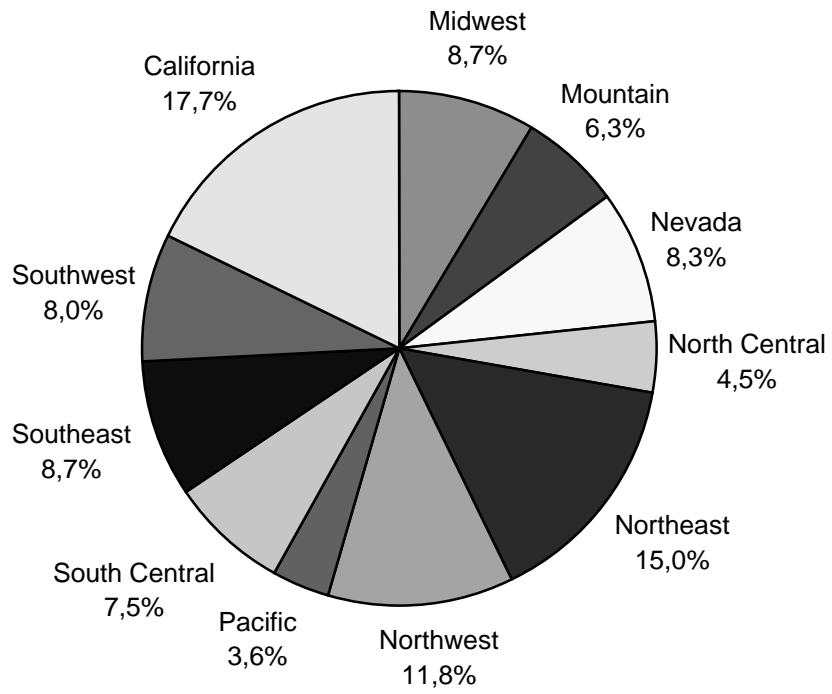
Rank	California Airport	Other Airport	1996 Pax (000)	Cumulative Percent
1	LAX	LAS (Las Vegas ,NV.)	2.023	2,10%
2	LAX	SFO (San Francisco ,CA.)	1.688	3,86%
3	LAX	OAK (Oakland, CA.)	1.675	5,60%
4	LAX	JFK (New York, N.Y.)	1.671	7,34%
5	LAX	PHX (Phoenix, AZ.)	1.412	8,81%
6	LAX	HNL (Honolulu, Oahu,HI.)	1.390	10,25%
7	LAX	SEA (Seattle, WA.)	1.225	11,53%
8	LAX	SJC (San Jose, CA.)	1.091	12,66%
9	SAN	SFO (San Francisco ,CA.)	1.077	13,78%
10	LAX	ORD (Chicago, IL.)	1.036	14,86%
11	SFO	JFK (New York, N.Y.)	968	15,86%
12	LAX	EWB (Newark, N.J.)	927	16,83%
13	SFO	SEA (Seattle, WA.)	907	17,77%
14	LAX	DEN (Denver, CO.)	896	18,70%
15	SFO	HNL (Honolulu, Oahu,HI.)	849	19,59%
16	OAK	BUR (Burbank, CA.)	840	20,46%
17	SNA	SJC (San Jose, CA.)	830	21,32%
18	SAN	PHX (Phoenix, AZ.)	828	22,18%
19	SFO	ORD (Chicago, IL.)	801	23,02%
20	LAX	SLC (Salt Lake City, UT.)	745	23,79%
21	SFO	EWB (Newark, N.J.)	740	24,56%
22	SMF	LAX (Los Angeles,CA.)	736	25,33%
23	SJC	SAN (San Diego, CA.)	731	26,09%
24	SFO	BOS (Boston, MA.)	728	26,84%
25	SAN	LAS (Las Vegas ,NV.)	723	27,60%
26	SNA	OAK (Oakland, CA.)	720	28,34%
27	OAK	SEA (Seattle, WA.)	711	29,08%
28	LAX	PDX (Portland, OR.)	704	29,82%
29	SFO	LAS (Las Vegas ,NV.)	689	30,53%
30	SFO	DEN (Denver, CO.)	668	31,23%

Table 3-4 (cont.)

Rank	California Airport	Other Airport	1996 Pax (000)	Cumulative Percent
31	LAX	BOS (Boston, MA.)	657	31,91%
32	BUR	LAS (Las Vegas ,NV.)	655	32,59%
33	SJC	SEA (Seattle, WA.)	654	33,27%
34	OAK	SAN (San Diego, CA.)	629	33,93%
35	SFO	PHX (Phoenix, AZ.)	627	34,58%
36	SMF	SAN (San Diego, CA.)	587	35,19%
37	LAX	IAD (Washington, D.C.)	586	35,80%
38	SFO	PDX (Portland, OR.)	584	36,41%
39	SFO	BUR (Burbank, CA.)	580	37,01%
40	SMF	BUR (Burbank, CA.)	575	37,61%
41	SMF	ONT (Ontario, CA.)	568	38,20%
42	ONT	OAK (Oakland, CA.)	567	38,79%
43	SJC	LAS (Las Vegas ,NV.)	552	39,36%
44	LAX	ATL (Atlanta, GA.)	551	39,93%
45	ONT	PHX (Phoenix, AZ.)	549	40,50%
46	SFO	IAD (Washington, D.C.)	542	41,07%
47	SJC	PDX (Portland, OR.)	515	41,60%
48	SAN	SEA (Seattle, WA.)	506	42,13%
49	OAK	LAS (Las Vegas ,NV.)	502	42,65%
50	LAX	MIA (Miami, FL.)	492	43,16%

