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Time to Work

Commuting Times and Modes of Transportation of California Workers

By Elisa Barbour

Summary

With public concern about traffic congestion and commuting on the rise, questions have come to the fore about how best to focus public investment for transportation systems in the state. In this context, a study of commuting behavior provides some insight into how workers adapt to economic growth and development and how public and private choices regarding transportation and housing interact. This information can help policymakers plan more effectively for the future.

In California during recent decades, jobs and housing have decentralized to suburban parts of major metropolitan areas. From 1990 to 2000, the share of total commutes going to suburbs increased from 45 to 48 percent. Suburb-to-suburb and central-city-to-suburb commutes increased more than other commutes. These trends influence commuting times in complicated ways. For example, suburban areas tend to have housing patterns associated with longer commute times, such as higher shares of single-family detached homes. In 2000, commutes from suburban locations were longer on average in duration than other commutes. But suburbanites are also more likely to drive alone to work, and commutes in single-occupant vehicles tend to be shorter on average than commutes by other transportation modes. Suburb-to-suburb commuters were especially likely to drive alone in 2000, and their commutes were fairly short in duration compared to others.

At 27.1 minutes, the average commute time for workers in the state in 2004 was 10 percent higher than for workers in the nation as a whole; however, it was lower than for workers in some other large states. From 1990 to 2004, the average commute time of California workers increased 10 percent, but the median commute time actually dropped 9 percent. Thus, the

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commute time of most California workers was actually shorter in 2004 than in 1990—perhaps surprising given public perceptions. Evidently, although many workers have escaped worsening commutes, some have not been so lucky. The share of commuters with commutes above 45 minutes increased from 15 to 18 percent during the decade.

Which workers have the longest commutes? Men have longer commutes than women, and African Americans tend to have longer commutes than other racial/ethnic groups. Higher-income workers and workers living in recently built housing also tend to have longer commutes.

Most California workers drive alone to work; 72 percent did so in 2000. But from 1990 to 2000, California bucked the national trend of a steady decline in transit commute shares. Instead, transit increased slightly as a share of commutes in the state, reflecting substantial recent investments in new systems. Carpooling and transit share increases were most rapid in suburban counties. Given that California counties with the sharpest increases in average commute times for solo drivers from 1990 to 2000 tended to adjoin large metropolitan areas, the findings suggest that some suburbanites are seeking alternatives to solo driving in the face of growing commute pressure.

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Introduction

This paper paints a broad picture of commuting trends in California. Using census data, it evaluates how commute times (durations) and choice of transportation mode have varied over time and location and among California workers with different characteristics. The text box "Measuring Commutes" describes the paper's data sources and methods.

Why would a policy audience care to know such details about commuting behavior? After all, most employed California residents (77%) say that they are satisfied with their commute to work, although in seemingly contradictory fashion, 59 percent also name traffic congestion as a big problem in their region (Baldassare, 2004). Although commuting patterns provide only a partial picture of transportation issues—work trips constitute less than one-fifth of all trips—commuting patterns provide a key indicator of the interaction between public and private choices about transportation and land use. Understanding this nexus should matter to anyone concerned about enhancing economic productivity and the quality of life in metropolitan areas.

Work trips generate disproportionately higher impacts on the transportation system because of their concentration during peak commute periods of the day and because they tend to be longer

Measuring Commutes

This study relies mainly on data from the decennial U.S. Census because it provides the most comprehensive information both on commuting trends in California over time at small geographic levels and on characteristics of workers. These advantages come at a price, however. A major drawback of the census data is that they include no information on commute distance or speed. But other major public use datasets with more extensive travel information, such as the National Household Transportation Survey, have small sample sizes that do not permit investigation of how trends vary by location within a state (in fact, the sample size of the National Household Transportation Survey is considered unreliable even at the state level).

Data on commute times employed in this study derive from responses to the census question, "How many minutes did it usually take this person to get from home to work last week?" Data on transportation choice are based on responses to the query, "How did this person usually get to work last week? *If this person usually used more than one method of transportation during the trip, mark the box of the one used for most of the distance."* For those workers who took a car, truck, or van to work, an additional question probed, "How many people, including this person, usually rode to work in this car, truck, or van?"

For 1990 and 2000 information, a special set of census tabulations were employed—the Census Transportation Planning Package (CTPP). This dataset presents information for both places of residence and places of work. For information on characteristics of individual commuters, the U.S. Census Public Use Microdata Sample (PUMS) was used. For more recent information (to 2004), data from the American Community Survey (ACS), conducted annually by the Census Bureau, were used. However, its smaller sample size and limited geographic coverage constrain its usefulness for many purposes.

In 2004, the average commute time of California workers age 16 and older who did not work at home was 27.1 minutes.

than nonwork trips. Therefore, government planners must consider commuting trends when evaluating new public investments in transportation infrastructure. In 2002, California state and local governments spent over $18 billion on highways and public transit capital investment and services in California (Rueben and de Alth, 2005). These investments help *accommodate* shifts in demand for different facilities but at the same time, along with land use policies, they also help *shape* urban areas and travel choices. Residential and employment location decisions are influenced by travel options including associated journeys to work. Thus, commuting plays a role in individual and public choices related to land use as well as transportation.

In recent decades, the steady dispersion of jobs and residences to outlying parts of metropolitan areas has resulted in more complex commuting patterns, with a rise in suburb-to-suburb commuting, for example. Research shows that polycentric models of employment concentration now explain spatial distribution better than traditional monocentric ones (Cervero and Wu, 1997). These more complex development patterns make it far more difficult to determine the most efficient transportation investments. For example, debates rage about the relative benefits of expanding public transit versus building new road capacity (Hanak and Barbour, 2005). Meanwhile, government fiscal constraint only increases pressure to invest more efficiently.

In this context, studying commuting trends helps us understand how workers are adapting to and helping reshape transportation options in California's rapidly changing metropolitan regions. This information can assist policymakers in planning more effectively for growth and change.

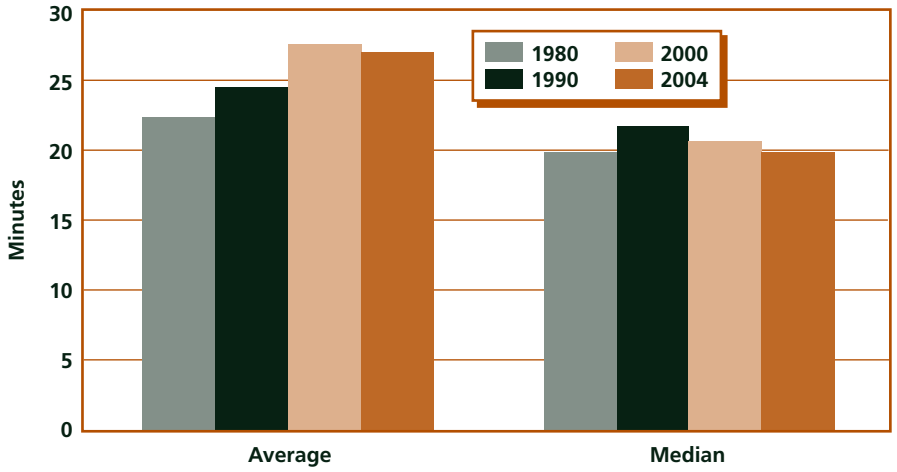
Commuting Basics: How Long Does It Take to Get to Work?

The big picture in terms of the average commute time for workers in California, viewed over time and compared to other states, suggests a pattern of general stability. In 2004, the average commute time of California workers age 16 and older who did not work at home was 27.1 minutes. This was 10 percent higher than for the nation as a whole but lower than for workers in some other large states such as Illinois and New York.

The average commute time in the state overall has risen since 1980 but not by as much as some might expect (Figure 1). The average one-way commute time in 2004 was about the same as in 2000.[1] Over the longer term, from 1980 to 2000, it increased 24 percent—a substantial increase in percentage terms but amounting to a gain of only about five minutes. (The 1980 census was the first to include a question about commute time.)

This pattern of relative overall stability in the average commute time for California workers who did not work at home masks interesting variations, however. Although the average commute time statewide in 2004 was 27.1 minutes, the median commute time was substantially lower, at 20 minutes (Figure 1). (The median marks the point at which half of commuters had a shorter commute and half had a longer commute.) This discrepancy indicates that extremely long commutes (in duration) for some workers pulled up the average relative to

Figure 1. Average and Median Commute Times in California, 1980–2004



Sources: 1980 PUMS; 1990 and 2000 CTPP; 2004 ACS.

Although the average commute time statewide in 2004 was 27.1 minutes, the median commute time was substantially lower, at 20 minutes.

the median; in fact, 18 percent of commuters traveled 45 minutes or more in 2004.[2]

From 1980 to 1990, the average and median commute times of California workers increased at a similar pace (10% and 9%, respectively). But from 1990 to 2004, as the average commute time increased 10 percent, the median commute time actually dropped 9 percent. Thus, the commute time of most California workers (who did not work at home) was actually *shorter* in 2004 than in 1990. Yet over the same period, the share of commuters traveling 45 minutes or more increased from 15 to 18 percent, which raised the average commute time. Variation in commute times increased substantially; the standard deviation (a common measure of variation) increased 20 percent from 1990 to 2004. The increase in variation was even higher from 1990 to 2000—a high point in the business cycle—at 37 percent.[3]

The contrast in the way that average and median commute times shifted during the past decade suggests one possible reason that a majority of Californians rank traffic congestion as a major concern, even though three in four are relatively happy with their own commutes. Although some workers are experiencing considerably higher commute times than in the past, most are not.

A perception that traffic congestion has worsened in recent decades is not inaccurate, at least by some measures. Considered as the share of peak period vehicle miles traveled under congested conditions, congestion increased by nearly half from 1982 to 1990, and by another 9 percent from 1990 to 2000 (Table 1).[4] However, measured as annual hours of delay per peak period traveler, the rise in congestion has been less evident. After a sharp increase during the 1980s, delay per traveler flattened out or even declined in some areas during the 1990s, and it has not picked up since. Using either measure, congestion did not worsen between 2000 and 2003 (the latest year available in the data).

