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Transportation Research at the University of California

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The University of California Transportation Center, founded in 1988, facilitates research, education, and public service for the entire UC system. Activities have centered on the Berkeley, Davis, Irvine, Los Angeles, Riverside, and Santa Barbara campuses.



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The University of California Transportation Center: 15 Years of Accomplishment

UCTC HAS JUST TURNED FIFTEEN; so it seems an appropriate time to assess our accomplishments. Clearly, our most important products have been transportation professionals. We've supported over a thousand students, nearly all of them now working for state and local transportation agencies and as transportation specialists in the private sector. We've helped educate over a hundred PhDs, many of whom are now transportation faculty members at universities across the US. And we've sponsored several dozen conferences, training sessions, and seminars for practicing professionals here in California and beyond.

UCTC has funded nearly 300 faculty research projects over the years. Many of these produced immediate benefits, while others laid the groundwork for substantial long-term gains. Here's a baker's dozen examples.

1. **Professor Donald Shoup** invented Parking Cash-Out, in which employers who pay for parking for their workers offer them the option of receiving the same amount in cash or in transit passes. Parking Cash-Out is now written into both state and federal law and has proved cost-effective in providing travel alternatives.
2. **Professor Amelia Regan** and her students developed a method for solving large intermodal fleet-routing problems in rail-maritime operations. In collaboration with the JB Hunt company, they have significantly reduced delays and costs without negatively affecting customer service.
3. **Professor Anastasia Loukaitou-Sideris's** research on bus-stop crime helped allay fear that new transit lines bring crime into neighborhoods and prompted the Los Angeles County Metropolitan Transportation Authority to allocate over \$1 million to retrofit dangerous bus stops.
4. **Professor Carl Monismith** and his students developed new pavement materials and application strategies, including quick-dry pavements, saving highway agencies millions of dollars. **Professor John Harvey**, who worked with Monismith as a student at Berkeley, is now on the UC Davis faculty experimenting with using rubber tires and recycled materials in pavement.
5. **Professor Michael McNally** is testing the market potential for hybrid electric and fuel-cell engines. He is using a GPS-based vehicle monitoring system, developed in UCTC research, to track vehicle use.
6. **Professors Robert Cervero, Paul Ong, Evelyn Blumenberg, and Brian Taylor** completed a series of studies on reverse commuting and welfare-to-work, showing the diverse transportation requirements of low-income workers and the need for better service management. Their findings were cited in new federal policies and are being used by a new state coordinating committee.
7. **Professor Daniel Sperling** and his research team carried out a long line of projects on electric and hybrid vehicles, relating vehicle and fuel technology to market studies and organizational analyses. The work has led to testing of electric and hybrid cars and buses, as well as of fuel cells for auxiliary power in trucks.
8. **Professor Kenneth Small's** research on highway financing, pricing, and travel behavior has influenced federal and state decisions about congestion pricing and public-private transportation finance, including for the State Route 91 HOT lane—the first highway congestion pricing experiment in the US.
9. **Professor Patricia Mokhtarian** worked with California state agencies to evaluate their telecommuting programs, and found that the programs increased workforce productivity, reduced energy use and air pollutant emissions, and increased job satisfaction. Her findings led several agencies to make their programs permanent and expand them to additional workers.
10. **Professor Reginald Golledge** developed a real-time GPS data-collection system that can be augmented by speech interface, making the reporting of travel-survey data a simple task for anyone. He also developed ways to provide travel information to people with vision impairments.
11. **Professor Samer Madanat** developed methods for incorporating information on real-world performance and risk into transportation infrastructure management systems, making for investments that are more cost-effective with respect to maintenance, rehabilitation, reconstruction, and replacement of pavements and bridges.
12. **Professor Steven Ritchie** created a real-time system for incident detection that has been incorporated into the advanced traffic management system being used by Caltrans. Early detection of incidents is a key way to combat congestion.
13. **Professor Theodore Cohn's** escalator safety project investigated how people judge—or misjudge—distances to objects. Insights from that study and follow-on research led to improved railroad crossing signals, embedded pavement warning signals, and new warning signals for transit vehicles.

Elizabeth A. Deakin
UCTC Director

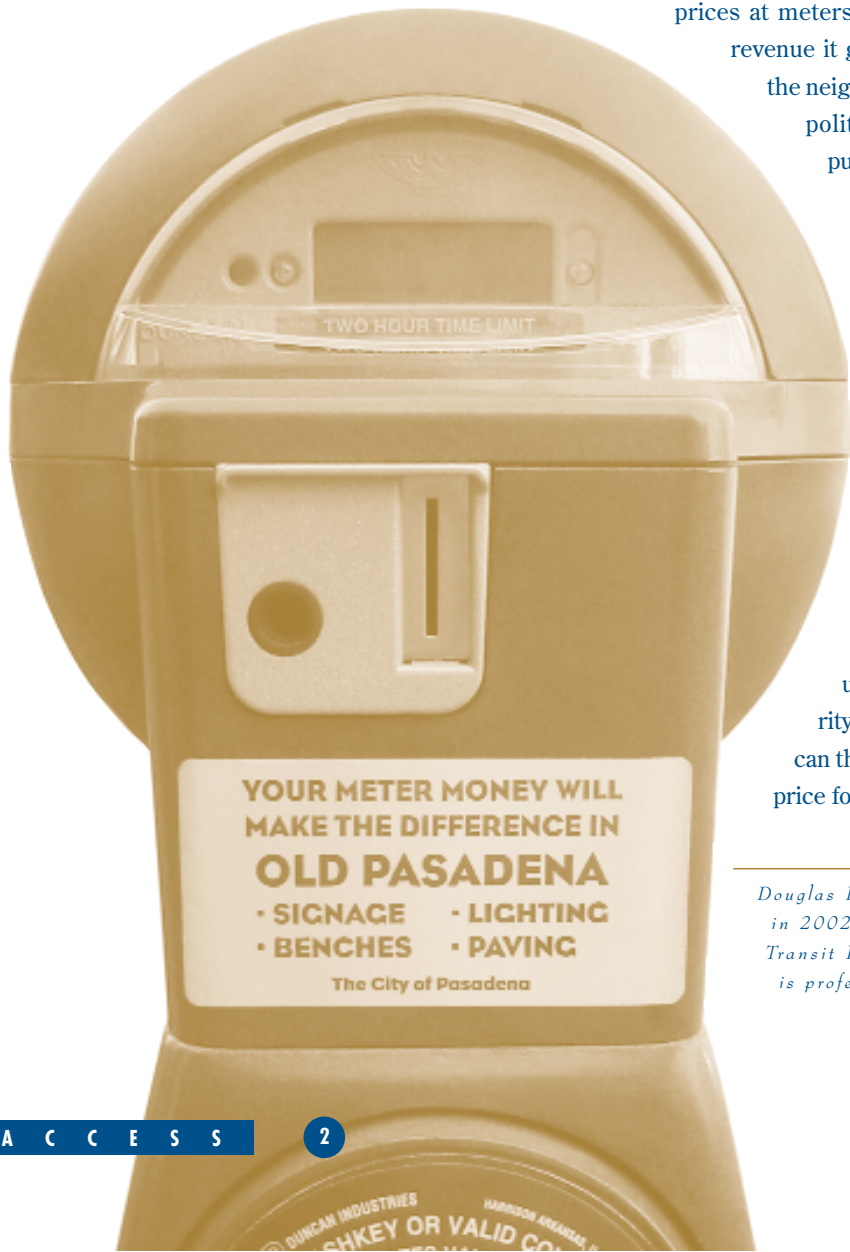
TURNING SMALL CHANGE INTO BIG CHANGES

BY DOUGLAS KOLOZSVARI AND DONALD SHOUP

THE MONEY YOU PUT INTO a parking meter seems to vanish into thin air. No one knows where the money goes, and everyone would rather park free, so politicians find it easier to require ample off-street parking than to charge market prices at meters. But if each neighborhood could keep all the parking revenue it generates, a powerful new constituency would emerge—the neighborhoods that receive the revenue. Cities can change the politics of parking if they earmark parking revenue for public improvements in the metered neighborhoods.