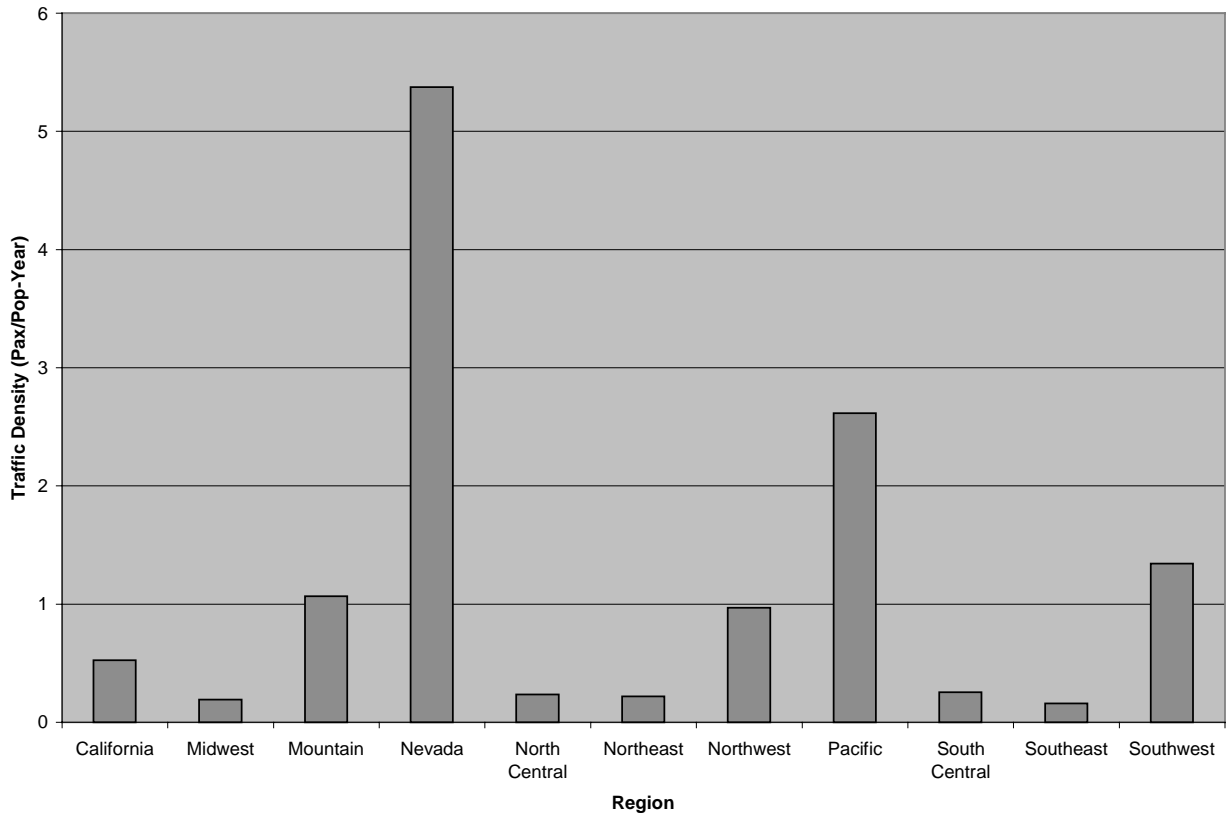
Source: Data Base Products, *ODPlus*

Figure 3-1 **Origins and Destinations of California Air Travelers, 1996**



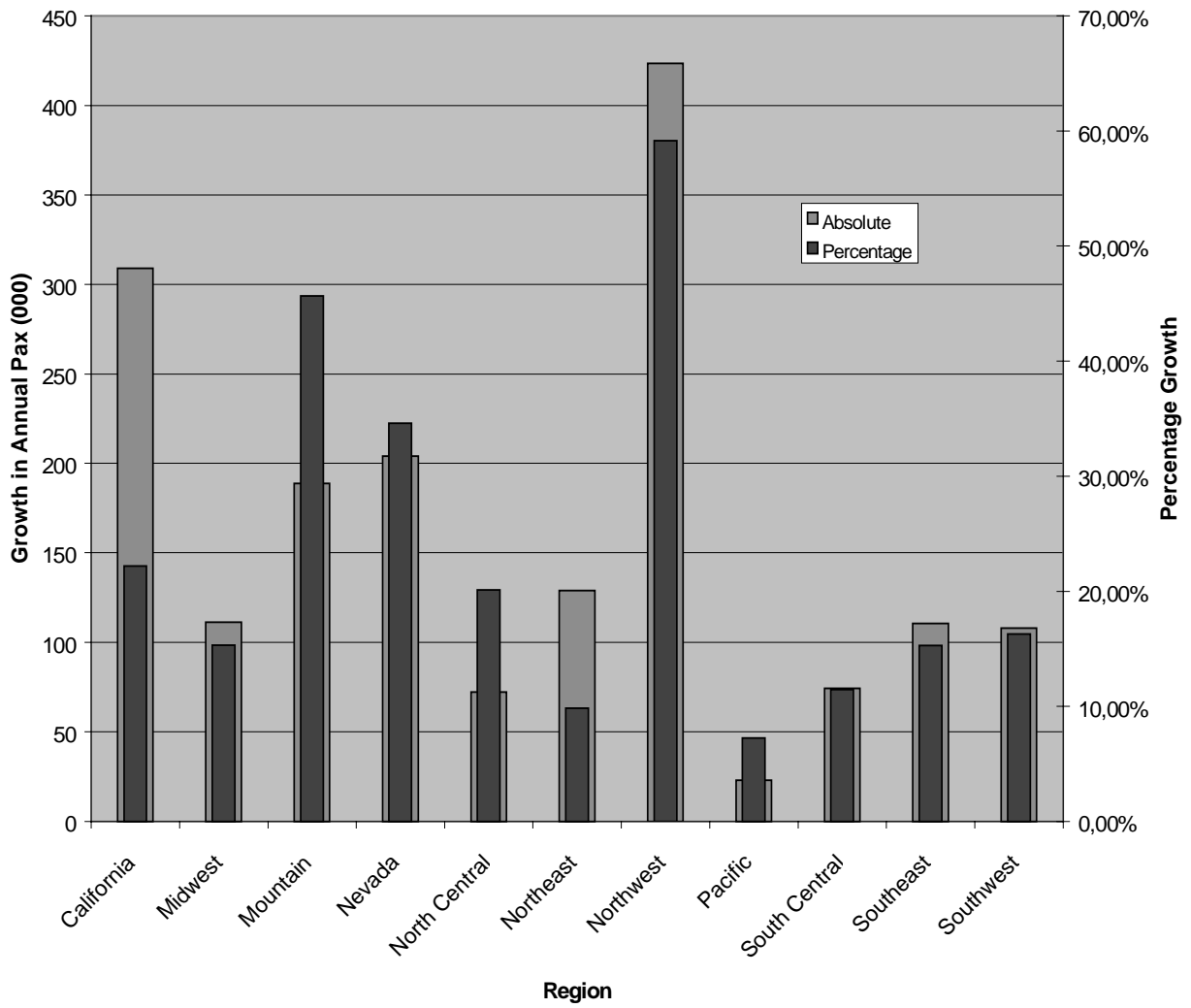
Source: Data Base Products, *ODPlus*

Figure 3-2 Traffic Density in California Regional Markets, 1996



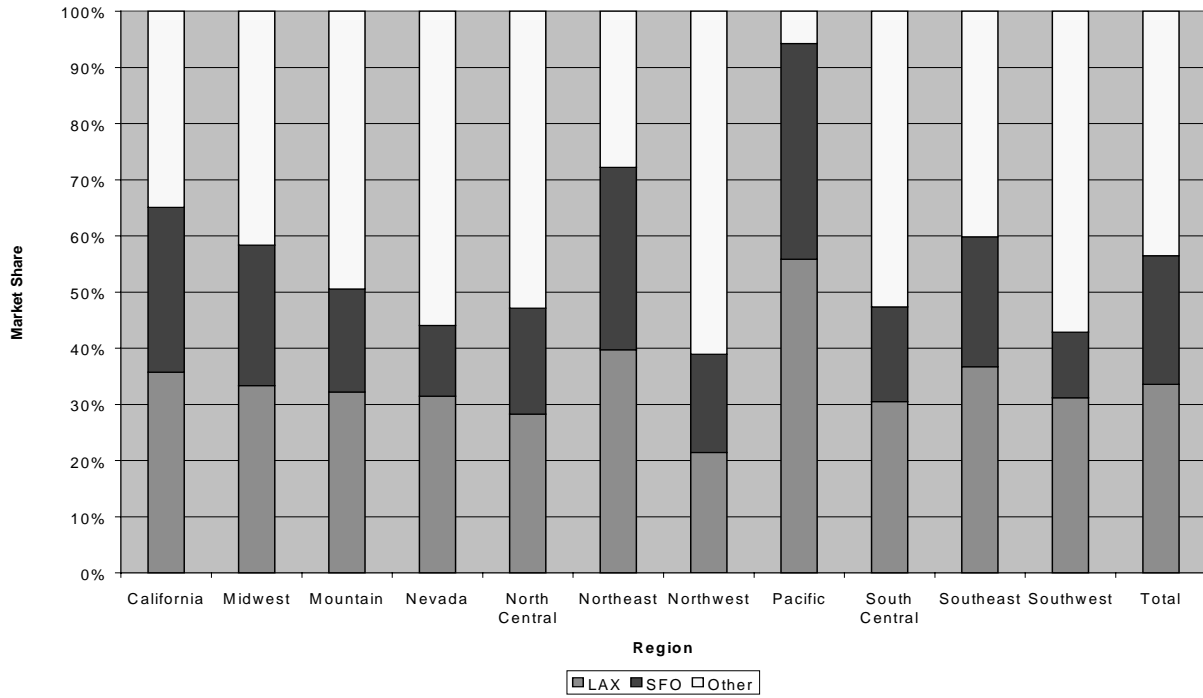
Source: Data Base Products, *ODPlus*

Figure 3-3 Traffic Growth in California Regional Markets, 1993-1996



Source: Data Base Products, *ODPlus*

Figure 3-4 Airport Shares of California Traffic by Regional Market, 1996



Source: Data Base Products, *ODPlus*

4. Aircraft Operations

This chapter considers recent trends in aircraft operations at California airports. An operation is a take-off or landing (or in the case of a touch-and-go operation, a combined landing and take-off) of an aircraft, regardless of service characteristics (*e.g.*, commercial, long-haul, short-haul, corporate, general aviation, domestic, international, *etc.*) or type of aircraft (*e.g.*, civilian or military). Operations are a good indicator of the amount of air traffic activity as experienced by the airfield and air traffic control infrastructure. In contrast to the passenger traffic statistics considered in Chapters 2 and 3 of this report, general aviation activity is strongly evident in aircraft operations statistics.

Figure 4-1 shows the distribution of aircraft operations by region. In contrast to the enplanements (see Figure 2-1), only about 55 percent of operations occur in the four large urban areas (compared to 97 percent of enplanements). Thus, while airport passenger traffic occurs disproportionately in large urban areas, the opposite trend is observed in the case of aircraft operations. This contrast is especially pronounced in the Bay Area, which in 1996 had 36 percent of the state's enplanements but only 17 percent of its operations, compared to 21 percent of the state population.

Table 4-1 and Figure 4-2 show the trend in operations from 1980 to 1996. In contrast to enplanements (shown in Table 2-4 and Figure 2-1), aircraft operations have declined throughout California since 1980, at an annual rate of about 1 percent. The trend has been fairly consistent across the various regions, with the exception of Sacramento, whose rate of decline is nearly double that of the other regions. As shown in Figure 4-2, there was a sharp decline in the early 1980s, followed by a slow resurgence that lasted into the early 1990s, after which the decline resumed.