Employment trends during recent decades help to explain the congestion patterns. From 1980 to 1990, employment in California

Table 1. Commuting-Related Trends in California, 1980–2000

	Percentage Increase	
	1982–1990	1990–2000
For nine major California urban areas:		
Percentage of peak period vehicle miles traveled under congested conditions	48	9
Annual hours of delay per peak traveler	177	–16
Vehicle miles of travel	45	15
	1980–1990	**1990–2000**
For California:		
Average commute time	10	13
Population growth	26	14
Employment growth	47	4
Vehicle miles of travel	61	19
State highway lane miles	2	3

Sources: For California urban areas, Texas Transportation Institute (2005); for the state, U.S. Census and CalTrans.
Note: For this table, urban areas include Bakersfield, Fresno, Los Angeles–Long Beach–Santa Ana, Oxnard–Ventura, Riverside–San Bernardino, Sacramento, San Diego, San Francisco–Oakland, and San Jose.

grew by nearly half—a rate nearly double the population growth during the period (Table 1). The number of vehicle miles traveled grew even more rapidly. However, population and job growth slowed substantially over the 1990s because of a severe economic recession in the first half of the decade. From 1990 to 2000, employment grew by only 4 percent while the population grew by 14 percent.

The data suggest that congestion trends have reflected economic and population growth trends. The relationship to commute times is harder to disentangle. Evidently, most commuters were able to adjust to economic conditions of the 1990s without a worsening of their commutes, but some were not. The increase in average commute time between 1990 and 2000 was actually more rapid than during the previous decade, in spite of the considerable slowdown in employment growth statewide. The increase in average commute time was more rapid even than the increase during the same period in the percentage of peak period vehicle miles traveled in congested conditions in major urban areas.

Unfortunately, the census data used for this study do not permit a direct analysis of the connection between commuting and congestion, because the data provide no information on distance and speed of commutes. Still, it is useful to consider some relationships between congestion and commute times, as they may help explain the observed patterns. Congestion is not linear; the addition of one more driver to a highly congested highway slows travel time by a larger increment than on a mildly congested highway. Therefore, overall hours of delay per peak period driver could rise if only certain key routes connecting residential areas to job centers become congested, even as the median commuter does not suffer. This scenario would be consistent with the finding of a rise in the share of commuters with extremely long commutes (45 minutes or more) at the same time that the median commute time declined.

Alternatively, systemwide congestion can also increase from a growth in large numbers of commute trips that might not be too onerous at the individual level. In fact, certain coping mechanisms by commuters that shorten individual commutes can add to aggregate congestion. For example, if an individual changes from using public transit to driving alone, or from a short-distance but slower urban route to a longer distance but faster suburban route,

personal commute time might decline while aggregate congestion increases (Ory et al., 2004). Such a scenario could help explain seemingly contradictory views expressed in opinion surveys about satisfaction with individual commutes combined with concern about congestion.[5]

As the following sections will show, trends in California in recent decades were consistent with the coping strategies just mentioned, with commuters shifting toward solo driving, especially during the 1980s, and toward more dispersed suburban residential and employment locations. Policymakers concerned about commute and congestion costs will want to pay attention to these trends and sort out their effects.

Where Are the Longest Commutes?

By region, the longest average commutes in 2000 were experienced by residents of the fast-growing Inland Empire (Riverside and San Bernardino Counties), followed by the nine-county San Francisco Bay Area, and then by the South Coast (Los Angeles, Orange, and Ventura Counties).

For major counties, more recent data are available. In 2004, Contra Costa commuters experienced the highest average commute times, with commuters from San Joaquin, Riverside, and Los Angeles Counties close behind (Table 2). Between 1990 and 2000, the average commute time in almost all major counties increased by 11 percent or more. The increase in San Joaquin County was highest (an average increase of 7.3 minutes, or one-

Table 2. Average Commute Times in California Counties, 1990–2004

	Average Commute Time (Minutes), 2004	Change (Minutes), 2000–2004	Percentage Change, 2000–2004	Change (Minutes), 1990–2000	Percentage Change, 1990–2000
California	27.1	0.4	1	3.1	13
Major counties					
Contra Costa	32.2	–2.4	–7	5.1	17
San Joaquin	31.5	5.5	21	7.3	33
Riverside	30.8	1.2	4	3.0	11
Los Angeles	29.2	1.2	4	2.9	11
San Bernardino	28.8	0.7	2	3.6	13
San Francisco	28.7	–0.8	–3	3.8	14
Alameda	27.5	–2.4	–8	5.0	19
Orange	27.0	0.9	3	1.7	7
Sacramento	26.0	2.0	8	3.7	17
Ventura	26.0	0.3	1	0.7	3
San Diego	25.7	1.0	4	3.1	14
San Mateo	24.2	–1.5	–6	3.0	13
Santa Clara	23.7	–1.5	–6	2.8	12
Kern	22.6	0.8	4	3.6	18
Fresno	20.1	–0.9	–4	3.1	16

Sources: 1990 and 2000 CTPP; 2000 and 2004 ACS.
Note: Major counties had a population in 2000 of 500,000 or more.

third). Kern, Alameda, Contra Costa, and Sacramento Counties also experienced rapid increases.

Many counties experienced a drop in average commute times during the economic downturn that occurred between 2000 and 2004. San Joaquin County was an exception, with a rise in average commute time of 5.5 minutes (21%). The largest declines were in Contra Costa and Alameda Counties—counties with among the highest increases in commute times between 1990 and 2000.[6]

Most of the counties in which average commute times—measured across all modes and also solo drivers only—increased most rapidly from 1990 to 2000 adjoin large metropolitan areas, suggesting that the decentralization of homes and workers has increased commute pressures in some outlying areas. Counties in which the average commute times increased faster than 30 percent between 1990 and 2000 include Merced and San Benito (adjoining Santa Clara County), San Joaquin (adjoining Alameda County), and Lake, Colusa, and Sutter (north of the Sacramento and Bay areas).

Which cities had high average commute times? Figures 2 and 3 show cities in the San Francisco Bay and Los Angeles regions—the state's largest and most complex metropolitan areas—that had average commute times in 2000 below the 75th percentile statewide (tan), between the 75th and

Figure 2. Average Commute Times in San Francisco Bay Area Cities, 2000

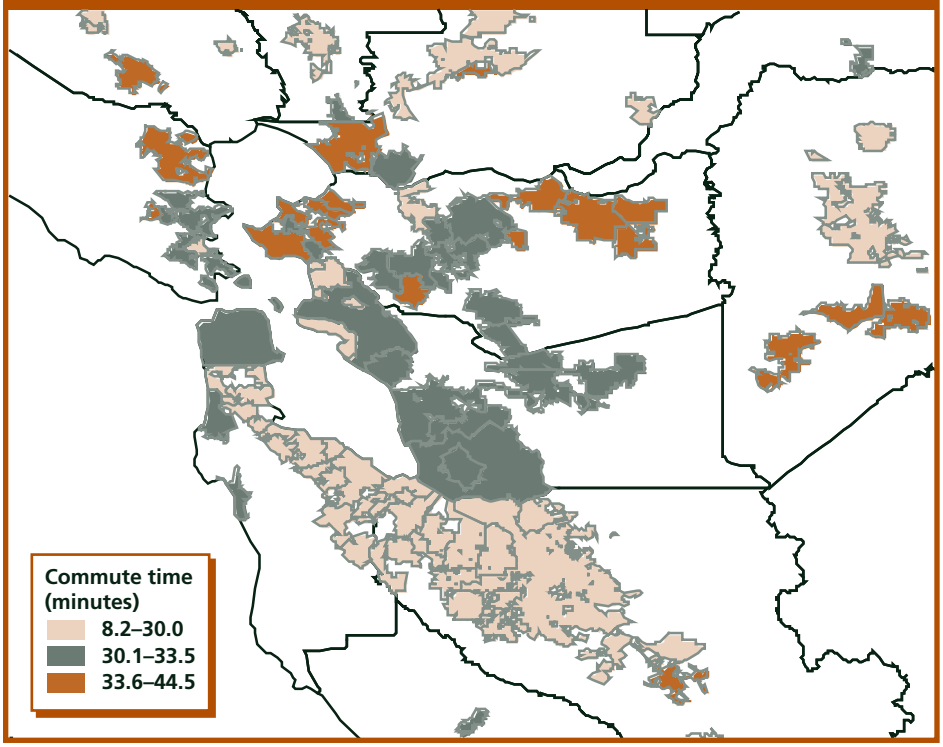
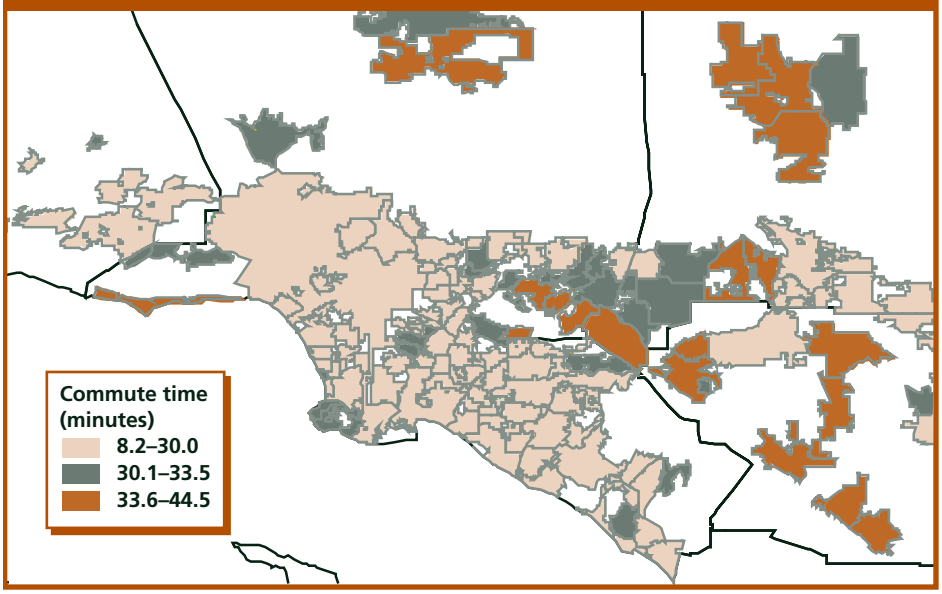


Figure 3. Average Commute Times in Los Angeles Area Cities, 2000



90th percentile (green), and above the 90th percentile (rust). Cities with the highest average commute times tended to be located at the suburban fringes.