Consider an older business district where few stores have off-street parking, and vacant curb spaces are hard to find. Cruising for curb parking congests the streets, and everyone complains about a parking shortage. Parking meters would create a few curb vacancies, and these vacancies would attract customers willing to pay for parking if they don't have to spend time hunting for it. Nevertheless, merchants fear that charging for parking would keep some customers away. Suppose in this case the city promises to use all the district's meter revenue to pay for public amenities that can attract customers, such as cleaning the sidewalks, planting street trees, putting overhead utility wires underground, improving store facades, and ensuring security. Using curb parking revenue to improve the metered area can therefore create a strong local interest in charging the right price for curb parking.

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RIGHT PRICES

The right price for curb parking is the lowest price that keeps a few spaces available to allow convenient access. If no curb spaces are available, reducing their price cannot attract more customers, just as reducing the price of anything else in short supply cannot increase its sales. A below-market price for curb parking simply leads to cruising and congestion. The goal of pricing is to produce a few vacant spaces so that drivers can find places to park near their destinations. Having a few parking spaces vacant is like having inventory in a store, and everyone understands that customers avoid stores that never have what they want in stock. The city should reduce the price of curb parking if there are too many vacancies (the inventory is excessive), and increase it if there are too few (the shelves are bare).

Underpricing curb parking cannot increase the number of cars parked at the curb because it cannot increase the number of spaces available. What underpricing can do, however, and what it *does* do, is create a parking shortage that keeps potential customers away. If it takes only five minutes to drive somewhere else, why spend fifteen cruising for parking? Short-term parkers are less sensitive to the price of parking than to the time it takes to find a vacant space. Therefore, charging enough to create a few curb vacancies can attract customers who would rather pay for parking than not be able to find it. And spending the meter revenue for public improvements can attract even more customers.

We can examine the effects of this charge-and-spend policy because Pasadena, California, charges market prices for curb parking and returns all of the meter revenue to the business districts that generate it. An evaluation of Pasadena's program shows it can help revitalize older business districts by improving their parking, transportation, and public infrastructure.

OLD PASADENA

Pasadena's downtown declined between 1930 and 1980, but it has since been revived as "Old Pasadena," one of Southern California's most popular shopping and entertainment destinations. Dedicating parking meter revenue to finance public improvements in the area has played a major part in this revival.

Old Pasadena was the original commercial core of the city, and in the early 20th century it was an elegant shopping district. In 1929, Pasadena widened its main thoroughfare, Colorado Boulevard, by 28 feet, and this required moving the building facades on each side of the street back 14 feet. Owners removed the front 14 feet of their buildings, and most constructed new facades in the popular Spanish Colonial Revival or Art Deco styles. However, a few owners put back the original facades (an early example of historic preservation). The result is a handsome circa-1929 streetscape that is now the center of Old Pasadena.

The area sank into decline during the Depression. After the war the narrow storefronts and lack of parking led many merchants to seek larger retail spaces in more modern surroundings. Old Pasadena became the city's Skid Row, and by the 1970s much of it was slated for redevelopment. Pasadena's Redevelopment Agency demolished >





three historic blocks on Colorado Boulevard to make way for Plaza Pasadena, an enclosed mall with ample free parking whose construction the city assisted with \$41 million in public subsidies. New buildings clad in then-fashionable black glass replaced other historic properties. The resulting “Corporate Pasadena” horrified many citizens, so the city reconsidered its plans for the area. The *Plan for Old Pasadena*, published in 1978, asserted “if the area can be revitalized, building on its special character, it will be unique to the region.” In 1983, Old Pasadena was listed in the National Register of Historic Places. However, despite these planning efforts, commercial revival was slow to come, in part because lack of public investment and the parking shortage were intractable obstacles.

PARKING METERS AND REVENUE RETURN

Pasadena devised a creative parking policy that has contributed greatly to Old Pasadena’s revival: it uses Old Pasadena’s parking meter revenue (\$1.2 million in 2001) to finance additional public spending in the area.

Old Pasadena had no parking meters until 1993, and curb parking was restricted only by a two-hour time limit. Customers had difficulty finding places to park because employees took up the most convenient curb spaces, and moved their cars every two hours to avoid citations. The city’s staff proposed installing meters to regulate curb parking, but the merchants and property owners opposed the idea. They feared that paid parking would discourage people from coming to the area at all. Customers and tenants, they assumed, would simply go to shopping centers like Plaza Pasadena that offered free parking. Meter proponents countered that employees rather than customers occupied many curb spaces, and making these spaces available for short-term parking would attract more customers. Any customers who left because they couldn’t park free would also make room for others who were willing to pay if they could find a space, and who would probably spend more money in Old Pasadena if they could find a space.

Debates about the meters dragged on for two years before the city reached a compromise with the merchants and property owners. To defuse opposition, the city offered to spend all the meter revenue on public investments in Old Pasadena. The merchants and property owners quickly agreed to the proposal because they would directly benefit from it. The city also liked it because it wanted to improve Old Pasadena, and the meter revenue would pay for the project.

The desire for public improvements that would attract customers to Old Pasadena soon outweighed fear that paid parking would drive customers away. Businesses and property owners began to see the parking meters in a new light—as a source of revenue. They agreed to an unusually high rate of \$1 an hour for curb parking, and to the unusual policy of operating the meters on Sundays and in the evenings when the area is still busy with visitors. The city also didn’t *lose* anything in the process. Because there had been no parking meters anywhere in the city before, returning the revenue to Old Pasadena didn’t create a loss to the city’s general fund. Indeed, the city gained revenue from overtime fines. Both business and government thus had a stake in the meter money, and so the project went ahead.

Only the blocks with parking meters receive the added services financed by the meter revenue. The city worked with Old Pasadena’s Business Improvement District (BID) to establish the boundaries of the Old Pasadena Parking Meter Zone (PMZ). The



city also established the Old Pasadena PMZ Advisory Board, consisting of business and property owners who recommend parking policies and set spending priorities for the zone's meter revenues. Connecting the meter revenue directly to added public services and keeping it under local control are largely responsible for the parking program's success. "The only reason meters went into Old Pasadena in the first place," said Marilyn Buchanan, chair of the Old Pasadena PMZ, "was because the city agreed all the money would stay in Old Pasadena."

The city installed the parking meters in 1993, and then borrowed \$5 million to finance the "Old Pasadena Streetscape and Alleyways Project," with the meter revenue dedicated to repaying the debt. The bond proceeds paid for street furniture, trees, tree grates, and historic lighting fixtures throughout the area. Dilapidated alleys became safe, functional pedestrian spaces with access to shops and restaurants. To reassure businesses and property owners that the meter revenues stayed in Old Pasadena, the city mounted a marketing campaign to tell shoppers what their meter money was funding.

As the area attracted more pedestrian traffic, the sidewalks needed more maintenance. This would have posed a problem when Old Pasadena relied on the city for cleaning and maintenance, but now the BID has meter money to pay for the added services. The BID has arranged for daily sweeping of the streets and sidewalks, trash collection, removal of decals from street fixtures, and steam cleaning of Colorado Boulevard's sidewalks twice a month. Dedicating the parking meter revenue to Old Pasadena has thus created a "virtuous cycle" of continuing improvements. The meter revenue pays for public improvements, the public improvements attract more visitors who pay for curb parking, and more meter revenue is then available to pay for more public improvements.

Old Pasadena's 690 parking meters yielded \$1.2 million *net* parking revenue (after all collection costs) to fund additional public services in FY 2001. The revenue thus amounts to \$1,712 per meter per year. The first claim on this revenue is the annual debt service of \$448,000 that goes to repay the \$5 million borrowed to improve the sidewalks and alleys. Of the remaining revenue, \$694,000 was spent to increase public services in Old Pasadena, above the level provided in other commercial areas. The city provides some of these services directly; for example, the Police Department provides additional foot patrols, and two horseback officers on weekend evenings, at a cost of \$248,000. The parking enforcement officers who monitor the meters until well into the night further increase security, at no additional charge. The city also allocated \$426,000 of meter revenue for added sidewalk and street maintenance and for marketing (maps, brochures, and advertisements in local newspapers). Drivers who park in Old Pasadena finance all these public services, at no cost to the businesses, property owners, or taxpayers.

Old Pasadena has done well in comparison with the rest of Pasadena. Its sales tax revenue increased rapidly after parking meters were installed in 1993, and is now higher than in the other retail districts in the city. Old Pasadena's sales tax revenues quickly exceeded those of Plaza Pasadena, the nearby shopping mall that had free parking. With great fanfare, Plaza Pasadena was demolished in 2001 to make way for a new development—with storefronts that resemble the ones in Old Pasadena.