Table 4-2 and Figure 4-3 show the aircraft operations at Southern California airports. The strongest declines have been at the general aviation (GA) airports and Long Beach Airport (LGB). LAX itself has experienced a growth in operations averaging 1.6 percent annually. These results suggest that a reduction in general aviation activity is a major reason for the overall

decline in operations. There is also evidence that the average size of commercial aircraft serving California has increased, since LAX's rate of growth in enplanements has been nearly twice that for its operations.

Table 4-3 and Figure 4-4 present similar statistics for the Bay Area. The general pattern is similar, with SFO being the only airport with significant growth in operations between 1980 and 1996, and the general aviation airports—along with San Jose Airport (SJC)—experiencing sharp declines. SFO's enplanement growth rate was three times its operations growth rate over the period from 1980 to 1996. This may reflect severe capacity constraints at SFO forcing airlines to absorb most passenger traffic through fleet upsizing.

Table 4-4 and Figure 4-5 show the trend in aircraft operations for the San Diego region. Again, there is a substantial decline in operations at general aviation airports, outweighing fairly strong growth in operations at San Diego International Airport (SAN). The latter is nonetheless well below the growth in enplanements between 1980 and 1996, which averaged 6.8 percent annually. Lastly, Table 4-5 and Figure 4-6 show a similar pattern in the Sacramento region, except that the growth in operations at Sacramento Metro Airport (SMF) was less pronounced, even though the enplanement growth, with an annual rate of 6.7 percent, was the highest of any region in the state.

The foregoing discussion has considered total aircraft operations of all types, including air carrier and general aviation, at each airport. Although there are relatively few general aviation operations at the two largest airports, Los Angeles International and San Francisco International, the other commercial service airports have a significant amount of general aviation activity, particularly Oakland International and San Jose International in the Bay Area and Orange County Airport in Southern California. Table 4-6 shows the change in the number of air carrier enplanements and aircraft operations between 1980 and 1996 at the air carrier airports in the four largest metropolitan regions.