How Do Californians Get to Work?

Solo driving is by far the most popular mode of travel to work; almost three-quarters of California workers drove alone to work in 2000 (Table 3).[7] The second most popular means was two-person carpooling. Still, only 11 percent of commuters selected this form of transportation. Two-person carpools formed three-quarters of all carpools; in all, 15 percent of commuters used carpools of any size. Five percent of California workers used public transit; bus was the most popular transit choice. Another 4 percent walked or biked, and another 4 percent worked at home. Californians were less likely than the average worker

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Table 3. Share of Workers by Mode of Transportation to Work in California, 2000

	Drove Alone	Two-Person Carpool	Three+ Person Carpool	Bus or Trolley Bus	Streetcar, Trolley, Subway	Railroad, Ferryboat	Walked or Biked	Other Means	Worked at Home
United States	75.7	9.4	2.8	2.5	1.5	0.5	3.3	1.0	3.3
California	71.8	10.8	3.8	3.8	0.9	0.3	3.7	1.1	3.8
Major counties	71.6	10.8	3.7	4.2	1.1	0.4	3.5	1.1	3.6
Alameda	66.4	9.7	4.1	4.5	5.4	0.7	4.5	1.3	3.5
Contra Costa	70.2	9.5	4.0	1.8	6.4	0.6	2.0	1.1	4.3
Fresno	74.2	11.1	5.6	1.6	0.0	0.0	3.1	1.3	3.1
Kern	73.8	12.2	6.2	1.2	0.1	0.0	2.5	1.4	2.7
Los Angeles	70.4	11.3	3.8	6.1	0.2	0.2	3.6	1.0	3.5
Orange	76.5	10.0	3.3	2.5	0.1	0.2	2.8	0.9	3.7
Riverside	73.4	13.0	4.7	1.0	0.1	0.3	2.4	1.3	3.9
Sacramento	75.4	11.4	3.0	2.4	0.4	0.2	2.9	0.9	3.4
San Bernardino	73.6	13.3	4.3	1.3	0.1	0.5	2.8	1.1	3.1
San Diego	73.9	10.3	2.8	2.9	0.2	0.2	4.0	1.4	4.4
San Francisco	40.5	8.2	2.6	21.4	8.8	0.6	11.3	2.0	4.6
San Joaquin	74.6	11.7	5.3	1.1	0.1	0.3	3.0	1.1	2.9
San Mateo	72.3	10.0	2.9	3.4	2.2	1.7	3.0	1.0	3.6
Santa Clara	77.3	9.7	2.5	2.6	0.3	0.6	3.0	0.9	3.1
Ventura	75.9	10.5	4.6	0.7	0.0	0.3	2.8	1.0	4.2

Source: 2000 CTPP.

Since the 1970s, an increasing share of transportation investment in the state has gone to public transit, and many major cities added new fixed rail systems.

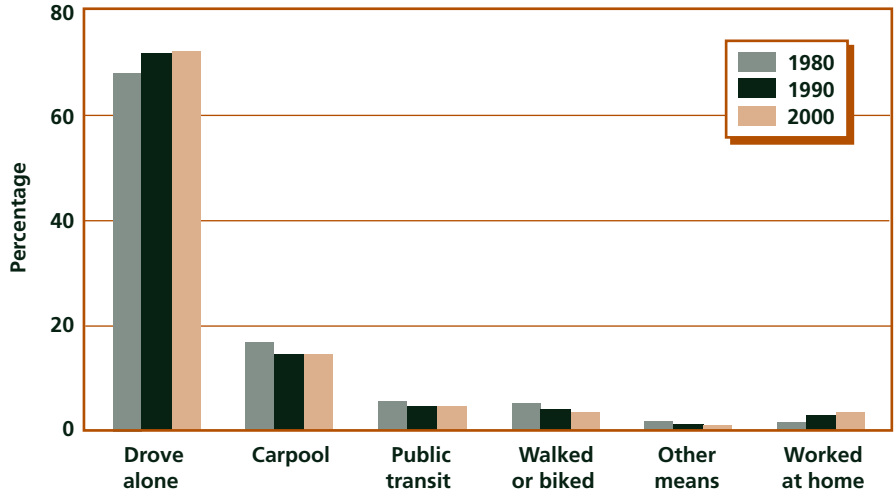
in the United States to drive alone to work and more likely to use all other methods of travel except subway, railroad, and ferryboat.

Why should we care how Californians get to work? Obviously, transportation planners, who program multibillion-dollar projects, care about accommodating shifting demand for different types of facilities. But transportation investments do more than accommodate demand for travel—they also help to shape it. Since the 1970s, an increasing share of transportation investment in the state has gone to public transit, and many major cities added new fixed rail systems.[8] With jobs and workers shifting toward suburban locations that are harder to serve with transit, some have questioned the efficiency of those investments. In fact, travel patterns reflect public as well as private choices about land use, not just transportation—for example, whether local governments choose to promote transit-friendly and pedestrian-friendly neighborhoods and coordinate their policies to support regional transit use and compact development. Studying trends in modal choice allows us to consider how individuals are adapting to current infrastructure and land use configurations and also how we might collectively shape our neighborhoods and urban regions in the future.

A few patterns in transportation modal choice by county are worth pointing out. San Francisco stands out as quite distinct from the others, with only 41 percent of resident workers in this densely settled county driving alone to work in 2000 and a much higher share than elsewhere (31%) using public transit. Carpooling was especially popular in counties adjoining major employment centers—Kern, Riverside, San Bernardino, and San Joaquin. These counties also had among the lowest public transit shares of those listed, so carpooling may form an alternative. Bus use was especially high in San Francisco and Los Angeles Counties. Only two counties had higher subway than bus use—Contra Costa and Alameda—reflecting patronage of the Bay Area Rapid Transit system. Rail use was highest in San Mateo and also relatively high in other major Bay Area counties.

Overall, choice of transportation mode shifted only slightly from 1980 to 2000 (Figure 4). From 1980 to 1990, solo driving rose in share by 4 percentage points, while other modes (with

Figure 4. Journey to Work by Mode in California, 1980–2000



Sources: 1980 STF3; 1990 and 2000 CTPP.

the exception of "worked at home") declined. A similar pattern was repeated throughout the nation as the increase in solo driving and the decline in public transit use reflected the suburbanization of jobs and residences (Pisarski, 1996). However, from 1990 to 2000, trends shifted somewhat in California. Public transit use actually increased in share statewide, although only by 0.2 percentage points. Although this shift toward public transit was marginal at best, it is notable nevertheless because it bucked the continuing national trend during the period (Table 4). Meanwhile, solo driving in California also increased only marginally, by 0.2 percentage points. Nationally from 1990 to 2000, solo driving increased in share by 2.5 percentage points, while all other modes of transportation declined except working at home.

Perhaps surprising, the solo driving share dropped or stayed the same in all the major California counties from 1990 to 2000 except the most central ones—Los Angeles, San Francisco, and San Diego. Meanwhile, carpooling increased in share in a number of suburban or outlying counties, including San Bernardino, Kern, and San Joaquin. Public transit use increased in share in all except San Francisco and San Mateo Counties, increasing most rapidly in San Bernardino, Contra Costa, and Alameda Counties.

What specific modes of transportation account for the rise in public transit share? Streetcar,

Table 4. Shift-in-Share by Mode of Transportation to Work for U.S. and California Workers, 1990–2000

	Drove Alone	Carpool	Public Transit	Bus or Trolley Bus	Subway, Streetcar, or Rail	Walked or Biked	Other Means	Worked at Home
United States	2.5	–1.2	–0.5	–0.5	–0.1	–1.0	–0.1	0.3
California	0.2	–0.1	0.2	–0.2	0.4	–0.6	–0.3	0.6
Major counties	0.2	–0.1	0.2	–0.3	0.4	–0.5	–0.3	0.6
Alameda	–0.4	1.0	0.7	–0.9	1.6	–0.8	–0.2	–0.4
Contra Costa	–1.3	–0.3	1.1	0.3	0.9	–0.3	–0.1	0.9
Fresno	–1.0	1.8	0.2	0.2	0.0	–0.9	–0.2	0.1
Kern	–0.9	1.1	0.4	0.3	0.1	–0.6	–0.5	0.6
Los Angeles	0.3	–0.5	0.1	–0.3	0.4	–0.3	–0.3	0.7
Orange	–0.2	–0.4	0.3	0.1	0.2	–0.4	–0.3	1.0
Riverside	–0.3	0.0	0.5	0.1	0.3	–0.7	–0.2	0.9
Sacramento	–0.4	0.4	0.2	0.3	–0.1	–0.6	–0.2	0.6
San Bernardino	–1.6	0.7	1.2	0.6	0.5	–0.6	–0.4	0.7
San Diego	3.0	–0.7	0.1	0.0	0.1	–1.4	–0.3	–0.6
San Francisco	2.0	–0.7	–2.4	–3.1	0.7	0.6	–0.3	0.8
San Joaquin	0.0	0.8	0.3	0.0	0.3	–0.7	–0.2	–0.2
San Mateo	–0.2	–0.2	–0.1	–0.4	0.3	–0.3	–0.1	0.9
Santa Clara	–0.4	–0.1	0.5	0.1	0.4	–0.5	–0.1	0.6
Ventura	–0.1	–0.4	0.4	0.1	0.3	–0.8	–0.2	1.2

Sources: 1990 and 2000 CTPP.
Note: The "subway, streetcar, or rail" category also includes elevated rail and ferryboat.

From 1990 to 2000, the average commute time of transit commuters increased more rapidly (by 18%) than for solo drivers (12%) or carpoolers (9%).

subway, and rail use gained share statewide, whereas bus use—traditionally the most popular transit mode—declined. These patterns reflect large investments made to improve subway and rail service in the state's major urban areas during the 1980s and 1990s. Streetcar, subway, and rail use increased most rapidly in share in Alameda, Contra Costa, and San Francisco Counties.