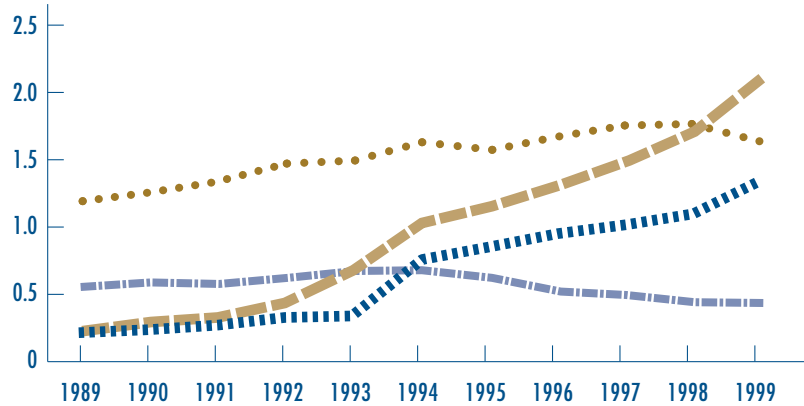
Would Old Pasadena be better off today with dirty sidewalks, dilapidated alleys, no street trees or historic street lights, and less security, but with free curb parking? Clearly, no. Old Pasadena is now a place where everyone wants to be, rather than merely another place where everyone can park free. ➤



Pasadena retail sales-tax revenue

- Old Pasadena
- ⋯ Playhouse District
- ▒ Plaza Pasadena
- South Lake

SALES TAX REVENUE
(in millions of dollars)



Westwood Village

A TALE OF TWO BUSINESS DISTRICTS' PARKING POLICIES

To see how parking policies affect urban outcomes, we can compare Old Pasadena with Westwood Village, a business district in Los Angeles that was once as popular as Old Pasadena is now. In 1980, anyone who predicted that Old Pasadena would soon become hip and Westwood would fade would have been judged insane. However, since then the Village has declined as Old Pasadena thrived. Why?

Except for their parking policies, Westwood Village and Old Pasadena are similar. Both are about the same size, both are historic areas, both have design review boards, and both have BIDS. Westwood Village also has a few advantages that Old Pasadena lacks. It is surrounded by extremely high-income neighborhoods (Bel Air, Holmby Hills, and Westwood) and is located between UCLA and the high-rise corridor of Wilshire Boulevard, which are both sources of many potential customers. Old Pasadena, by contrast, is surrounded by moderate-income housing and low-rise office buildings. Tellingly, although Westwood Village has about the same number of parking spaces as Old Pasadena, merchants typically blame a parking shortage for the Village's decline. In Old Pasadena, parking is no longer a big issue. A study in 2001 found that the average curb-space occupancy rate in Old Pasadena was 83 percent, which is about the ideal rate to assure available space for shoppers. The meter revenue has financed substantial public investment in sidewalk and alley improvements that attract visitors to the stores, restaurants, and movie theaters. Because all the meter revenue stays in Old Pasadena, the merchants and property owners understand that paid parking helps business.

In contrast, Westwood's curb parking is underpriced and overcrowded. A 1994 parking study found that the curb-space occupancy rate was 96 percent during peak hours, making it necessary for visitors to search for vacant spaces. The city nevertheless reduced



Westwood Village

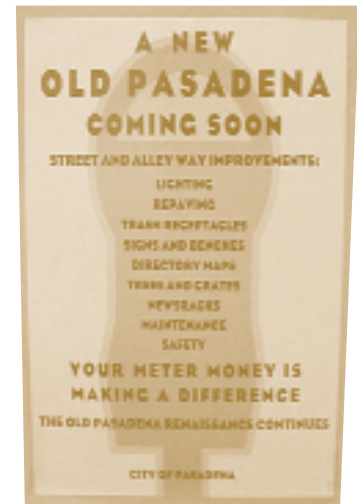
meter rates from \$1 to 50¢ an hour in 1994, in response to merchants' and property owners' argument that cheaper curb parking would stimulate business. Off-street parking in any of the nineteen private lots or garages in Westwood costs at least \$2 for the first hour, so drivers have an incentive to hunt for cheaper curb parking. The result is a shortage of curb spaces, and underuse of the off-street ones. The 1994 study found that only 68 percent of the Village's 3,900 off-street parking spaces were occupied at the peak daytime hour (2 p.m.). Nevertheless, the shortage of curb spaces (which are only 14 percent of the total parking supply) creates the illusion of an overall parking shortage. In contrast to Old Pasadena, Westwood's sidewalks and alleys are crumbling because there is no source of revenue for repairing them—the meter revenue disappears into the city's general fund.

The Old Pasadena/Westwood Village comparison suggests that parking policies can help some areas rebound,

and leave other areas trapped in a slump. If Westwood Village had always charged market prices for curb parking and had spent the revenue on public services, it probably would have retained its original luster rather than fallen into a long economic decline. If Old Pasadena had kept curb parking free and not spent \$1.2 million a year on public services, it probably would still be struggling. The exactly opposite parking policies in Westwood Village and Old Pasadena have surely helped determine their different fates. As the signs on Old Pasadena's parking meters say, "Your meter money makes a difference."

CONCLUSION

Charging market prices for curb parking and returning the meter revenue for public improvements have helped pave the way for Old Pasadena's renaissance. The meter revenue has paid to improve the streetscape and to convert alleys into pleasant walkways with shops and restaurants. The additional public spending makes the area safer, cleaner, and more attractive for both customers and businesses. These public improvements have increased private investment, property values, and sales tax revenues. Old Pasadena has pulled itself up by its parking meters. ♦



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Older Drivers Should We Test Them Off the Road?

BY SANDI ROSENBLOOM

ON JULY 16, 2003, a disoriented older person drove at high speed down a Santa Monica street closed for a farmer's market. His car traveled almost three blocks, killing ten people and seriously injuring scores of others before coming to a stop. Editorials throughout the nation immediately demanded that all older drivers be subject to regular and rigorous retesting. An op-ed piece by Jorge Mancillas in the San Francisco *Chronicle* commented,

None of [this] had to happen.... As we age, our vision and hearing often dim, reflexes slow. Arthritis can make looking over one's shoulder a painful experience. The rate of illnesses and the intake of medications increase.... The results can be fatal...older people make up nine percent of the population but account for fourteen percent of all traffic fatalities and seventeen percent of all pedestrian fatalities.

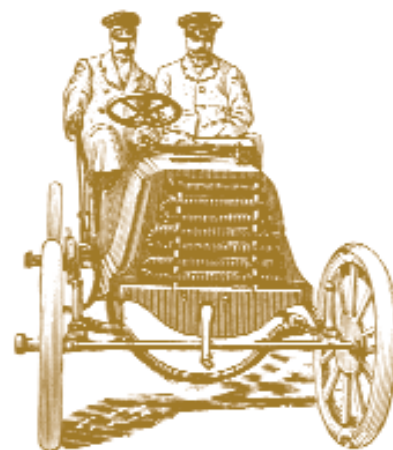
Mr. Mancillas blamed California's failure to require mandatory screening of all older drivers on "powerful opposition" led by AARP and the Congress of California Seniors.

It would probably surprise the *Chronicle's* readers to learn that most traffic safety experts in the US and internationally agree with AARP in opposing mandatory retesting and relicensing of all older drivers. Despite assumptions to the contrary, the elderly are not disproportionately more likely to be involved in crashes. In 2001 people over 65 accounted for roughly one in seven *drivers* but less than one in eight of all crashes (and an even smaller percentage of fatal crashes). Further, most research finds that mandatory testing—as currently practiced—is ineffective in reducing crash rates among the elderly. Such testing would probably not have prevented the Santa Monica tragedy.

BACKGROUND NUMBERS

In 2000, 35 million Americans, or 12.4 percent of the total US population, were over 65; almost 4.5 million were over 85. By 2030 the absolute number of Americans 65 and over will rise to almost 70 million and the overwhelming majority will be drivers. In 2001 roughly 95 percent of men and 80 percent of women over 65 were licensed drivers; with the licensing gap between the sexes narrowing, in just a few years almost everyone over 65 will have a license.