The ratio of the growth in air carrier operations to the growth in air passenger enplanements varied widely across these airports. The average number of passengers per operation remained nearly the same at Oakland International and Orange County airports, and increased slightly at Ontario International and San Diego International. Sacramento Metropolitan and San Jose International had a somewhat greater increase in passengers per operation, and

Burbank airport greater still. Los Angeles International and San Francisco International had the greatest increase in passengers per operation, with air carrier aircraft operations increasing at an average rate of only about 1 percent per year at Los Angeles International, while enplaned passengers increased at an average rate of about 3.4 percent per year. Long Beach Municipal Airport was the only exception to this trend of stable or increasing numbers of passengers per operation, with air carrier aircraft operations increasing at a somewhat greater rate than enplaned passengers.

Table 4-1

Aircraft Operations at California Airports, 1980-1996, by Region

(Thousands)

Year	Southern				Rest of	Total
	California	Bay Area	San Diego	Sacramento	State	
1980	5.461	3.051	906	530	7.320	17.268
1981	5.033	2.863	797	465	7.055	16.213
1982	4.151	2.385	588	396	6.717	14.237
1983	4.370	2.382	706	367	6.627	14.452
1984	4.808	2.573	750	400	6.960	15.491
1985	4.630	2.463	793	405	7.025	15.316
1986	4.637	2.598	767	424	6.744	15.170
1987	4.574	2.695	814	431	7.143	15.657
1988	4.491	2.702	817	451	7.231	15.692
1989	4.609	2.728	831	456	7.052	15.676
1990	4.745	2.810	885	459	7.230	16.129
1991	4.938	2.745	857	439	7.076	16.055
1992	5.021	2.707	868	435	6.984	16.015
1993	4.780	2.642	816	437	6.877	15.552
1994	4.733	2.617	811	409	6.584	15.154
1995	4.606	2.549	791	414	6.184	14.544
1996	4.523	2.575	776	397	6.284	14.555
Average						
Growth	-1.17%	-1.05%	-0.96%	-1.79%	-0.95%	-1.06%

Source: Federal Aviation Administration, *Terminal Area Forecast*; numbers include GA operations.

Table 4-2
Aircraft Operations at Southern California Airports, 1980-1996
 (Thousands)

Year	GA							Total
	Airports	LAX	SNA	LGB	BUR	ONT	PSP	
1980	3.231	534	570	645	216	167	98	5.461
1981	3.015	511	482	593	194	155	83	5.033
1982	2.375	473	431	507	179	105	81	4.151
1983	2.615	498	453	417	195	116	76	4.370
1984	2.874	543	484	451	241	128	87	4.808
1985	2.698	546	522	399	245	128	92	4.630
1986	2.667	565	540	397	236	132	100	4.637
1987	2.470	655	527	438	243	137	104	4.574
1988	2.431	632	528	435	222	141	102	4.491
1989	2.492	632	534	462	246	143	100	4.609
1990	2.577	669	523	483	235	151	107	4.745
1991	2.779	661	551	461	229	156	101	4.938
1992	2.893	678	557	432	214	153	94	5.021
1993	2.727	682	494	426	207	153	91	4.780
1994	2.616	688	509	475	194	159	92	4.733
1995	2.462	716	493	491	184	158	102	4.606
1996	2.369	764	475	482	185	154	94	4.523
Average								
Growth	-1,92%	2,26%	-1,13%	-1,80%	-0,96%	-0,51%	-0,26%	-1,17%

Source: Federal Aviation Administration, *Terminal Area Forecast*; numbers include GA operations.

Table 4-3

Aircraft Operations at Bay Area Airports, 1980-1996

(Thousands)

Year	GA				Total
	Airports	SFO	OAK	SJC	
1980	1.776	371	488	416	3.051
1981	1.698	329	460	376	2.863
1982	1.384	315	386	300	2.385
1983	1.355	349	361	317	2.382
1984	1.437	401	374	361	2.573
1985	1.331	396	371	365	2.463
1986	1.455	423	371	349	2.598
1987	1.488	451	398	358	2.695
1988	1.483	461	402	356	2.702
1989	1.573	434	403	318	2.728
1990	1.664	437	389	320	2.810
1991	1.559	435	414	337	2.745
1992	1.520	425	419	343	2.707
1993	1.468	423	439	312	2.642
1994	1.418	430	471	298	2.617
1995	1.338	437	503	271	2.549
1996	1.337	442	517	279	2.575
Average Growth	-1.76%	1.10%	0.36%	-2.47%	-1.05%

Source: Federal Aviation Administration, *Terminal Area Forecast*; numbers include GA operations.

Table 4-4

Aircraft Operations at San Diego Airports, 1980-1996

(Thousands)

Year	GA		Total
	Airports	SAN	
1980	750	156	906
1981	658	139	797
1982	456	132	588
1983	566	140	706
1984	600	150	750
1985	632	161	793
1986	603	164	767
1987	621	193	814
1988	611	206	817
1989	624	207	831
1990	673	212	885
1991	651	206	857
1992	653	215	868
1993	607	209	816
1994	596	215	811
1995	562	229	791
1996	532	244	776
Average			
Growth	-2.12%	2.84%	-0.96%

Source: Federal Aviation Administration, *Terminal Area Forecast*; numbers include GA operations.

Table 4-5
Aircraft Operations at Sacramento Airports, 1980-1996
(Thousands)

	GA		
Year	Airports	SMF	Total
1980	359	171	530
1981	316	149	465
1982	287	109	396
1983	251	116	367
1984	271	129	400
1985	270	135	405
1986	269	155	424
1987	268	163	431
1988	269	182	451
1989	279	177	456
1990	297	162	459
1991	287	152	439
1992	272	163	435
1993	268	169	437
1994	260	149	409
1995	237	177	414
1996	223	174	397
Average			
Growth	-2.93%	0.11%	-1.79%

Source: Federal Aviation Administration, *Terminal Area Forecast*; numbers include GA operations.