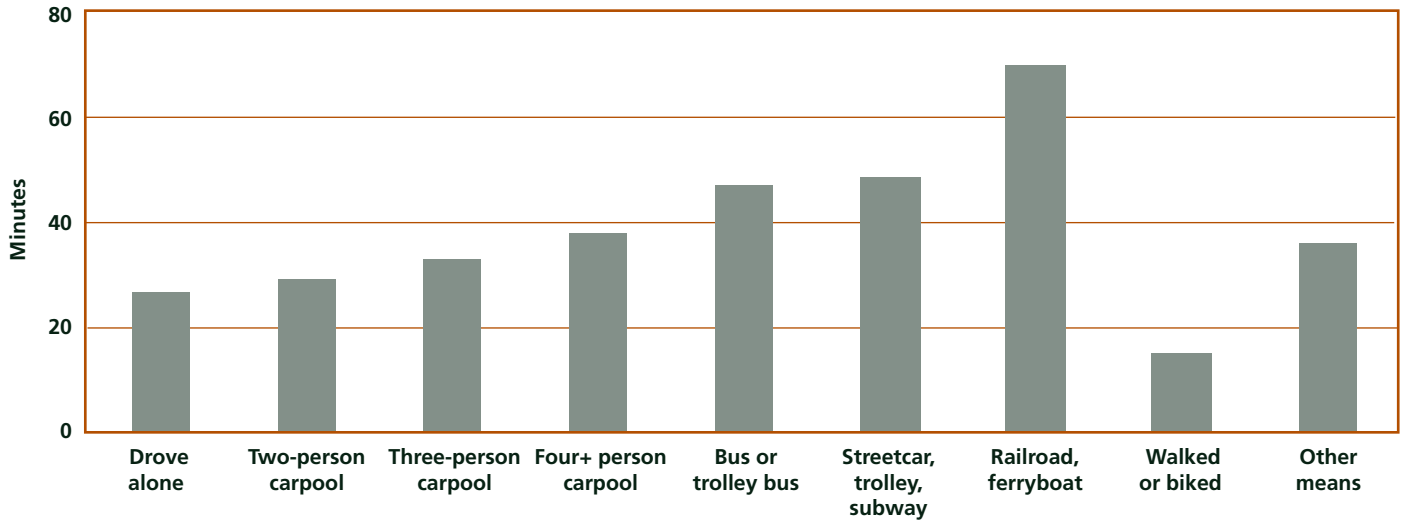
The increase in public transit commuting between 1990 and 2000 was very small when considered as a share of all workers. However, viewed in terms of ridership growth (percentage increase in commuters), the gain was much larger. This discrepancy reflects the fact that public transit shares were small to begin with, so even very rapid increases in public transit use compared to other transportation modes produced only small overall gains in public transit share. But the gains in terms of percentage growth were high, with subway, streetcar, or rail use jumping 54 percent statewide over the period. Some of these gains were remarkable, reflecting small ridership levels to start—for example, in San Bernardino (3,038%), Riverside (1,932%), Ventura (1,304%), and San Joaquin (900%) Counties.

How do commute times vary by transportation mode? Solo drivers had the shortest average commute time of all in 2000 compared to all other mechanized means of travel to work (Figure 5). In contrast, public transit riders experienced the longest average commute times—about twice as long as solo drivers on average.[9] Commutes by rail or ferryboat were especially long in duration. Public transit riders were more than twice as likely as users of other modes of transportation to experience commutes of 45 minutes or more; half of public transit riders experienced these long commutes in 2000.[10] From 1990 to 2000, the average commute time of transit commuters increased more rapidly (by 18%) than for solo drivers (12%) or carpoolers (9%).

Without information on distance and speed, it is difficult to judge which form of transportation was most competitive in terms of time for any given trip. That said, we can use census data on commutes by "place" in California, to test how public transit compared to solo driving for given place-to-place commutes in the state in 2000.[11] In these comparisons, solo driving appears to be faster for the overwhelming number of commuters. Average bus commutes were shorter than average single-occupant-vehicle commutes for less than 2 percent of place-to-place journeys. Commutes by other forms of public transit were shorter than solo driving commutes for less than 1 percent of place-to-place journeys.

These findings conform to other research demonstrating that cars generally offer travelers the benefit of reduced travel time compared to other transportation modes, as well as greater portability of goods, accessibility to destinations, and flexibility (Fontaine, 2003). Given these advantages of solo driving, how can we explain the small shifts toward public transit and carpool use in many of the state's suburban counties from 1990 to 2000? Time is only one cost of travel that commuters face, and other forms of transportation may compete with solo driving for reasons other than time savings. For example, factors that measure auto access and utility (e.g., ownership, parking cost, and availability) have been shown to be more important in explaining variation in public transit use than any other family of factors, including economic factors such as employment density and worker income, spatial factors such as residential neighborhood density, and socioeconomic factors such as household type (Fontaine, 2003; Taylor

Figure 5. Average Commute Time by Mode of Transportation to Work in California, 2000



Source: 2000 CTPP.

and Fink, n.d.). In other words, various costs associated with driving to work, especially in dense, central business districts, help account for the appeal of using public transit for those commutes.

Indeed, rising transit use among suburb-to-central-city commuters helps to explain the overall shift toward transit use statewide from 1990 to 2000; this finding is described in more detail below. However, greater transit use among suburb-to-suburb commuters also played a role. As jobs and residents have decentralized from inner, urban areas (a trend also discussed in more detail below), pressure on some suburban commuters and transportation systems has increased. Construction of new state highway lane miles failed to keep pace with population and employment growth in recent decades (Table 1)—the result of higher costs and lower inflation-adjusted per capita revenues from such traditional sources as the gas tax (Hanak and Barbour, 2005). Meanwhile, investment in mass transit has increased more rapidly (Rueben and de Alth, 2005; Hanak and Barbour, 2005).

These findings suggest that residents of some suburban counties may have sought alternatives to solo driving to cope with transportation pressure. This shift has been only marginal, however, as solo driving remains the overwhelming transportation choice for California commuters.

Commuter Characteristics

How does commuting behavior (commute time and modal choice) differ depending on characteristics of workers, their households, and homes? This section provides a sketch of such variations, without suggesting that the factors considered fully account for all demonstrated differences among commuters. This caveat is important, because influences on travel behavior are notoriously hard to disentangle and many important factors cannot be captured in our data.[12]

Table 5 shows differences in average commute times and modal choices in 2000 for a variety of

Table 5. Commute Length and Mode Choice by Worker Characteristics in California, 2000

	Percentage of Commuters	Average Commute Time (Minutes)	Percentage with Commutes of 45 Minutes or More	Percentage Who Drove Alone	Percentage Who Took Transit
All commuters	100	27.7	18	75	5
Individual characteristics					
Sex					
Men	56	29.3	20	75	5
Women	44	25.7	16	74	6
Race					
White	52	26.9	18	81	3
African American	6	31.8	23	71	10
Latino (Hispanic)	27	28.1	18	63	8
Asian/Pacific Islander	12	28.5	19	73	6
Other (includes multirace)	3	27.7	19	74	5
Age					
Under 18	1	19.2	9	50	8
18–24	14	24.2	14	63	7
25–34	24	28.1	19	73	6
35–44	27	29.0	20	77	4
45–54	21	28.7	20	79	4
55–64	9	27.6	18	80	4
65+	3	25.5	15	80	4
Education					
Less than high school	18	27.7	17	56	9
High school graduate	19	27.0	17	74	5
Some college, associate degree	34	27.5	18	79	4
Bachelor's degree +	29	28.5	20	81	5
Marital status					
Married, or domestic partner	60	28.5	19	77	4
Unmarried	40	26.6	17	72	7
Household headship					
Household head	51	28.9	20	79	4
Other	49	26.5	17	70	6
Household characteristics					
Number of workers					
One	32	28.7	20	80	5
Two	46	27.8	19	77	4
Three or more	23	26.8	17	65	7
Household income					
Under $20,000	8	26.6	16	63	10
$20,000–$39,999	18	26.6	16	69	7
$40,000–$59,999	20	27.2	17	74	5
$60,000–$79,999	17	28.0	19	77	4
$80,000–$99,999	12	28.6	20	79	4
$100,000–$149,999	15	29.2	21	80	4
$150,000+	10	28.9	20	82	4

Table 5. continued

	Percentage of Commuters	Average Commute Time (Minutes)	Percentage with Commutes of 45 Minutes or More	Percentage Who Drove Alone	Percentage Who Took Transit
Homeownership					
Home owned	60	28.4	19	81	3
Home rented	40	27.1	17	67	9
Presence of children					
None under age 18	50	27.2	18	77	6
One or more under age 18	50	28.2	19	72	5
Hybrid: household type/employment/presence of children					
Family households					
Married household head or spouse, with children, both spouses working	23	28.0	19	77	3
Married household head or spouse, without children, both spouses working	16	27.8	19	79	3
Married household head or spouse, with children, one spouse working	8	31.1	23	78	3
Married household head or spouse, without children, one spouse working	5	28.8	19	82	4
Single head, with children under age 18	5	28.2	19	73	6
Single head, no children under age 18	3	27.7	18	74	7
Other family member	20	27.1	17	65	8
Nonfamily households					
Householder living alone	10	26.6	17	83	6
Member of nonfamily household, not alone	9	26.8	17	72	8
Housing characteristics					
Housing type					
Single-family detached	62	28.1	19	79	3
Single-family attached	8	27.7	18	74	6
Apartment building, 2–9 units	13	26.9	17	66	10
Apartment building, 10 or more units	14	27.6	18	66	10
Other (boat, RV, van, etc.)	3	26.6	16	73	2
Housing age					
1995–2000	6	30.8	23	79	3
1990–1994	7	29.6	21	79	3
1980–1989	18	28.7	20	78	4
1970–1979	20	27.2	17	76	4
1960–1969	16	27.0	17	74	5
1950–1959	16	27.0	17	75	5
1940–1949	7	27.3	18	72	7
1939 or earlier	9	27.4	18	66	12

Source: 2000 PUMS.