In 2001 drivers over 70 were involved in *fewer* crashes per 100,000 population than those 16 to 54 and almost half as many as those 21 to 24. While those over 65 made up 14.4 percent of all drivers in 2001 they accounted for only 8.4 percent of fatal crashes, 12.2 percent of all driver fatalities, and 12.8 percent of all crashes regardless of severity. (Note that the *Chronicle* op-ed piece was using, incorrectly, data from 1997.) Moreover, the people most likely to be injured or killed in these crashes are *the elderly themselves* and not innocent bystanders. And there is no evidence that older drivers cause ➤



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Drivers over 70 were involved in fewer crashes than those 16 to 54 and almost half as many as those 21 to 24.

crashes in which they themselves are not involved. As the National Highway Traffic Safety Administration commented, “In two-vehicle fatal crashes with an older and a younger driver, the older driver’s vehicle was three times as likely to be the one that was struck.”

There is substantial evidence that today’s older drivers are more careful, more experienced, and have better coping skills than comparable people just a few decades ago. As a result, per capita crash rates have been declining among those over 65 for decades. At the same time, there is a safety problem, and it is growing. Even with declining per capita rates, the large increase in the sheer number of older drivers will cause an absolute increase in crash rates. Moreover we should question whether per capita rates will continue to decline. While older drivers do have fewer accidents per capita until they are very old, they have more per trip and per mile driven. Because all older drivers appear to be increasing their auto-based trip-making and thus their exposure, their crash rates may go up even if they drive more safely than comparable drivers in the past. Moreover, a greater percentage of older drivers will be over 85, which is when crash rates go up rapidly.

In addition, per capita crash rates for older people are low because older drivers *self-regulate*; they avoid congested areas, left turns, night time driving, unfamiliar roads, and freeways. However, my research suggests it is doubtful that future generations of older drivers will self-regulate as much as those currently over 65. Used to the flexibility and convenience of the car they simply may not be willing to change their driving habits substantially because doing so will negatively affect their lifestyles. If so, per capita crash rates among the elderly may well increase despite greater driving skills.

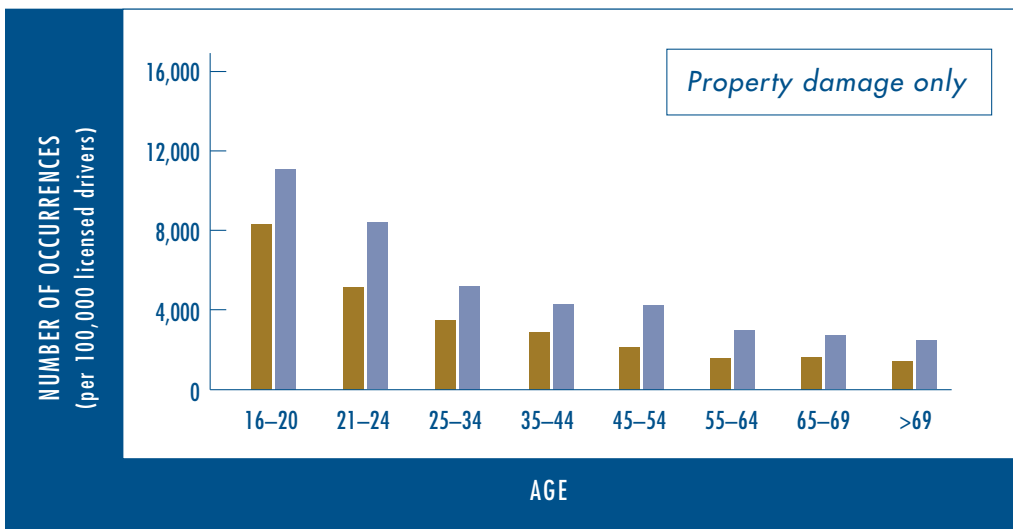
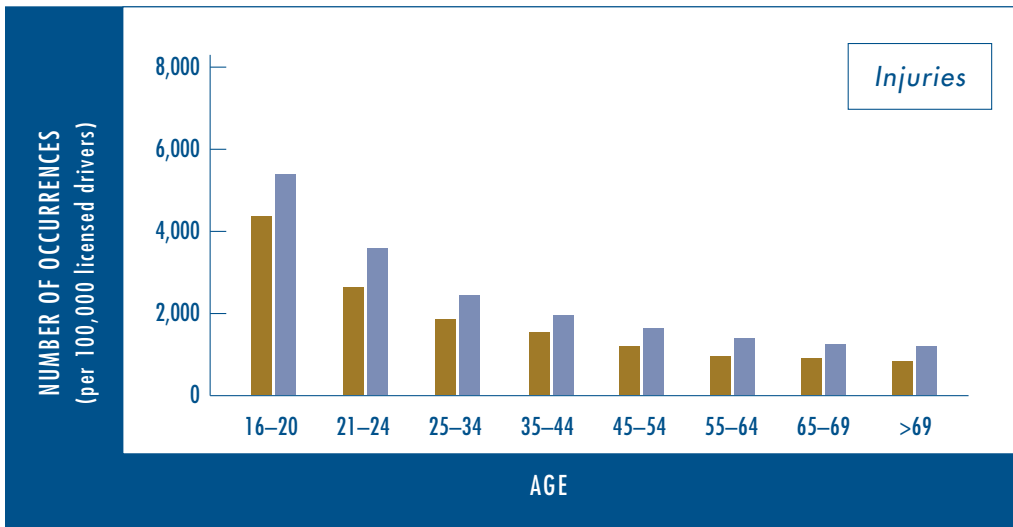
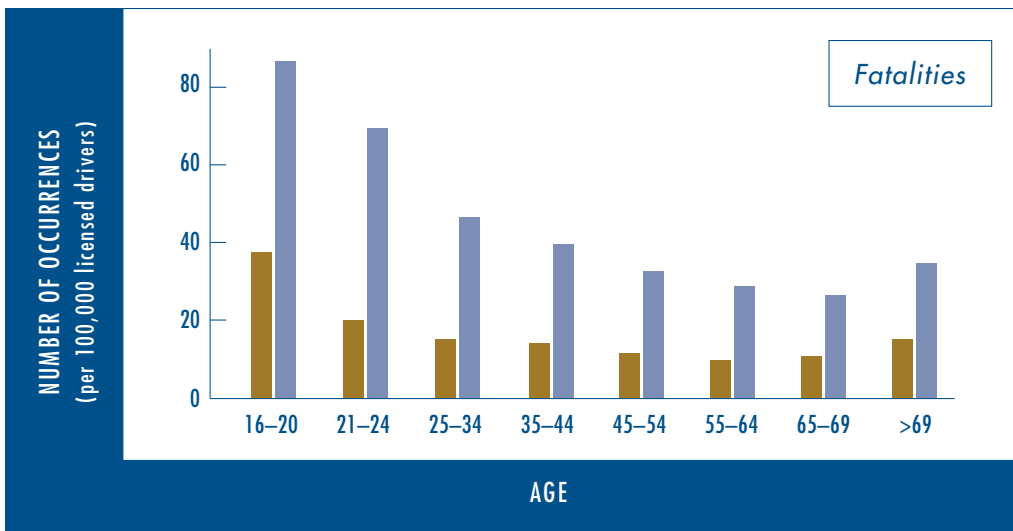
THE GREAT DEBATE: AGE VS. BEHAVIOR

Around the US and the developed world some jurisdictions impose *age-based* restrictions to deal with these trends. When older drivers reach a certain age (often 70 or 75) they must submit to more frequent or different kinds of vision, performance, and driving tests. Such approaches are not consistent across the US, but they clearly are politically salient. However, many countries and a few US states are moving away from age-based testing to behavior-based testing. That is, rather than testing all 70-plus drivers, many jurisdictions have begun to test only those drivers—of any age—who have had serious crashes or multiple traffic violations or who have been reported by friends or family. Germany, for example, has a “driving for life” policy and reassesses driving competence only after a driver has multiple violations. In 2000, the state of Indiana abandoned age-based testing for license renewal because a major task force found no proof that its expensive testing actually reduced crashes among the elderly.