Table 4-6

**Growth in Air Carrier Aircraft Operations 1980 to 1996
Airports in the Four Largest Metropolitan Regions**

Airport	Enplaned Passengers (000)			Aircraft Operations		
	1980	1996	Average Annual Growth (%)	1980	1996	Average Annual Growth (%)
Burbank/Glendale/Pasadena	1,049	2,409	5.3	32,213	56,823	3.6
Los Angeles International	15,782	27,144	3.4	419,506	497,792	1.1
Long Beach Municipal	97	221	5.3	2,901	8,143	6.7
Oakland International	1,044	4,785	10.0	36,156	169,641	10.1
Ontario International	1,084	3,119	6.8	35,326	94,040	6.3
Orange County/John Wayne	1,175	3,474	7.0	27,168	80,989	7.1
Sacramento Metropolitan	1,200	3,231	6.4	36,749	79,925	5.0
San Diego International	2,741	6,503	5.5	69,513	155,012	5.1
San Francisco International	10,505	17,732	3.3	253,260	322,328	1.5
San Jose International	1,532	4,721	7.3	47,255	115,785	5.8

Source: Federal Aviation Administration, *Terminal Area Forecast*

Figure 4-1 California Operations by Region, 1996

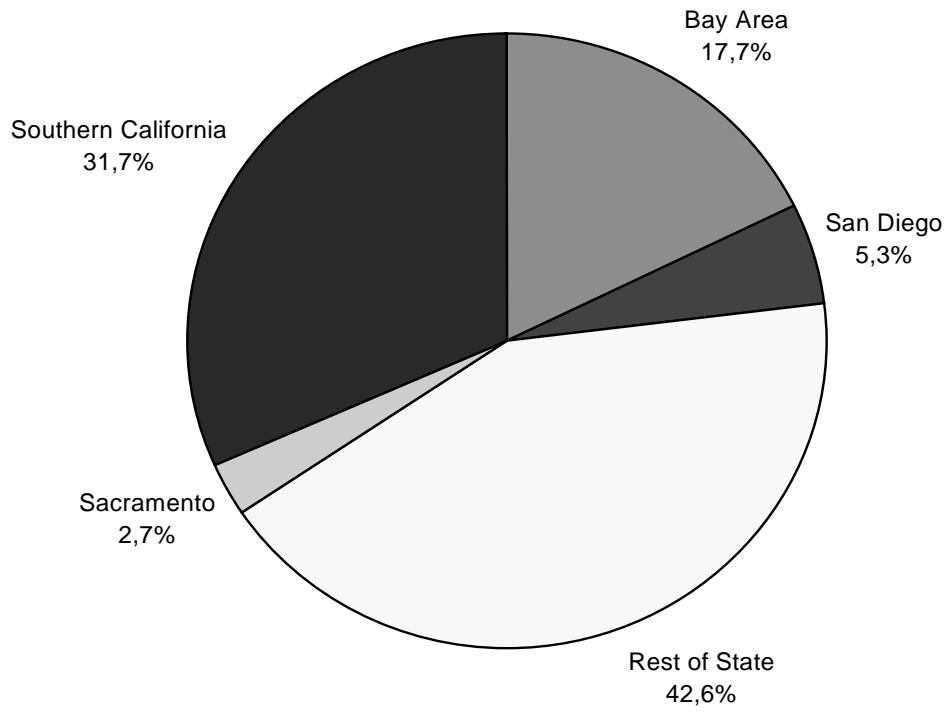


Figure 4-2 California Operations by Region, 1980-1996

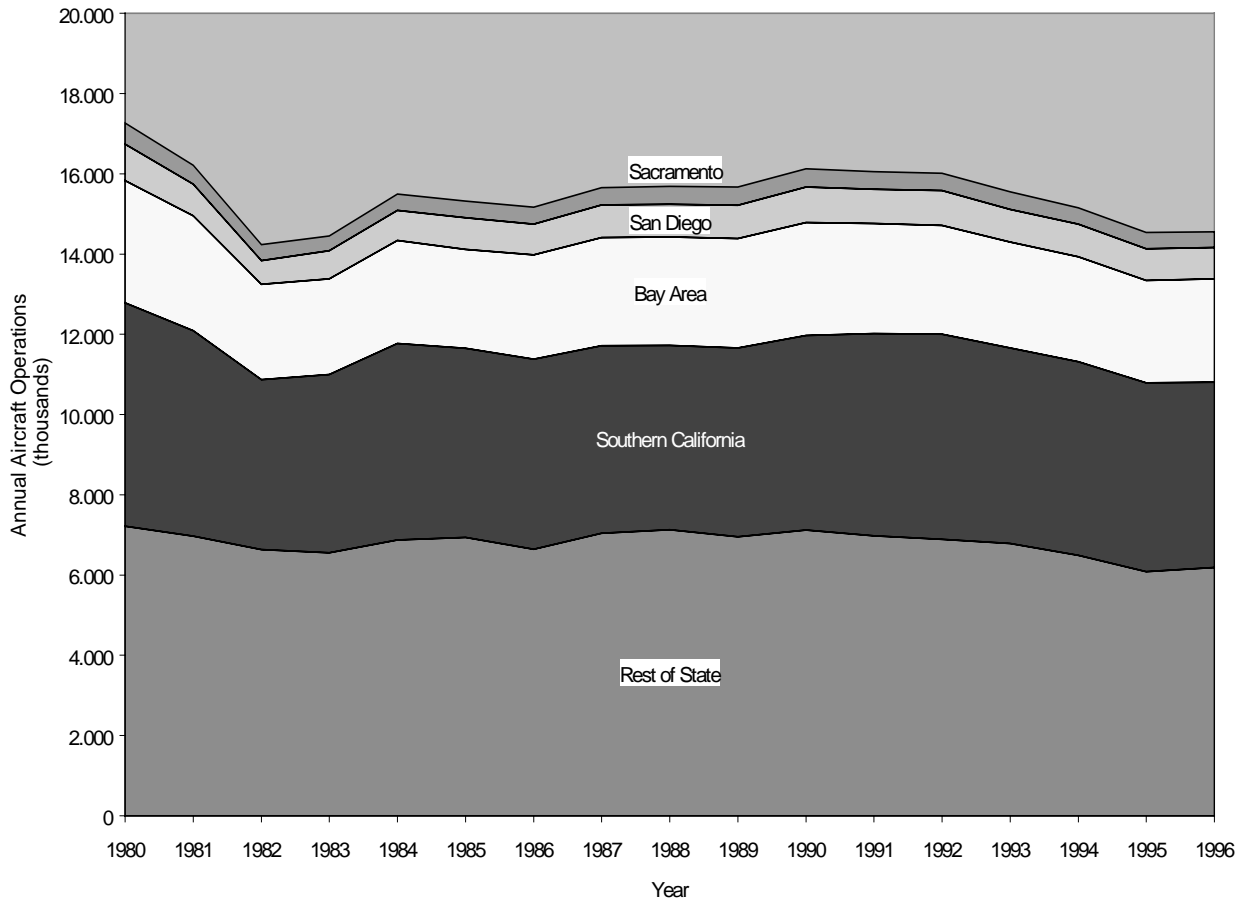


Figure 4-3 Southern California Operations, 1980-1996

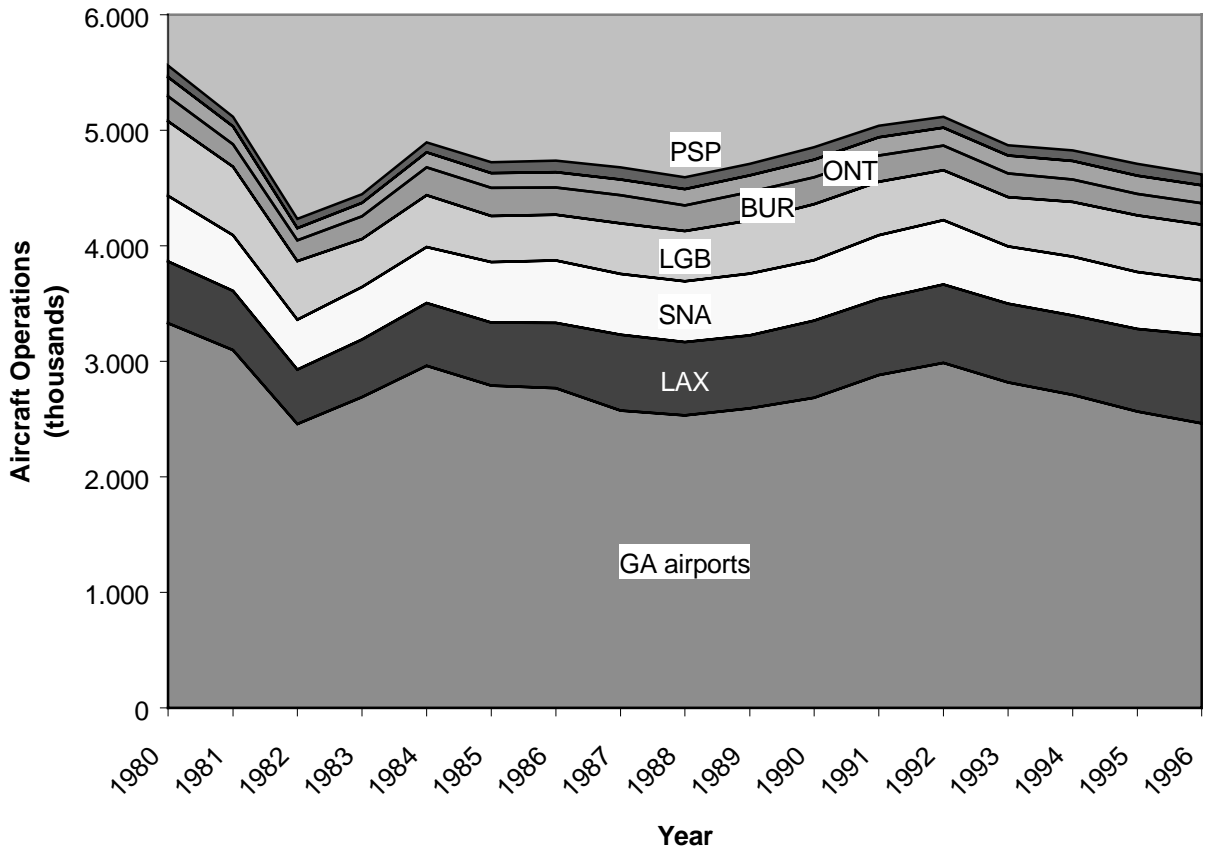


Figure 4-4 Bay Area Operations, 1980-1996

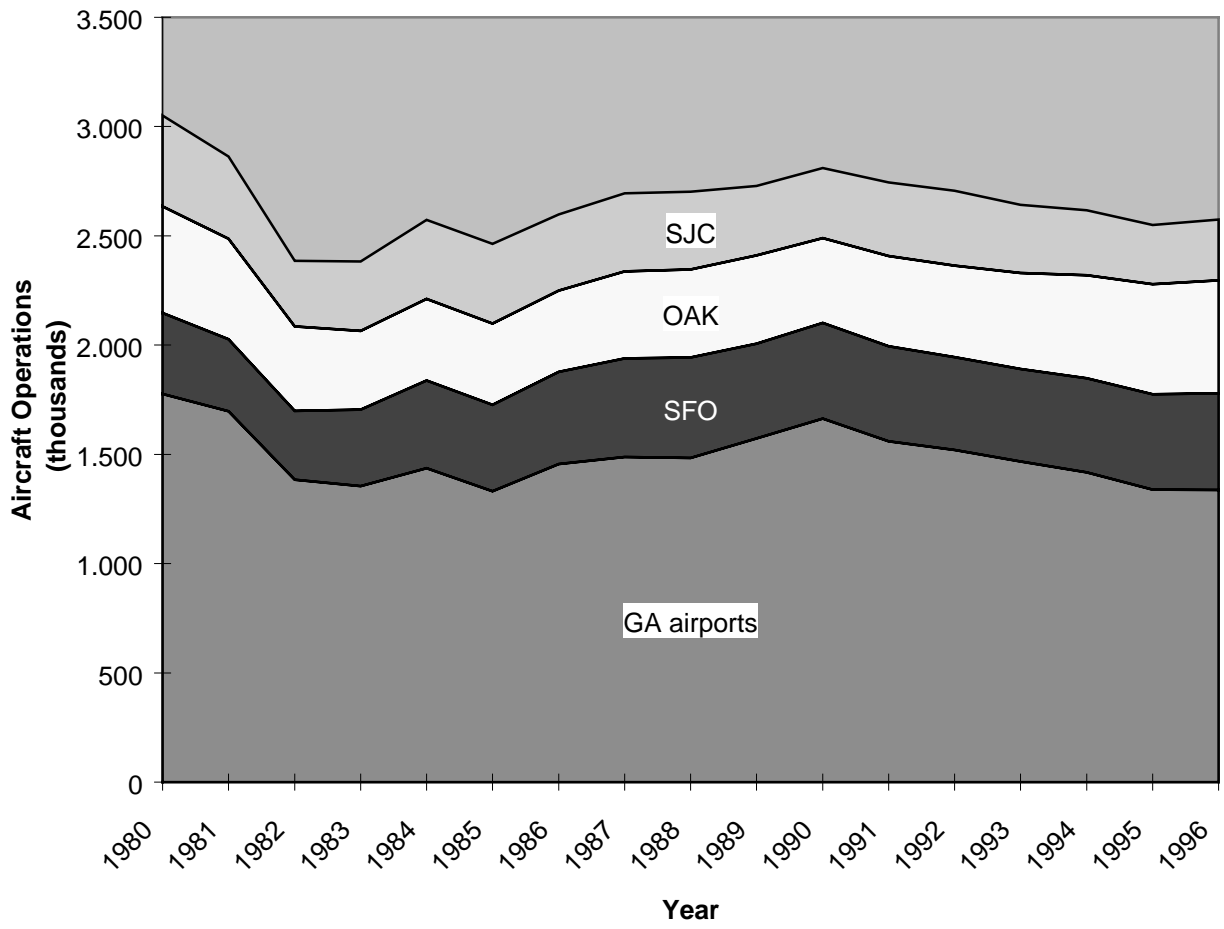


Figure 4-5 San Diego Operations, 1980-1996

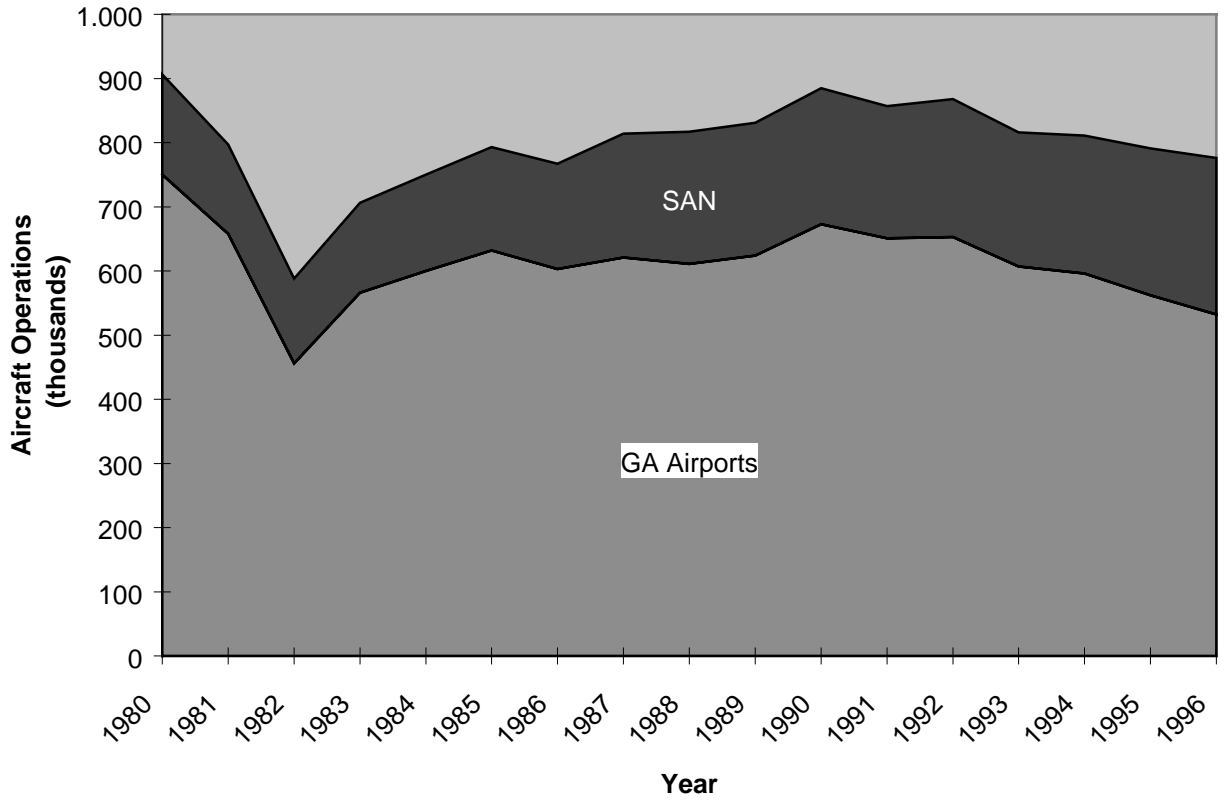
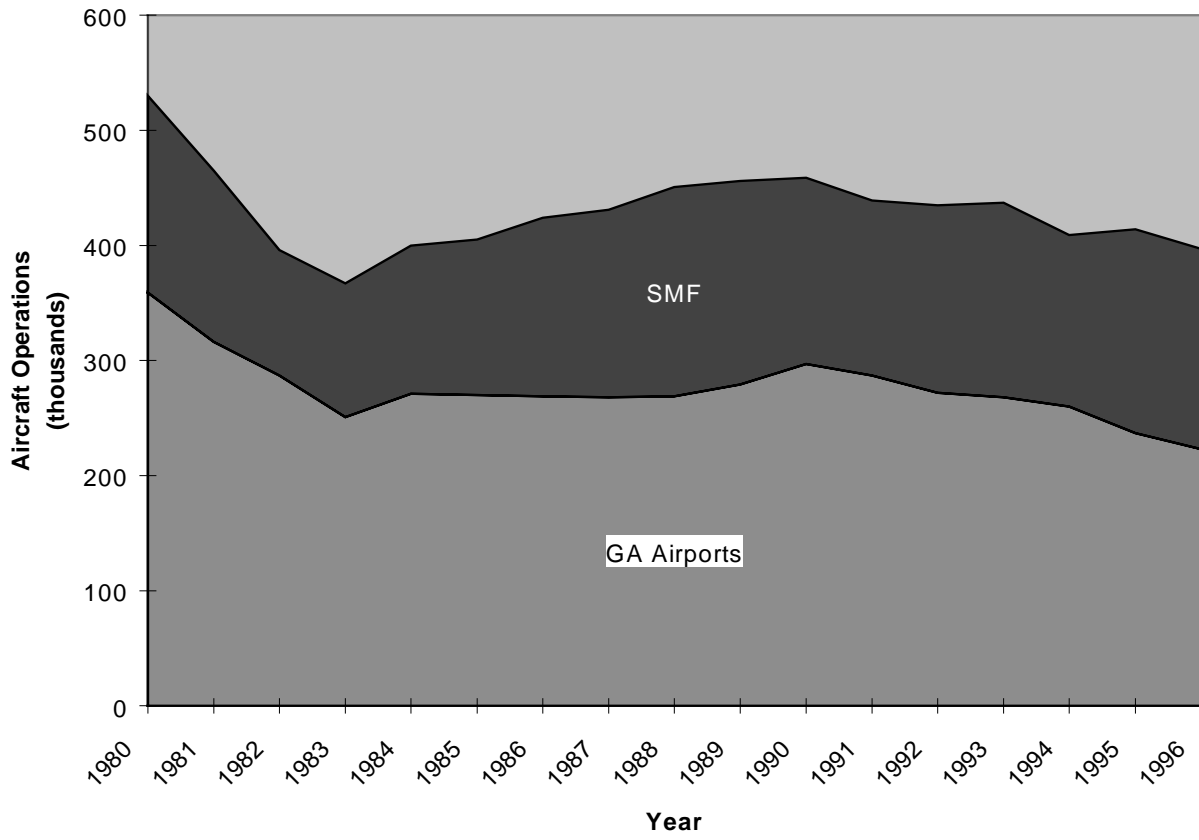