Race/ethnicity was also strongly associated with differences in commute time. African Americans had longer average commutes than others, and white non-Hispanics had shorter commutes.

individual, household, and housing characteristics that distinguish commuters. In the following discussion, the individual influence of these factors on commuting behavior is discussed, but some factors are also highlighted as the most significant when all are considered simultaneously, in other words, after controlling for the others through regression analysis. In the regressions, the influence of certain housing-related characteristics of the areas in which workers lived was controlled for, in addition to the factors shown in Table 5: the area's resident population density, the median decade that its housing was built, and the share of its housing consisting of single-family detached homes.[13]

The most influential predictor of commute time, after controlling for all factors simultaneously, was mode of transportation used. Transit trip times were 73 percent longer in duration, and carpooling commutes 17 percent longer, than commutes by solo drivers.

After modal choice, two personal or socioeconomic characteristics of commuters stand out in terms of predicting who had the longest commute times: sex and race. On average, men had longer average commute times than women—12 percent longer after controlling for all individual, household, housing, and area characteristics simultaneously. The finding of a shorter average commute time for women has been well-established in other research, which has attributed the difference to women's lower wages, their need to balance the needs of home and work, and their relatively more even spatial distribution of jobs (Clark, Huang, and Withers, 2003).

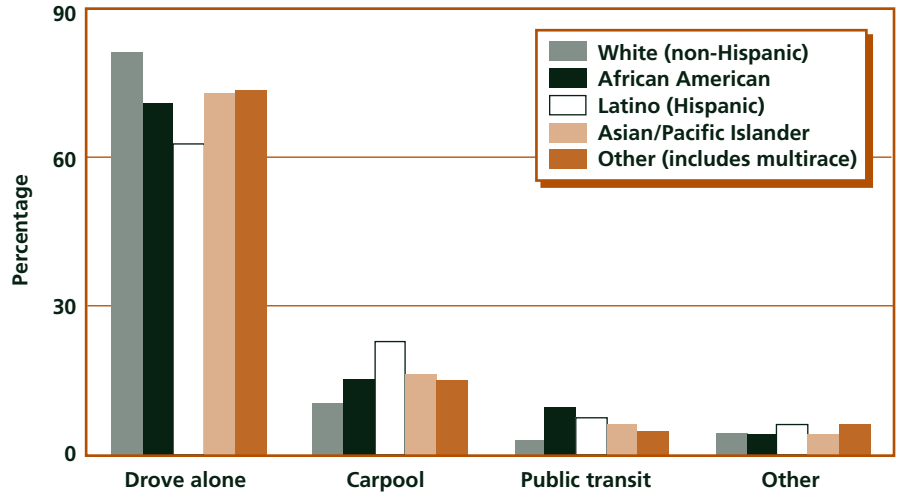
Race/ethnicity was also strongly associated with differences in commute time. African Americans had longer average commutes than others, and white non-Hispanics had shorter commutes. To some degree, these differences were related to modal choice (Figure 6). Whites were more likely than others to drive alone to work; Latinos were more likely to carpool. Meanwhile, African Americans were twice as likely as all workers on average to take public transit, helping explain why their average commute times were higher.

However, even after controlling for differences in modal choice, the average commute time for African Americans was higher than for other racial/ethnic groups. In fact, controlling simultaneously for all the factors in Table 5 as well as area-type variables, commutes for African Americans were 14 percent longer than commutes for whites.

The finding that average commute times for African Americans are longer than for other groups has been confirmed in other research (Shen, 2000), although the explanation is still debated. Some attribute their higher commute times to a "spatial mismatch" between residential and job locations. According to this hypothesis, various factors including racial discrimination in housing and the shift of jobs to suburban areas may serve to distance African Americans from job opportunities, thus lengthening commutes. Other research suggests that slower average public transit speeds, rather than longer distances covered, better account for the longer commute times for African Americans than for whites (Taylor and Ong, 1995).

Other individual-level characteristics of commuters also were associated with differences in average commute times. Workers in their prime childrearing years (35 to 44) had longer average commutes than workers in other age groups, as did more highly educated workers compared to

Figure 6. Mode of Transportation to Work by Racial/Ethnic Group in California, 2000



Source: 2000 PUMS.

Commuters in traditional "Ozzie and Harriet" household relationships—married-couple household heads or their spouses, with children present and with only one spouse working—had the longest average commute times among the household types.

others. Married workers and heads of household had longer average commutes than others.[14]

Two household-level factors proved very influential in predicting higher commuting time after controlling for all other factors analyzed: number of workers and household income. Workers in households with three or more workers had 10 percent shorter commutes than those in one-worker households, controlling for other factors. Workers in the top two household income quartiles had 8 percent higher commute times than those in the poorest quartile, after controlling for other factors. This finding tends to support the notion that higher-income households may be willing to trade longer commute times for more desirable housing located farther from urban centers. However, an alternative explanation is that job availability for these workers is less spatially ubiquitous. Longer commute times may be required to access desirable, high-paying jobs.

Combining indicators of employment status of household heads and their spouses, presence of children, and household headship and family relationships, commuters can be analyzed in relation to some key determinants that might be expected to influence housing choice (type and location), with possible implications for commuting. According to such a measure (the hybrid listed in Table 5), householders living alone had shorter average commute times than others in 2000, as did members of multiperson nonfamily households. Commuters in traditional "Ozzie and Harriet" household relationships—married-couple household heads or their spouses, with children present and with only one spouse working—had the longest average commute times among the household types.

Who was most likely to experience an extremely long commute of 45 minutes or more? This question brings us back to issues posed above, regarding how to explain why some commutes lengthened substantially over the 1990s in spite of the economic downturn of the decade. The salient factors tend to match those associated with commute time in general.

Among all the factors analyzed, race and household income were the strongest predictors of transit use.

Choice of transportation mode dominated all other factors in influencing the odds that a worker experienced an extremely long commute in 2000; those odds were nearly eight times as high for those using public transit as for those who drove alone. Sex, race, and income were most predominant among other factors, with men, African Americans, and richer workers more likely than others to experience extremely long commutes.

How did extreme commuters (those with commute times of 45 minutes or more) differ in 2000 from those in 1990? These commuters in 2000 were more likely to be solo drivers, to be from poorer households, to be apartment dwellers, to be less highly educated, and to be from middle-aged housing (especially 11 to 20 years old), than commuters with extremely long commutes in 1990, after discounting for overall shifts in the commuting population according to these factors.

How were individual and household characteristics related to commuters' choice of mode of transportation to work? As noted above, solo drivers were most likely to be white. In addition, the propensity to drive alone increased with age and education (Table 5). Married workers and heads of household were more likely than others to drive alone, as were commuters from one-worker households, higher-income households, households that owned instead of rented, and households without children.[15] Among all the factors analyzed, education, income, and the number of workers in the household exerted the strongest influence on the likelihood of driving alone, after controlling for the others.[16]

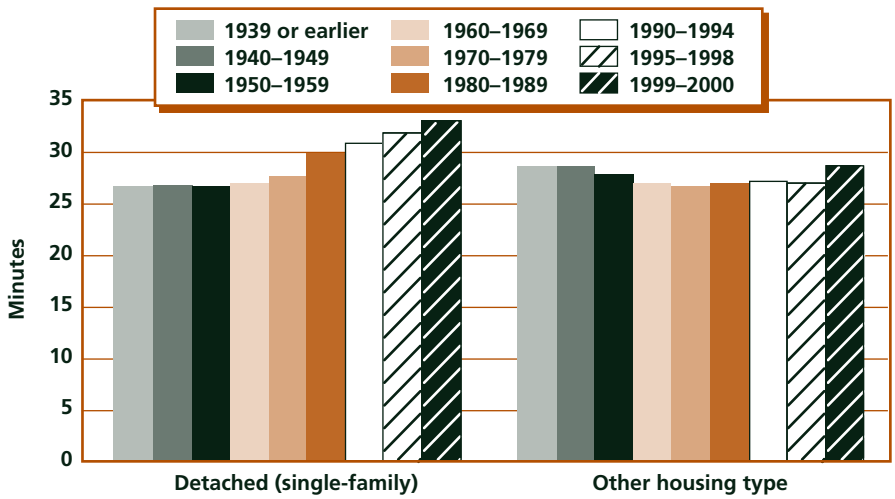
Just as in the case of driving alone, the propensity to carpool was strongly related to the number of workers in a commuter's household—but with the opposite effect. Although 10 percent of commuters in one-worker households carpooled, 15 percent of commuters in two-worker households, and 22 percent of commuters in households with three or more workers carpooled to work. Seventy-four percent of carpools were two-person carpools and of these, 48 percent were married couples.

The odds that a commuter took public transit to work were higher among women, African Americans, younger workers, and unmarried workers, than for other groups. In addition, workers from poorer households, three-worker households, and those in rented homes were more likely than others to use transit. Among all the factors analyzed, race and household income were the strongest predictors of transit use.[17] Again, this finding is supported by other research (Badoe and Miller, 2000; Pucher and Renne, 2003). Income may proxy for the effect of vehicle ownership, which has been demonstrated to be a major determinant of transit use.

Housing characteristics—both type and age—also affect commute times and mode choices. The average commute time for workers who lived in single-family detached housing (62% of all housing in 2000) was higher than for workers in other housing types (Table 5). Commuters in these houses also were substantially more likely to drive alone to work (79% drove alone, compared to 66% of those who lived in apartment buildings). Commuters who lived in apartment buildings were far more likely to take public transit, reflecting the fact that public transit can be more viable in areas with dense concentrations of residents and jobs.

Housing age also figured into commuting patterns (Figure 7). For commuters living in detached, single-family homes, the average commute time was directly related to housing age—the newer the

Figure 7. Average Commute Time by Housing Type and Year Built in California, 2000



Source: 2000 PUMS.