This change in strategy responds to a growing literature showing that age-based testing is rarely useful or cost-effective. Studies in both 1988 and 2002 found no difference in crash rates between older drivers in Victoria—the only Australian state without mandatory older driver retesting—and those in the other Australian states. Probably the most compelling evidence came from a large multiyear study comparing the crash rates of older drivers in Finland and Sweden. Sweden has a “driving for life” policy with automatic license renewals, while Finland requires extensive testing and screening of older drivers. Although the tests in Finland did lower licensing rates among the elderly, there were no significant differences in the crash or injury rates of older drivers in the two countries. >

Driver involvement rates by crash severity, age, and sex

Female Male



Source: *Traffic Safety Facts 2001*, National Highway Traffic Safety Administration

Mandatory retesting does get some older people to stop driving, as it did in Finland, but apparently not the right drivers—or crash rates among older people would drop. Every month Pennsylvania rescreens 1,600 drivers of all ages who have been reported or have certain kinds of accidents. Although less than one percent of retested drivers fail either the vision or medical test, more than 28 percent voluntarily stop driving or give up their licenses. Those most likely to be discouraged are women over 65—who have substantially lower crash rates per capita and per exposure than men over 65. Thus we may be removing drivers who are not contributing significantly to older-driver crash rates.

The single most used criterion for determining whether drivers required additional testing was how they looked when they came through the door.

Because testing does reduce the number of older drivers some people assume we've accomplished our purpose when we haven't.

As a result of such research many analysts have joined elderly advocates in arguing that it makes more sense to test only high-risk drivers—those whose record has created a rationale for assuming that they are poor drivers—and to do so with better, more sophisticated techniques.



THE PROBLEMS WITH TESTING

Age-based testing may not be more effective because it is far more subjective than it appears. Which drivers get tested—and how—varies widely even in the same jurisdiction, while current tests are not very good.

First, while 28 US states require all drivers to come to the Department of Motor Vehicles each time they renew their licenses, only a few states specify an age limit for appearing in person. But in all these states whether and how an older person is retested is entirely *at the discretion of the examiner*. A 1997 study of 51 DMV examiners across the US revealed that the single most used criterion for determining whether drivers required additional testing was *how they looked when they came through the door*. (At the same time, the examiners did not feel that requiring a driver to report in person before a licensing official was a useful way to identify unsafe drivers.)

Second, in many states the type and content of additional testing may depend entirely on the examiner's evaluation of the older driver. For example, in the District of Columbia all drivers 75 and above *must* take a vision test but *may* be asked to take reaction and/or road tests. Thus there is wide variation in the type of additional tests required. Who passes and who fails can also be arbitrary. In a 1988 study, licensing authorities in Vermont and Maine noted that in rural areas examiners were inclined to allow older people to keep their licenses, even when they were not safe drivers, because examiners knew the drivers had no other mobility options.

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Third, we don't have accurate tests of driving safety, although research is ongoing to develop better measures. Studies over several decades have consistently shown that neither age nor the presence of many medical conditions or impairments has a strong relationship to crash rates. Even poor vision—the most common condition older drivers are screened for—has little relationship to crashes among the elderly. The Sacramento Bee took a thoughtful approach in its editorial on the Santa Monica tragedy:

While older drivers don't constitute a "health crisis" today, that could change as the percentage of older people both in the population and on the road grows. That's why efforts to develop more accurate and reliable driver's tests should continue.

WHAT'S THE ANSWER?

The US and Australia have developed and are currently testing model programs that individual states could adopt to increase the cost-effectiveness and equity of their licensing approaches. The model is a two-tier program with initial screening processes based on behavior rather than age or appearance; they are designed to be easily, cheaply, and uniformly applied to drivers required to undergo evaluation. The first-tier tests can identify those older people who can continue to drive safely, those who might benefit from additional in-car driving training, and those who require additional screening or evaluation. Then appropriate—and more detailed and expensive—tests are applied to those requiring additional evaluation; the outcome of the second-tier testing could be removal of the license, restrictions on the license, or mandatory retraining to keep the license.

But both the US and Australian governments recognize that a better system of testing by itself will be ineffective unless 1) we develop and widely implement age-appropriate driver retraining courses, 2) older drivers have ways to test their own competence in a noncoercive situation (to encourage them to either relinquish licenses or seek retraining voluntarily), and, perhaps most importantly, 3) they have meaningful mobility alternatives—which most communities currently lack.

The general public and the traffic safety community have too long assumed that there are sufficient community resources—like paratransit services, taxis, and public transit—to meet the needs of older people forced to give up driving. But most communities are far from meeting the transportation needs of the elderly today and are less likely to do so in the next three decades when the population of older people doubles. Perhaps the best way to encourage older people to reduce and ultimately give up driving when they should is to ensure that each community has a large and effective repertoire of transportation options, including volunteer networks, better and safer conventional public transit, expanded nontraditional community-based transit services, voucher programs for both profit and not-for-profit providers, and expanded roles for informal transportation providers. These options should be augmented by better land use, housing, and transportation planning to develop and maintain more pedestrian-oriented and elder-friendly neighborhoods.

The aging of the population, and the fact that most older people are drivers, raise serious questions that policymakers must address. There is no magic bullet, no easy answer to this complex problem, although that is really what most people are seeking when they advocate mandatory retesting of older drivers. ♦

AS JOBS SPRAWL, WHITHER THE COMMUTE?

BY RANDALL CRANE AND DANIEL G. CHATMAN

THE MOST TRANSPARENT TREND in metropolitan areas is the decentralization of jobs and housing into the suburbs and beyond. Scholars blame sprawl for many things, ranging from car-generated air pollution to commute-induced social alienation. But what do we know about its effects on travel behavior?

According to conventional wisdom, people are driving farther to work these days—but supporting evidence is thin. It's not clear whether homes and jobs are growing farther apart or closer, nor which industries and occupations are dispersing most or least. Here we tackle one key unanswered question: How does job sprawl affect average commute length?

EXPLAINING THE JOURNEY TO WORK

According to classical urban theory, land is most expensive where firms most want to locate, and prices decline with distance from there. If firms all want to be in one place (let's call it "downtown"), land (and housing) will tend to be cheaper in the suburbs, and many workers would commute from suburb to center. But what if jobs move out to the suburbs too, as indeed many have?

When choosing a location, firms must balance the cost of land against the benefits of clustering, access to markets, and proximity to workers. For some firms, cheaper land and the presence of a labor pool outside the city center may outweigh the benefits of being near other businesses they deal with. According to this simple view, firms would decentralize in part to gain shorter commutes for their workers, expecting that to translate into reduced wage costs.

Of course, the real world cannot be explained by this simple theory. Consider three further complications.

First, workers are less likely to choose where to live based on job proximity if they know they'll change jobs, if the location of their next job is uncertain due to job decentralization, or if their household has more than one worker. The choice becomes a gamble. Since it's costly to move, workers may hedge their bets by locating at some intermediate spot, say somewhere between the city center and the suburbs, to reduce their long-range commute and moving costs. For households with two or more workers whose current and expected future jobs are in different places, finding a place to live near work may not even be possible. In either case, decentralization of jobs might increase commute distances.

Second, firms may not choose to locate in suburbs solely to be near their work forces. They may enjoy other benefits from decentralization, including underused transportation capacity in outlying areas, better access to external markets, lower taxes, and proximity to suburban customers. If these factors are >

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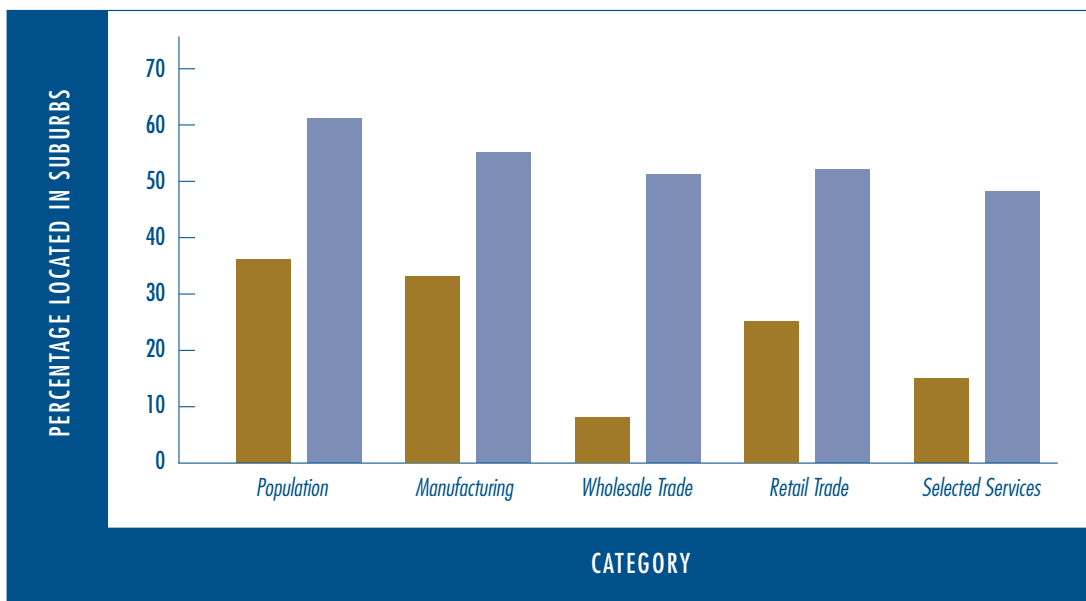
Commute times have indeed risen in many metropolitan areas. Is job sprawl to blame?