Figure 4-6 Sacramento Operations, 1980-1996



5. Air Cargo

California would be the seventh largest economy in the world, if it were a nation. Efficient goods movement is crucial to California's economy. Air cargo consists predominantly of high-value, time-sensitive or time-definite goods, *e.g.*, electronic equipment, emergency shipments, overnight packages, *etc.* Timely delivery of these goods has become an important element of many manufacturing and service operations in California. Therefore, the air cargo industry is a vital part of the state's economy. The continued ability of the state's air cargo industry to serve the other industries in the state, and the state's ability to capitalize on the forecast growth of air cargo routes between the Pacific Rim countries in Asia and North America, are essential to the prosperity of California.

Given the increasing importance of air cargo to California's economy, it is imperative to understand the role of air cargo in California. There are many important aspects of California's air cargo market that deserve further study. A more detailed discussion of air cargo activities in California can be found in *The Role of Air Cargo in California's Goods Movement* (Tsao, 1998). This chapter focuses on the total weights of air cargo enplaned or deplaned at the top ten California cargo airports, shown in Table 5-1. These ten airports are among the sixteen largest passenger airports in the state, listed on Table 2-1.

The *Worldwide Airport Traffic Report* published by the Airports Council International includes air cargo data for the ten California airports. Table 5-1 presents the total weight of air cargo enplaned or deplaned at these airports in 1990 and 1996, as well as the percentage changes between the two years.

It is clear from Table 5-1 that the growth of air cargo at the ten airports has been very fast. Seven out of the ten airports experienced growth higher than 50 percent in the six years between 1991 and 1996. Three of these seven experienced more than a doubling of their total air cargo tonnage, with growth at Orange County, Oakland and Sacramento airports of 952 percent, 189 percent and 121 percent, respectively. The average annual growth rate for Orange County Airport during the six years was well over 100 percent. The ten airports experienced a combined

growth rate of 58 percent over the six years, giving an average annual growth rate of almost 10 percent.

Table 5-2 shows the same data aggregated at the regional level, using the regional definitions discussed in Chapter 2. Air cargo growth in all four regions exceeded 50 percent during the six years, while air cargo in the two smaller regions grew faster than in the two larger regions.

Table 5-1

Total Weights of Cargo Enplaned or Deplaned at Top Ten California Cargo Airports

Airport	Total Tons 1990	Total Tons 1996	Change from 1990	Annual Change from 1990
Los Angeles	1,164,926	1,719,449	47.6 %	7.9 %
San Francisco	567,177	711,877	25.5 %	4.3 %
Ontario	247,283	396,485	60.3 %	10.0 %
Oakland	212,740	615,298	189.2 %	31.5 %
San Jose	83,164	91,798	10.3 %	1.7 %
San Diego	52,821	92,980	76.0 %	12.7 %
Sacramento	29,539	65,426	121.5 %	20.2 %
Long Beach	18,151	27,392	50.9 %	8.5 %
Burbank	20,010	37,751	88.7 %	14.7 %
Orange County	1,883	19,822	952.7 %	158.8 %
<i>Total</i>	2,397,694	3,778,278	57.6 %	9.6 %

Source: Airports Council International, *Worldwide Airport Traffic Report*

Table 5-2

Total Weights of Cargo Enplaned or Deplaned at Airports in California Regions

California Regions	Total Tons 1990	Total Tons 1996	Change from 1990	Annual Change from 1990
Southern California	1,452,253	2,200,889	51.6 %	8.6 %
Bay Area	863,081	1,418,973	64.4 %	10.7 %
San Diego	52,821	92,980	76.0 %	12.7 %
Sacramento	29,539	65,426	121.5 %	20.2 %
<i>Total</i>	2,397,694	3,778,278	57.6 %	9.6 %

Source: Airports Council International, *Worldwide Airport Traffic Report*.

6. Airports

As of September 1998, there were 257 public-use airports in California, of which 230 were publicly owned. Information on each of these airports is provided in the Inventory Element of the California Aviation System Plan (Caltrans, 1998). For the purposes of the California Aviation System Plan (CASP), the California Department of Transportation divides the state into nine regions, as shown in Figure 6-1. CASP Regions 3, 8 and 9 (Bay Area, Los Angeles/Desert, and San Diego) correspond to the Bay Area, Southern California and San Diego regions discussed elsewhere in this report. The Sacramento region discussed elsewhere in this report forms the northern part of CASP Region 6 (Central California).

The CASP Inventory Element classifies airports into a number of *Functional Categories*, based on the services provided by each airport and the role that it plays in the aviation system. This system follows FAA practice of classifying air carrier airports as either Commercial or Primary, based on the level of enplanements, and general aviation airports as either General Aviation or Reliever, depending on whether the airport is eligible to receive funding as a reliever airport under the FAA Airport Improvement Program. Within these categories, airports are classified by the California functional classification as Metropolitan, Regional, Community or Limited Use airports. Details of the functional classification system are provided in the CASP Inventory Element (Caltrans, 1998). In addition to the foregoing categories, there are also two joint-use military/commercial airports in the Los Angeles/Desert region (March Air Force Base and Palmdale Air Force Base).

The number of airports in each category in each of the CASP regions is shown in Table 6-1.

Table 6-1
Number of Airports in each California Region

		General Aviation					Joint Use
		Commercial Primary	Metro-politan	Regional	Community	Limited Use	
1	North Coast	2	-	4	16	3	-
2	North State	2	-	6	20	10	-
3	Bay Area	4	6	7	6	-	-
4	Sierra	-	-	6	3	-	-
5	Central Coast	4	-	4	4	3	-
6	Central California	6	2	16	36	8	-
7	East Sierra	-	-	2	5	4	-
8	Los Angeles/Desert	8	9	19	10	8	2
9	San Diego	2	1	4	3	2	-
<i>Total</i>		28	18	68	103	38	2

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