Housing characteristics—both type and age—also affect commute times and mode choices. The average commute time for workers who lived in single-family detached housing . . . was higher than for workers in other housing types.

home, the longer the commute time on average. This pattern can be explained by considering that newer single-family homes are most likely to be located at the fringes of metropolitan areas, farther away from major job centers, where there is more room for such housing.[18]

The effect of housing age for other housing types (mainly multiunit) was different, however. In this case, commuters living in the newest housing, but also in the oldest housing, experienced the longest commute times on average (although only slightly longer). This suggests that workers residing in older core, central cities—areas more likely to have apartments or attached homes—experienced longer commutes. In part, higher commute times for these workers may reflect a greater likelihood that they took public transit. Thirteen percent of commuters who lived in apartments or attached homes built from 1940 to 1959 took transit to work and 21 percent from homes built before 1939, compared to only 5 percent of commuters as a whole. But solo auto commutes for these workers also took longer on average than for others.

Housing age had only a minimal effect on the likelihood that a commuter drove alone to work, among those who lived in single-family detached homes. However, housing age made more of a difference for workers in multiunit housing. Those who lived in newer multiunit housing were considerably more likely than those living in older housing of this type to drive alone to work.[19]

How important were these housing-related factors when considered in relation to all the other worker characteristics discussed in this section? The regression analysis indicates that housing-related variables measured at the areawide level were significant predictors of commuting behavior (see footnote 13). Longer individual commute times were associated with higher population density in the commuter's area of residence, a higher share of housing consisting of single-family detached homes, and a newer median housing age.

The likelihood of driving alone was higher and the likelihood of taking transit was lower for residents of areas with a higher single-family detached home share and a newer median housing age.

Although the density and single-family detached home share findings may seem contradictory, they could be explained by considering the congestion effects of density and the distance effects of housing type. The likelihood of driving alone was higher and the likelihood of taking transit was lower for residents of areas with a higher single-family detached home share and a newer median housing age. The likelihood of taking transit also increased with area population density. Even after controlling for these area housing characteristics, housing age for individual commuters also exerted a strong influence on commute time. Commuters in homes built before 1969 had 9 percent shorter commutes than those in homes built in 1990 or later, after controlling for all other factors.[20]

One variable not discussed much so far deserves further mention for policy reasons. The effect of age on commute behavior was altered considerably by controlling for other factors, with interesting implications. When age is considered on its own, older workers were more likely to drive alone and less likely to take transit (Table 5). However, after controlling for other factors, the odds of driving alone were lower and the odds of taking public transit considerably higher for older workers. This finding might have implications for future commuting trends, as the state's population is expected to grow increasingly older in coming decades (Johnson, 2005). If factors related to mode choice and age—housing type, for example—are amenable to change, then older workers might help boost future transit ridership in the state.

Taken as a whole, the results in this section suggest that two seemingly competing effects can help explain long commutes. On the one hand—and characterized somewhat emblematically—wealthier men may be experiencing especially long commutes, associated at least partly with living in less compact housing located at greater distances from urban job centers, or with traveling to less spatially ubiquitous job sites that are farther away. At the same time, some African Americans and lower-income workers also may experience longer commutes than others, mediated somewhat by such effects as higher propensity to use transit.

Trends in Commuting to and from Urban, Suburban, and Rural Places

This section analyzes more systematically the relationship between commute behavior and job and residence locations by type. First, a broad trend is characterized—the continuing decentralization of both jobs and housing from major central cities and counties to more outlying areas. Next, this decentralization is analyzed in terms of how shifts over time in commute flows by type of place—urban, suburban, and rural—are associated with changes in modal choice and commuting time. Finally, some major characteristics that distinguish cities are considered in relation to commute behavior, with an eye to policy implications.

From 1980 to 2000, jobs in the state's major metropolitan areas decentralized more rapidly than homes. Over the period, the share of jobs located in the central counties of the three largest metropolitan areas (the San Francisco, Los Angeles, and Sacramento areas) declined from 55 to 47 percent, while the share of workers residing

in these same counties declined from 50 to 44 percent.[21]

Considering decentralization in relation to major central cities, rather than counties, allows us to add the San Diego region into the analysis.[22] Of all jobs in these four regions, the share located in the major central cities declined from 36 to 31 percent from 1980 to 2000, while the share of workers residing in the major central cities declined from 29 to 27 percent over the same period.[23]

Decentralization can affect commuting in various ways. For example, as noted above, modal choice is related to area housing characteristics, and such characteristics differ by type of place. Newer suburban areas, for example, tend to be less densely developed and to have higher shares of single-family detached homes than older urban areas, with implications for modal choice. Also, concerns about congestion have drawn attention from policymakers and the press to the purported need for "jobs-housing balance" or, in practical terms, the need for an adequate supply of housing for workers located close to their jobs.

Reflecting this decentralization, commutes with a suburban origin increased from 1990 to 2000, as did commutes with a suburban destination. In 2000, 52 percent of commutes had a suburban origin—up 2 percentage points from 1990 (Table 6).[24] A third of commutes (33%) traversed from one suburban location (or "place" as designated by the census) to another, either within the same suburban place or to another. Also in 2000, 46 percent of commutes had a suburban destination; that share increased by 3 percentage points from 1990 to 2000.

An evaluation of the shift in commutes by type of place from 1990 to 2000 is hampered by changes in census designation of places—changes which themselves reflect the decentralization of jobs and housing.[25] Applying the same designations for central cities and metropolitan counties used in 1990 to the commute data from the 2000 Census, we gain a sense of the trend holding definitions constant.[26] By this measure, within-central-city commutes declined most in share over the decade, and suburb-to-suburb and central-city-to-suburb commutes increased most among specific place-to-place commute types.

Suburban residents had the longest average commute time in 2000, followed by central city residents. The shorter average commute time of central city residents was the result of the high share of these commuters working within their city of residence; commutes originating in central cities but going elsewhere were long compared to other cross-place commutes (those from one place to another). Among cross-place commutes, those from one suburb to another were relatively short.

Between 1990 and 2000, average commute times increased most rapidly for residents of rural places and most slowly for residents of suburbs.

Not surprisingly, commutes to central cities took longest. Workers who lived in rural places had the worst and best of it when it came to their commute times. Those who worked in the same place they lived had a short, sweet average commute time of 12 minutes, but those who commuted to suburbs or central cities had it much worse.

Between 1990 and 2000, average commute times increased most rapidly for residents of rural places and most slowly for residents of suburbs. Over the period, the most noteworthy increases were a 14 percent increase for within-suburb commutes, an 11 percent increase for suburb-to-suburb commutes, and a 10 percent increase for within-central-city commutes. On average, commute times for the "classic" commute—from a

Table 6. Commutes According to Place Type in California, 1990 and 2000

	Percentage of Commutes, 2000	Shift-in-Share, 1990–2000[a]	Average Commute Time (Minutes), 2000	Rise in Average Commute Time (Minutes), 1990–2000	Percentage Rise in Time, 1990–2000	Percentage Who Drove Alone, 2000	Percentage Who Carpooled, 2000	Percentage Who Took Bus, 2000	Percentage Who Took Other Transit, 2000	Percentage Who Biked or Walked, 2000
All place-to-place commutes	100	0.0	27.5	3.0	12	74.6	14.7	4.4	1.4	3.9
All commutes with central city origin	43	–1.5	26.5	2.9	12	70.6	14.8	6.9	1.6	5.0
Within same central city	25	–3.4	21.8	1.9	10	67.6	13.8	8.5	1.4	7.4
From central city elsewhere	18	1.9	33.3	2.7	9	74.9	16.2	4.5	1.9	1.5
Central city to other central city	6	0.4	36.9	2.3	7	71.9	16.4	4.6	4.5	1.5
Central city to suburb	12	1.5	31.5	2.4	8	76.3	16.0	4.6	0.6	1.6
Central city to rural	<1	0.0	32.7	2.8	9	75.8	19.8	1.5	0.1	1.7
All commutes with suburb origin	52	2.0	28.6	2.9	11	77.9	14.4	2.6	1.4	2.8
Within same suburb	10	–0.5	14.6	1.8	14	72.5	13.6	2.1	0.1	10.3
From suburb elsewhere	43	2.5	31.8	2.8	9	79.2	14.6	2.7	1.7	1.1
Suburb to central city	19	0.4	34.4	2.4	8	77.0	14.5	3.3	3.4	0.9
Suburb to suburb	24	2.2	29.5	2.9	11	81.0	14.6	2.1	0.4	1.2
Suburb to rural	<1	0.0	36.5	3.7	11	77.8	18.5	1.2	0.5	0.9
All commutes with rural origin	4	–0.4	24.0	3.7	18	74.9	16.9	0.9	0.2	6.0
Within same rural	2	–0.4	11.6	1.7	17	69.9	15.9	0.8	0.1	11.8
From rural elsewhere	2	0.0	33.2	3.2	11	79.0	17.7	1.0	0.2	1.2
Rural to central city	1	–0.1	38.8	5.5	17	79.3	17.6	1.0	0.4	0.9
Rural to suburb	1	0.0	43.0	2.3	6	80.1	17.9	0.7	0.1	0.6
Rural to rural	1	0.1	21.2	0.5	0.0	78.2	17.8	1.1	0.0	1.8

Source: Calculated from 1990 and 2000 CTPP.
[a]Employs 1990 definitions for central cities and metropolitan areas.

suburb to a central city—actually increased relatively slowly compared to other journeys.

These findings suggest that although suburb-to-suburb commutes remained comparatively short among cross-place commutes in 2000, the decentralization of jobs and housing did increase pressure on suburban commuters during the 1990s—but more so for suburb-to-suburb and within-suburb commuters than for "classic" commuters traveling to central city jobs. Notably, the rapid rise in commute times within places of all types suggests that rising density and congestion across the board helped account for the overall increase in average commute times during the 1990s.

Modal choices of commuters differ by place type. For example, in 2000 a substantially higher share of suburb-to-suburb commuters drove alone (81%) compared to within-central-city commuters (68%). Commuters to suburban places were most likely to drive alone, but commuters traveling within and to central cities were most likely to use public transit—10 percent of within-central-city commuters, 9 percent of central-city-to-central-city, and 7 percent of suburb-to-central-city com-

muters did so. By contrast, only 2 percent of within-suburb and 3 percent of suburb-to-suburb commuters used public transit.