FIGURE 1

Percentage of US population and employment in the suburbs, 1948 and 1990

■ 1948 ■ 1990



Source: Place of Work Data, US Bureau of Census

important, then job decentralization will not necessarily produce shorter commutes.

Third, households clearly think about more than just job location when choosing where to live. They also consider access to shopping and other nonwork activities, the quality of the neighborhood, schools, and other public services, and the resale value of the property (which reflects all of these). In general, the higher priority they give other considerations, the less likely it is that people will reduce commute length when firms decentralize.

So, in theory, sprawl might either lengthen *or* shorten the commute. To understand what happens in practice, we need to examine actual travel data.

EARLIER STUDIES

Relatively little empirical work directly examines the influence of sprawl on commute distance or duration. One exception is an important county-level study published in the late 1980s by Peter Gordon, Ajay Kumar, and Harry Richardson, which looked at the amount of time involved in commutes. They found that commutes in spatially large cities took more time than in small cities, while quicker commutes were associated with higher proportions of industrial employment. High overall residential density and high shares of employment in the central city were both strongly associated with time-consuming commutes. The authors concluded that both residential and employment dispersion reduce commute duration.

Other research using data on individuals has found that decentralization lengthens the commute under some circumstances or for particular household groups. For example, in his UC Berkeley dissertation and subsequent research, Jonathan Levine found that commutes of low-income households increased in distance as employment suburbanized, in part due to shortages of affordable housing nearby. This finding raises a further complication: although land tends to be cheaper in the suburbs, regulations on the construction of higher density, cheaper housing units may reduce the available supply in many areas.

This line of research remains in its infancy. Behavioral data typically are either too aggregated or are limited in some other way, making it difficult to explore individual choices; and statistical models are insufficiently developed. Although empirical relationships may be too complex ever to be fully understood, it is certainly possible to understand them better.

OUR RESEARCH

As it turns out, commute times have indeed risen in many metropolitan areas (Figure 2). Is job sprawl to blame? To find out, we need detailed data and appropriate analytical techniques that isolate the independent roles of numerous possible contributing factors.

Below we explain our hypotheses, discuss the data we used, and analyze our results. Although we give few details here, our analytic model accounts for time trends, housing costs, and

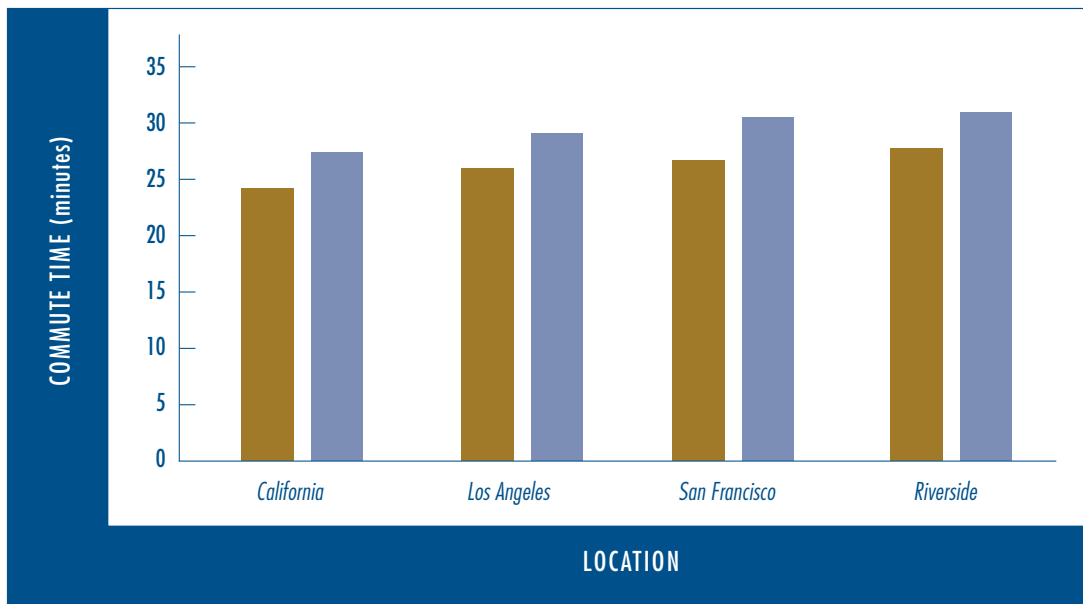


FIGURE 2
Commute times in California, 1990 and 2000

■ 1990 ■ 2000

Source: US Bureau of Census

wages. For details on our methods, please refer to Further Reading at the end of this article.

HYPOTHESES

All things considered, commute duration should shrink as employment suburbanizes. A key trade-off for firms is between proximity to other firms and proximity to workers. Suburbanization of employment may indicate that firms are choosing the latter over the former, which should in turn translate into shorter commutes.

The commute should be longer for those with greater uncertainty about future job location or with high moving costs. Within a given city, the frequency of job relocation may be high for some occupations, such as construction workers, and low for others, such as university professors. Also, those with high expected moving costs tend to stay put in one place longer. Therefore, workers with high moving costs in high-turnover occupations would have longer commutes, everything else being equal.

Benefits of decentralization may vary by industry. For example, decentralization of manufacturing jobs may be driven by the search for larger, cheaper land parcels. But the benefits of firm clustering may actually be increasing over time in such industries as software production, clothing design, and filmmaking. For such industries, any broad pattern of decentralization may actually be highly clustered, reducing the extent to which work-

ers in that industry will locate nearby. Because the data we use are available with old-style Standard Industrial Classification codes, we can roughly test the idea that different kinds of business engage in different kinds of decentralization, and therefore have different effects on average commute distance.

DATA

For information on individuals and their commute distances, we use data from 1985 to 1997 from the American Housing Survey (AHS), a large, nationwide survey administered every two years by the Census Bureau. The AHS samples most of its housing units repeatedly over time, with some replacements and additions.

We then merge the AHS data with metropolitan-level measures of employment suburbanization, calculated using county-level data from the US Bureau of Economic Analysis. We classify any county containing a city as part of the central urban area. Only employment in counties without large agglomerations or high density is designated as decentralized. This means that our definition of suburbanization is conservative, accounting for the fact that the urbanized portion of a metropolitan area may be polycentric or irregularly shaped. Thus, in one sense, our measure of job sprawl is more accurate than the typical measure of decentralization, namely distance from a single city center. In another sense the measure is somewhat crude, because it relies on county geography. ➤

RESULTS

Using conventional economic models of travel demand, we investigated the commute *distance* of individual workers in combination with household characteristics and community factors, such as household income, size, race, education, and the population and geographic size of the metropolitan area. In many respects, commute *time* would be a better measure; the AHS, however, reports commute distance only over this period. The extent to which these two track each other depends mainly on congestion and the use of different modes, which in turn vary within a metropolitan area.

Surprisingly, despite all the potential complications, the results are largely consistent with our hypotheses (Figure 3). Taken by itself, job suburbanization *shortens* the average commute. A five percent increase in employment in a metropolitan area's outlying counties is associated with a 1.5 percent reduction in average commute distance, if we control for other factors.

However, this is not the same as saying that commute distances got shorter. Other factors, for example rising incomes, lead to longer commutes. Also, there is a trend over time toward longer commutes that is explained by neither job sprawl nor other obvious factors, although it appears that job suburbanization has mitigated this increase. In other words, the average commute would be longer still if jobs were more centralized.

When suburban employment is broken out by industry, an interesting pattern emerges (Figure 3). Increased decentralization of construction and wholesale jobs reduces the average commute distance for workers in a given metropolitan area, while when manufacturing and government jobs decentralize, average commute distance grows. Retail and service jobs moving out to the suburbs do not appear to have much effect on commute length.

The pattern of firm clustering by industry on a county level may explain why decentralization of some kinds of employment increases commute distance. More clustering means less mixing of residential and nonresidential land uses, which increases commute distances

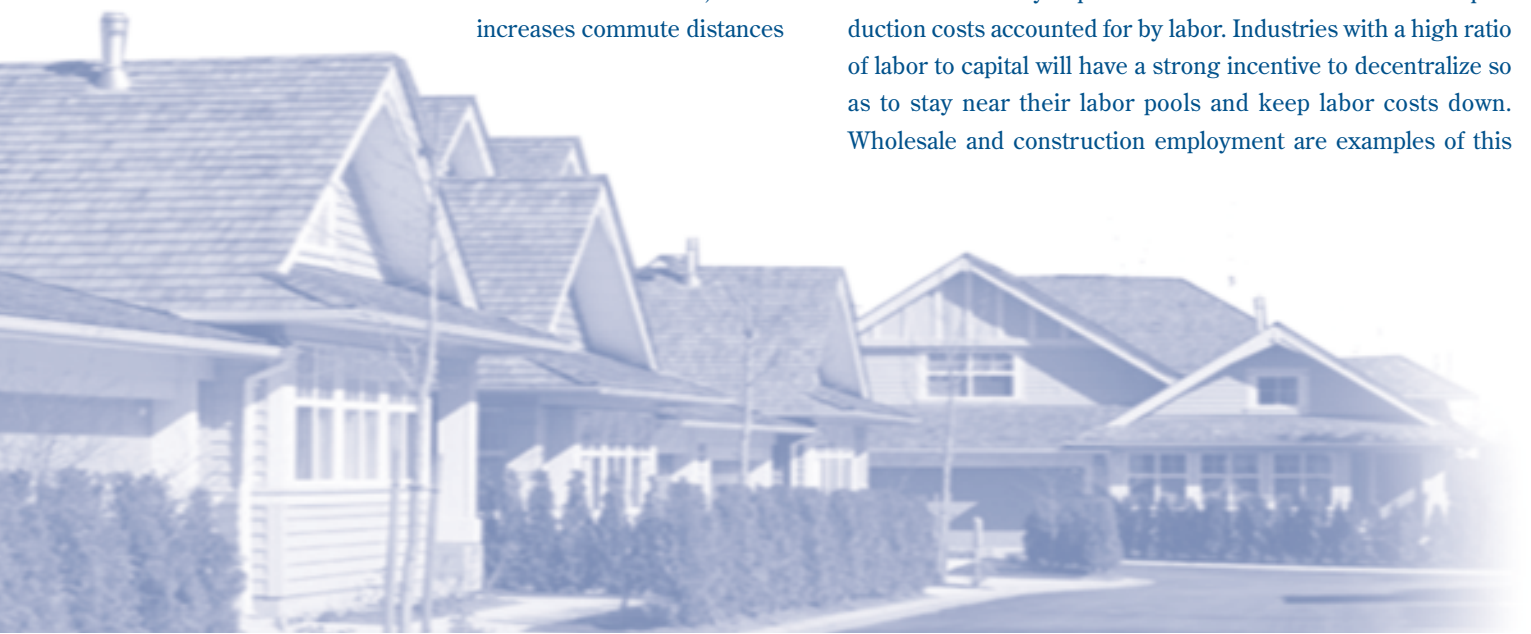
FIGURE 3

Hypothetical influence of suburbanized employment on commute distance

INDUSTRY	EFFECT ON COMMUTE DISTANCE
All Employment	Shortens
Construction Employment	Shortens
Government	Lengthens
Manufacturing	Lengthens
Retail	No Effect
Service	No Effect
Wholesale	Shortens

compared to an entirely dispersed pattern. Construction and wholesale firm decentralization may be more dispersed than manufacturing and government employment, so people can more easily choose jobs near their homes (or homes near their jobs). Certain kinds of manufacturing (particularly, small firms in technologically advanced industries) may value being near other firms, and they decentralize for reasons other than to reduce the commutes of their workers. In this case manufacturing employment decentralization might occur in a more clustered fashion and/or in a way that does not follow the population pattern. Meanwhile, retail and service firms tend to cluster with each other, while the size of retail outlets has been increasing, so one might expect longer commutes due to reduced dispersion. But because such firms are population-serving, they tend to follow dispersed residential patterns in the metropolis they serve.

Another likely explanation has to do with the share of production costs accounted for by labor. Industries with a high ratio of labor to capital will have a strong incentive to decentralize so as to stay near their labor pools and keep labor costs down. Wholesale and construction employment are examples of this



kind of industry, whereas of the classifications we use, manufacturing probably has the lowest ratio of labor to capital. Meanwhile, the government sector is a special case. The location of government facilities probably does not take wage costs into account when deciding where to locate, since other criteria are more important.

Do these results settle the question? No. Our conclusions are much too tentative. Although the panel nature of the AHS is particularly well suited to this analysis, the data unfortunately do not allow us to test the determinants of commute *duration*, because only commute distance information is available over the sample period. If traffic congestion is lower in suburban areas, jobs moving out to those areas might reduce average commute durations more than average commute distances.

We also have not fully explored the roles of multiple earners, uncertainty of job location, alternative measures of employment decentralization, or other competing explanations for where people choose to live relative to where they work. The results at this stage of the analysis are useful mainly to clarify the questions at hand and suggest how future research should proceed.

CLOSING COMMENTS

Our new evidence supports the argument that, on average, decentralized employment reduces commute distance. Suburbanization of construction and wholesale jobs means commutes of shorter distance, although deconcentrated manufacturing and government jobs are associated with longer commutes. These differences by industry indicate the complexity of the relationships among the various factors including metropolitan characteristics, household dynamics, and the economics of travel, housing, and labor.

If job sprawl is not to blame, what does explain longer commutes—both longer distance, such as in our data, and longer duration over the past ten years in California as in Figure 2? Our analysis shows that rising incomes extend commute distances, and over this period household income increased by about eight percent in real terms in the US. Other factors not included in our analysis played their roles as well. Longer distance commutes may be explained by the increasing numbers of two-worker households, or by households focusing more on school quality than on job location when deciding where to live. And commutes of longer duration due to increased traffic congestion might be expected as urban areas gain population without adding new roads. These hypotheses deserve further exploration in future research. Our early analysis treats but a small piece of a much bigger puzzle. ♦



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Driving Less

BY SUSAN HANDY

BESIDES HAVING TO USE our air conditioner only occasionally now, one of the nicest things about moving to Davis, California, last year after nine years in Austin, Texas, has been the biking. Before the end of our second week here, we had bought a bike trailer so we could commute by bike to campus with our two pre-schoolers in tow. The purchase was a sort of initiation rite: the city of Davis estimates there are more bikes in Davis than people, and I suspect that family-oriented Davis accounts for a significant share of all bike trailers sold in the US. I confess that over the past year we didn't *always* bike to campus. But in that time we put less than five thousand miles on our primary car, and got some exercise along the way.

We are definitely bucking the trend by choosing to drive less. In 2001, according to the Nationwide Household Transportation Survey, the typical 35- to 44-year-old American spent over eighty minutes a day in a car, the average American household drove over 31,000 miles, and the average American car was driven nearly 13,000 miles. The growth in total vehicle miles traveled in the US has continued unabated for decades, growing two-and-a-half times as fast as the nation's population between 1936 and 2001, according to the US Department of Transportation's Highway Statistics (Figure 1). A slight leveling off in the last couple of years may prove to be no more than a blip in the relentless trend toward more driving.