Bus transit was used most heavily for within-central-city commutes (8.5%) and for commutes from central cities to other areas. By contrast, subway, streetcar, and rail were more heavily favored for cross-place commutes, especially from one central city to another and from suburbs to central cities. Nevertheless, bus commutes were still more common than other public transit modes, even for the typically longer cross-place commutes. Biking or walking nearly matched public transit as a share of within-central-city commutes and far outpaced public transit for commutes within other place types.

From 1990 to 2000, the solo driving share increased most rapidly for commuters from central cities and, in particular, for those who traveled to suburbs. The solo driving share also increased rapidly for suburb-to-rural and suburb-to-central-city commuters. The public transit share declined for central city commuters but increased for suburban and rural commuters for all cross-place commutes. The carpooling share increased for within-same-place commutes but declined for almost all other place-to-place commute types. These findings confirm that increased transit use among suburbanites helped account for the shift toward transit during the 1990s. The carpooling trend is harder to interpret, however.[27]

Finally, Table 7 shows the differences in average commute times and solo driving shares at key quantile break points, measured for four city characteristics—resident worker density, job density, jobs-to-resident-worker ratio, and median year housing was built. These characteristics could be expected to influence commuting, as they distinguish job-rich cities, denser cities, and newer cities from others, as well as those cities with a closer "jobs-housing-balance" (for which the job-to-resident-worker ratio is a common measure). The factors are useful to consider at the city level because they could be amenable to city government policy action.

More densely populated cities had slightly higher average commute times among resident workers and somewhat lower shares of solo drivers. By contrast, cities with greater job density tended to have slightly lower average commute times; they also had lower solo driver shares. Cities with a higher job-to-resident-worker ratio had substantially lower average commute times in 2000, but they did not have lower solo driver shares. This may reflect an aspect of the jobs-housing balance concept that is not always recognized. As homes continue to decentralize, one means to achieve a greater jobs-housing balance is for jobs to follow workers to suburban locations—and, as we have seen, that has been occurring. However, because suburban areas are less well served by transit, this outcome may result in shorter commute times but higher car use.

More densely populated cities had slightly higher average commute times among resident workers and somewhat lower shares of solo drivers.

Cities with older housing had slightly higher average commute times than cities with middle-aged housing. This difference reflects higher commute times in more congested, central areas. But cities with newer housing also had substantially higher average commute times—especially cities with the newest housing. These cities also had higher shares of solo drivers. This information confirms earlier findings, but at the city level.

Which city characteristics could best predict high average commute times, after controlling for multiple factors simultane-

Table 7. Commuting Behavior of Resident Workers by California City Characteristics, 2000

	Bottom Decile (Lowest 10th)	First Quartile	Second Quartile	Third Quartile	Fourth Quartile	Top Decile (Top 10th)
Resident worker density (resident workers per square mile of land area)						
Commute time (minutes)	26.2	24.8	26.4	27.5	27.4	28.2
Percentage drove alone	76	77	76	77	73	70
Job density (workers by location of work, per square mile of land area)						
Commute time (minutes)	27.7	27.6	26.4	25.9	26.3	25.6
Percentage drove alone	77	77	77	76	74	75
Jobs-to-resident-worker ratio (number of jobs in the city/number of working city residents)						
Commute time (minutes)	29.9	29.9	27.4	26.0	23.0	22.0
Percentage drove alone	75	75	76	76	76	77
Median year housing built						
Commute time (minutes)	26.2	26.1	25.6	25.1	29.3	32.6
Percentage drove alone	72	74	76	76	78	78

Source: 2000 CTPP.
Note: Based on unweighted data for 474 cities in California.

ously? Residents of suburban cities with newer housing, higher population density, higher homeowner shares, more children, and more African Americans but fewer Latinos relative to whites tended to have higher average commute times in 2000.[28]

Which city characteristics in 1990 were most likely to predict change in commute times from 1990 to 2000? After controlling for multiple factors simultaneously, a few stand out. Suburban cities were less likely than other city types to have experienced rapid increases. Workers from Central Valley cities were more likely to have experienced rapid increases. Workers from cities with higher jobs-to-resident-worker ratios, lower homeowner shares, and higher shares of residents who had been living in the same housing for at least five years were most likely to have experienced rapid increases in average commute times over the decade.

How was the change in commute times for cities related to the change in other key variables over the same period? Cities with more rapid increases in their average commute times from 1990 to 2000 tended also to have experienced more rapid population growth (of resident workers) but less job growth.

Conclusion

During the 1990s, slower rates of job and population growth in California provided something of a reprieve from the intense growth pressure experienced in the state during the 1980s, at least in some regions. Although housing affordability problems in coastal areas pushed more state residents inland and away from the major job centers, the commute time experienced by most

California commuters actually declined from 1990 to 2000.

The decentralization of employment and a shift toward solo driving helped keep many commute times from getting much worse.[29] Driving alone to work provides the shortest average commute time for Californians—other modes, particularly public transit, cannot compete in most cases. Suburb-to-suburb commuting, which increased most rapidly among place-to-place commute types between 1990 and 2000, provides relatively low commute times (likely related to high solo driving shares) among cross-place commutes. Jobs-housing balance is being achieved through the suburbanization of jobs more than through the residential densification of central cities. Although cities with higher jobs-to-resident-worker ratios did have shorter average commute times in 2000, they did not have smaller shares of resident workers driving alone.

But the benefits of decentralization did not come without a price for suburban commuters during the 1990s. Some counties adjoining metropolitan regions experienced sharp increases in average commute times during the 1990s. The trend toward solo driving was facilitated during recent decades by the availability of excess roadway capacity, but that surplus may be drying up in some areas (Pisarski, 1996). High—and rising—carpool shares, and low but rising public transit shares in such bedroom counties as San Bernardino and San Joaquin, suggest that some suburban commuters are already seeking alternatives to solo driving. At the same time, workers from the major coastal counties have turned more rapidly toward solo driving than have workers from other counties, reflecting job decentralization to suburban locations.

Commuters in the state bucked the national trend away from public transit use from 1990 to 2000. Substantial investments made in public transit in California in recent decades must help to account for the small shift toward transit use. But given that California's investment in public transit has amounted to 20 to 40 percent of all capital outlay spending for transportation in recent years, some have asked whether the investment has been cost-effective (Hanak and Barbour, 2005).

Others counter that land use patterns have not been modified to support public transit use effectively. This study confirms that housing-related factors exert considerable influence on the likelihood of taking public transit to work. Regional transportation agencies in California are encouraging policy changes to promote higher-density development near public transit stops to promote more public transit use (Hanak and Barbour, 2005; Barbour and Lewis, 2005).

Driving alone to work provides the shortest average commute time for Californians—other modes, particularly public transit, cannot compete in most cases.

What can we surmise about the future of the commute in California? Projections suggest that from 2000 to 2020, the rate of employment growth in inland areas will outstrip the rate in coastal areas—perhaps by a factor of two-to-one. But in absolute numbers, the vast majority of new jobs will still be located in coastal zones.[30] In absolute terms, population growth in inland areas is expected to be higher relative to population growth in coastal areas than the corresponding ratio of absolute employment growth. This projected trend suggests that pressure on inland-to-coastal-area commutes could increase substantially. Efforts to encourage more efficient use of the existing transportation infrastructure may become paramount.

Meanwhile, projected demographic trends also will shape the future of the commute. Particularly

As our transportation infrastructure ages and many facilities are growing more strained, questions about how to invest wisely to expand and maintain capacity have come to the fore.

salient factors include a projected rapid rise in the Latino share of the state's population, expected to become the largest racial or ethnic group within a decade and to reach a majority by 2040 (Johnson, 2005). The effect of this shift on commuting behavior is not so easy to predict. Certain factors suggest that a higher Latino population share might translate into more compact housing patterns and less solo driving: On average, Latinos have larger household sizes than other racial/ethnic groups and a greater tendency to carpool, for example (Myers, 2001; Johnson, Moller, and Dardia, 2004). But current patterns among Latinos may modify in future years as second- and third-generation Latinos form a larger share of this racial/ethnic group and their household structures and other behaviors possibly come to more closely resemble those of other native-born Californians.

Another important trend will be the aging of the population, with the number of seniors expected to double by 2030 (Johnson, 2005). Although older workers tend to prefer solo driving, this reflects the influence of factors correlated with age, such as household income, rather than age itself. An intriguing question is whether older Californians might boost demand for more compact housing in coming years, which in turn could support public transit use.

In the end, why should we care about the commute in California? Or, more specifically, although we may care about our own individual commute options and challenges, why dissect myriad permutations of factors that influence aggregate trends?

As our transportation infrastructure ages and many facilities are growing more strained, questions about how to invest wisely to expand and maintain capacity have come to the fore. With jobs and residents decentralizing to areas harder to serve with public transit, strategies to get Californians out of their cars sometimes seem to be working against the tide. However, many of the benefits of solo driving depend on adequate roadway capacity, and if fiscal constraint, high construction costs, or public opposition (or a combination) prohibit new road building, then the appeal of solo driving may diminish.

Transportation investments can have long-range consequences for shaping metropolitan growth, and many of the choices boil down to preferences regarding the type of growth and development we seek to foster. By understanding commuting behavior we may gain insight about how Californians—individually and collectively—are adapting to and shaping metropolitan growth and development. ◆

Notes

[1] There are discrepancies between information from the decennial census—which we employ for information for 1980, 1990, and 2000—and the American Community Survey—which we employ for information from 2004. These discrepancies make it somewhat difficult to compare the data over time. For 2000, the ACS put the average commute time for Californians at 26.7 minutes, whereas the decennial census put it at 27.7 minutes.

[2] Throughout this analysis, "long" and "short" commutes, unless otherwise indicated, refer to the duration of the commute trip, not the distance.

[3] Unfortunately, accurate assessment of trends in extremely long commutes is hampered by a change in census methods between 1990 and 2000. For the 1990 Census, the maximum travel time assigned to any worker was 99 minutes (survey responses above this value were recoded). For the 2000 Census and the continuing ACS, the maximum travel time was increased to 200 minutes. The effect of this coding change is that increases in average travel time and in the standard deviation from 1990 to subsequent years are somewhat overstated. At the national level, the Census Bureau estimates that about 29 percent (0.9 minutes) of the 3.1 minute increase in average travel time from 1990 to 2000 is attributable to the coding change (U.S. Census Bureau, "Notes on CTPP 2000 Profiles"). If this pattern is also reflected in California data, then the average commute time in California may have increased only by about 9 percent between 1990 and 2000, rather than by 13 percent as the data suggest. However, that would still not compensate for the discrepancy between the shift in the median commute time over the period—a decline—and the shift in average time—an increase. Clearly, in spite of the coding changes, workers with extremely high commutes still pulled up the average commute length among Californians relative to the median.

[4] By this "on-off" measure, roadways are considered either uncongested, with travel at free-flow speeds, or congested, with travel at slower speeds. The Texas Transportation Institute measures delay for freeways and major arterials as the difference in time required to travel peak period vehicle miles at average speeds and at free-flow speeds. Half of all daily travel is assumed to occur during peak periods, standardized at seven hours per day (6:00 a.m. to 9:30 a.m. and 3:30 p.m. to 7:00 p.m.).

[5] Another possible explanation for the public's view that congestion remains a major worry, in spite of tolerable commutes, is that congestion may have worsened for *nonwork* trips, which constitute the majority of trips. This trend cannot be captured in these data.

[6] Residents of some less-populous counties also experienced long average commutes in 2000 (ACS data by county are limited, precluding a statewide comparison for 2004). For example, residents of Calaveras County had the highest average commute time in the state that year, at 34.5 minutes. Residents of San Benito, Marin, and Solano Counties (all adjacent to or within the San Francisco Bay Area) and Mariposa County also had high average commute times—all above 30 minutes. The counties with the shortest average commute times in 2000 were Modoc and Del Norte in the far north—both below 15 minutes.

[7] In this section on means of transportation to work, workers who worked at home are included in the analysis. However, in other sections of the paper, these workers are excluded unless noted. Census data from 2000, rather than American Community Survey data from 2004, are presented because the ACS does not split out biking and walking nor does it provide average commute times by mode.

[8] In recent years, between 20 and 40 percent of transportation capital outlay funds in the state went to public transit (Hanak and Barbour, 2005).

[9] Public transit includes bus or trolley bus, streetcar, trolley car, subway, or elevated rail, and railroad or ferryboat.

[10] Among the 15 major counties, average drive-alone commute times were shortest in Fresno, Kern, and Ventura. Public transit commute times were especially high in suburban counties. Average bus commutes were 50 minutes or more one way in San Bernardino and Contra Costa Counties, for example. Average subway or streetcar commutes were 70 minutes or more in San Joaquin and San Bernardino, and above 50 in Contra Costa, Orange, and Santa Clara Counties. Average rail commutes were above 80 minutes in San Joaquin, San Bernardino, Riverside, Orange, and Ventura Counties.

[11] The U.S. Census tracks journey-to-work flows for "places" with populations of 2,500 or more; census-designated places are "concentrations of population, housing, and commercial structures that are identifiable by name but are not within incorporated places" (U.S. Census Bureau, *Census 2000 Geographic Terms and Concepts*). Incorporated places are more commonly called cities.

[12] A vigorous debate has emerged among researchers about the relative influence of various factors on travel behavior including individual socioeconomic characteristics, land use patterns of both origin and destination neighborhoods, accessibility and cost of transportation options, and other factors. Many of these influences are interrelated and hard to disentangle. For example, although studies have demonstrated that workers residing and working in more compactly built neighborhoods are more likely to use transit, the effect of density alone remains unclear. Various factors associated with denser areas may increase the likelihood of using transit, such as higher parking costs and lower parking availability, more congestion, better provision of transit service with greater accessibility to multiple locations, and more pedestrian-friendly environments. Individuals who reside in transit-friendly neighborhoods may have chosen to do so in part so they could use transit, making it hard to distinguish land use effects from travelers' attitudes and preferences (Badoe and Miller, 2000; Crane, 2000; Ewing and Cervero, 2002; Fontaine, 2003). Similarly, many households may be willing to trade longer, car-oriented commutes for the benefits of owning more affordable, single-family housing located at the fringe of urban areas. Various factors such as the quality of schools and housing options outweigh commuting time in the locational calculus of many, if not most, households (Giuliano and Small, 1993).

[13] Ordinary least squares regression was employed to test the influence of the factors listed in Table 5 on the natural logarithm of

commute time. Logistic regression was used to test probabilities of solo driving, transit commuting, and experiencing an extremely long commute of 45 minutes or more, controlling for the same set of factors. Variables measuring area characteristics described above, were constructed at the scale of census-designated "Public Use Microdata Areas" (PUMAs), which contain a minimum population of 100,000. This geographic scale is the smallest available in the census data employed. Metropolitan area of residence was also included as a control variable. The regression results, not shown in Table 5, are available from the author on request.

[14] In this analysis, "married couples" include those designated by the census as "unmarried partners."

[15] Because the census question on carpooling asks "how many people, including this person, usually rode to work in the car, truck, or van," it is possible that some carpoolers included children being transported to jobsite child care.

[16] The odds that a worker with at least some college education drove alone to work were about one-and-a-half times as high as for workers with a high school diploma or less. The odds that commuters from households in the top two quartiles of household income drove alone were more than one-and-a-half times higher than for those from households in the bottom (poorest) quartile. The odds of driving alone were only half as high for workers in households with three or more workers compared to those in one-worker households, and three-quarters as high for workers in two-worker households.

[17] The odds that African Americans and Latinos took transit were twice that of whites. Household income influenced public transit use most especially for workers from the poorest households; the odds that a commuter from a household in the top two quartiles of household income took public transit were 0.62-to-one compared to those in the bottom (poorest) quartile.

[18] Johnson and Hayes (2003) confirm that the majority of new housing built in California during the 1990s was located in neighborhoods established during the 1980s and 1990s, often near the urban fringe. Housing built in the 1980s and 1990s was built at lower densities overall than during previous decades. Only 17 percent of housing units built in new neighborhoods in the 1990s consisted of multifamily units—a lower share than in most previous decades.

[19] To test the hypothesis that new homeowners experienced long commutes, commute behavior for "young homeowners" was considered, defined as workers ages 25 to 35 in single-family detached houses that were owned, not rented, and who had moved to that home within the five years before the census. Young homeowners (6% of all commuters) had slightly longer average commutes than other workers (by less than three minutes) and were somewhat more likely to drive alone to work.

[20] Regressions also were conducted separately for commuters in the San Francisco Bay and Los Angeles areas, to see how results compared. Differences were most noticeable for modal choice. The area-type variable measuring the share of homes that were single-family detached exerted a much stronger positive influence on the chance of driving alone for Bay Area workers than for Los Angeles region workers. Interestingly, however, this variable proved stronger for Los Angeles region workers (in a negative direction) when it came to influencing the likelihood of taking transit. After controlling for area-type effects, demographic variables exerted a considerably stronger influence over modal choice for Los Angeles region commuters than for Bay Area commuters, whereas housing-related variables exerted a stronger influence in the Bay Area.

[21] The three largest multicounty metropolitan areas in the state are the Los Angeles region (comprising Los Angeles, Orange, Ventura, Riverside, and San Bernardino Counties), the San Francisco Bay Area (comprising Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties), and the Sacramento area (comprising El Dorado, Placer, Sacramento, and Yolo Counties). The San Diego region is excluded from the county-scale analysis because it has traditionally been primarily a single-county metropolitan area. The central counties are considered to be Los Angeles, San Francisco, and Sacramento.

[22] The San Diego region comprises San Diego and Imperial Counties. Major central cities include Los Angeles, San Francisco, San Jose, Oakland, San Diego, and Sacramento.

[23] Job decentralization was particularly rapid in the Los Angeles and Sacramento regions. Jobs located in the City of Sacramento dropped by 12 percent as a share of all regional jobs between 1980 and 2000. Jobs located in Los Angeles County dropped by 9 percent as a share of all regional jobs over the same period.

[24] The U.S. Census tracks journey-to-work flows for "places" with populations of 2,500 or more; see footnote 11. In this analysis, central cities are those designated by the census as such. Many may not be commonly thought of in that way (Petaluma, for example). In 1990, there were 49 census-designated central cities, and in 2000 there were 59. In this analysis, "suburban places" (incorporated and unincorporated) include those places not designated as central cities that were within census-designated urbanized areas and metropolitan counties. "Rural" places are those not designated as suburban or central city. Note that totals in Table 6 do not match data from other tables in this report because these data are only for those workers who lived in "places"; these workers comprised 85 percent of all workers in the state in 2000.

[25] Although in 1990 there were 49 census-designated central cities in California, by 2000 the number had been increased to 59. Two additional counties were designated as metropolitan. Over 200 new places (21%) were added, and 77 of the places that existed in 1990 (9% of the total) that had been designated nonurbanized were redesignated as falling in urbanized areas in 2000.

[26] Because this exercise does not hold constant the definition of urbanized areas, it underestimates the total shift over the period. Although urbanized area definitions could be held constant for places that existed in both census years, the addition of new places in the 2000 Census and the reconfiguration of existing ones renders a consistent and inclusive definition quite problematic.

[27] A decomposition of the overall change in average commute time and modal shares from 1990 to 2000 into shifts that occurred *within* given place-to-place commute types,

on the one hand, and shifts attributable to the distributional change in commutes by place-to-place type (the *across*-commute-type shift), on the other, shows that most of the overall increase in average time during the period was attributable to trends within commute types. The shift toward solo driving helped keep average commute times lower than they would have been otherwise, but only marginally. Most of the shift toward solo driving was attributable to shifts within commute types, especially for within-central-city, central-city-to-suburb, and suburb-to-central city commuters. The shift to greater transit use during the decade also could be chalked up mainly to a within-commute-type effect; greater transit use among suburbanites was especially influential.

[28] This conclusion is based on a regression analysis that also included other factors that proved to be less influential: job density, jobs-to-workers ratio, percentage of residents who lived in the same house five years previously, Asian population share, and average household size. Control variables included region and modal shares.

[29] An additional factor has been a shift in commuting schedules away from peak congested periods. From 1990 to 2000, the share of workers who did not work at home who left for work between 6:00 a.m. and 9:00 a.m. declined from 67 to 64 percent.

[30] Calculations from data from the California Department of Transportation.

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