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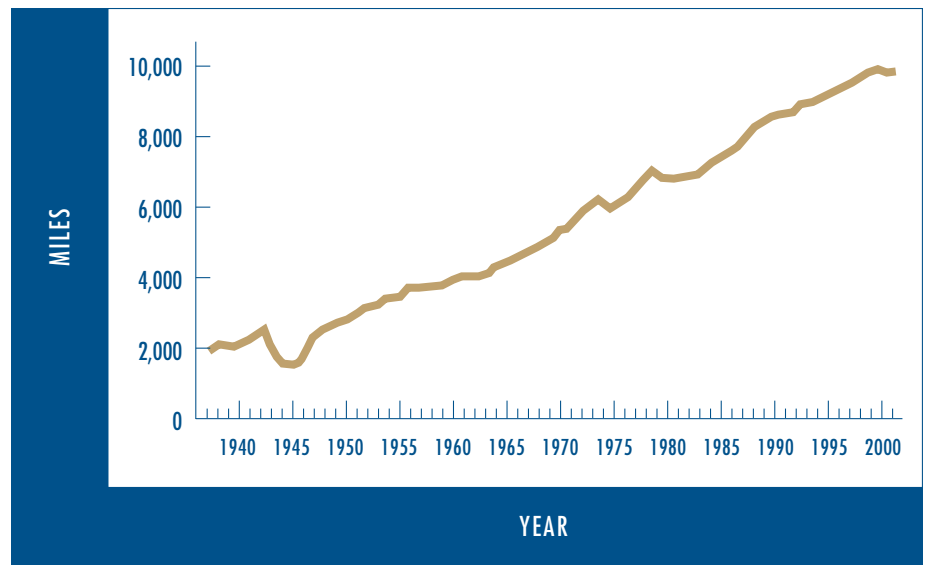
DRIVEN TO DRIVE

Although Americans seem to complain more and more about how much time they spend in the car (or at least how much time they spend stuck in traffic), we also have growing evidence that they often choose to drive more than they really need to. Studies by my colleagues Pat Mokhtarian and Ilan Salomon have shown that travel has its own intrinsic value—“a desire to travel for its own sake”—and that this is likely to lead to more travel than necessary for mandatory and maintenance activities. My own study in Austin found that as much as fifty percent of driving associated with trips to the supermarket can be attributed to the choice to shop at stores other than the one closest to home—further suggestion of more driving than necessary. These studies raise an interesting question: to what degree are we driving more because we have to, and to what degree are we driving more because we choose to?

In an ongoing study of this question sponsored by the Southwest Region University Transportation Center, my colleagues and I found the answer is some of both. In a series of focus groups and in-depth interviews, we explored the ways and reasons for which people drive more than they, in theory, need to—what we called “excess driving.” We found convincing evidence that people often take extra trips, choose longer routes, pick more distant destinations, and opt for the car over other possible travel modes. They make these choices for various reasons, including among others enjoyment of driving, enjoyment of activities while driving, desire for variety, habit, laziness, and poor planning. Said one participant, “There’s just something about getting in the car and getting out on a country road.” When pressed, people acknowledge that they’re driving more than they really need to. But the driving they want to eliminate is, not surprisingly, the driving they need to do rather than the driving they choose to do. >

FIGURE 1

Vehicle miles traveled per person
in US, 1936–2001



REDUCING THE NEED

So what does this mean for planners? The easier problem to tackle is the driving we do by necessity rather than choice. Although “need” is subjective, it’s clear that most Americans do need to drive as they go about their daily lives, at least given the choices they’ve made about where to live, where to work, and what to do with their free time. Planners can create policies that will help lessen this need by bringing destinations closer to origins and by improving the viability of alternative modes. The Congress for the New Urbanism, for one, has been a vocal promoter of this approach; its charter states that “neighborhoods should be compact, pedestrian-friendly, and mixed use” and that “many activities of daily living should occur within walking distance.”



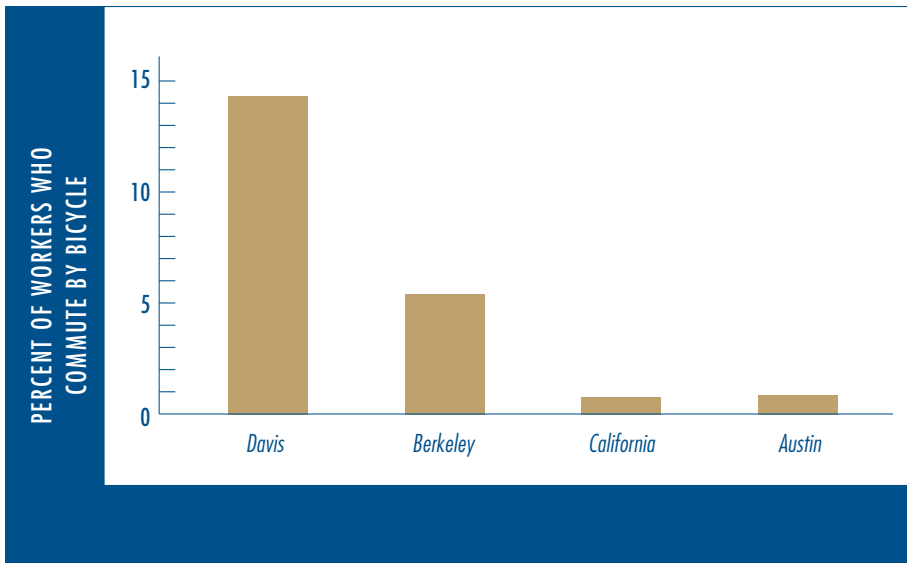


FIGURE 2

Bicycle as usual means of transportation to work in 2000

Davis is a good example of how this approach can work, although it looks a lot more like typical suburban America than what the new urbanists have in mind. In Davis, I can live in my 2,300-square-foot house on a 10,000-square-foot lot on a cul-de-sac in a 1970s subdivision, but be within two miles of work and a half-mile of a supermarket, Peet’s coffee, and two burrito shops. I’m also linked to work by a relatively direct bus route and to the entire community by an extensive system of greenbelt trails and on-street bike lanes.

That Davis residents have less need to drive is a matter of plan rather than chance. In 1966, the Davis City Council made a conscious effort to promote bicycle use, and today the city has nearly fifty miles of bike lanes and fifty miles of bike paths in an area of only ten square miles or so. In 1973, in response to forecasts of explosive growth, the city adopted a general plan designed to avert suburban sprawl and its environmental impacts. Guided by this plan, the city adopted policies to encourage infill development and the distribution of multi-family housing throughout the city, meaning that densities everywhere are relatively high, at least by California suburban standards. The city has also followed through on its policy of locating services conveniently within each neighborhood with the explicit goal of moderating the length of trips and facilitating walking, biking, and transit as alternatives to driving.

Of course, having the choice to drive less doesn’t mean that people will actually choose to drive less. Although most of my colleagues in the Department of Environmental Science and Policy here at UC Davis do bike to work, not all of my Institute of Transportation Studies colleagues do. I’ve been surprised at how few of my neighbors use bikes. Most of them work outside of Davis but I don’t often see them biking to the farmer’s market or to the library or to the pool the way we do. According to the 2000 US Census, over fourteen percent of Davis residents usually bike to work. This is less than you might expect given the town’s reputation, but it’s more than Berkeley and considerably more than California as a whole—or than Austin (Figure 2). Still, everyone I talk to in Davis appreciates the option not to drive, even if they rarely take advantage of it. (I also believe that even the people who do not drive less are taking advantage of the greenbelt system to walk and bike more for exercise—but that’s another topic for discussion.) ➤





THE CHALLENGE FOR PLANNERS

What, if anything, do we do about driving by choice rather than necessity? I can tell you what they do in Texas: they try to accommodate it. Even coming from California, purported land of freeways, I was struck by the sense of entitlement Texans feel about driving. Texans seem to believe that driving anywhere they want at any time of day at seventy miles per hour or more is a fundamental right, at least on par with freedom of speech or maybe even property rights. In California, we seem to recognize that we'll never be able to accommodate all the increased demand for driving coming from population growth, let alone continued increases in the rate of driving per person—and that for a variety of reasons we probably shouldn't try. In its mission statement, Texas DOT prioritizes the “safe, effective and efficient movement of people and goods”; Caltrans, in contrast, pledges “a renewed emphasis on nonhighway transportation” on its website.

A possible alternative to accommodating driving by choice is to discourage it through various forms of pricing, as many researchers have suggested in these pages. The implementation of congestion pricing, for example, could shift optional driving away from commute times, thereby freeing up capacity for necessary driving during peak hours. Strategies that make drivers pay for their travel more directly (e.g., pay-at-the-pump insurance) or that “internalize” externalities such as environmental impacts (e.g. emissions taxes) could lead to significant cutbacks in driving by choice. A problem

with pricing is that it's hard to apply it only to driving by choice and not also to driving by necessity, raising issues about equity that are challenging—though not insurmountable. So far, pricing strategies have garnered little political support; and in Texas, at least, pricing in the form of tolls is seen as a way to fund new road capacity to accommodate more driving rather than as a way to discourage it.

Based on a review of the research and lots of thinking about these issues, I say “no” to accommodating driving by choice, “possibly” to discouraging driving by choice, and an emphatic “yes” to doing what we can to reduce driving by necessity. We could have a protracted debate on the first two points, but this last point is one that I think all sides could eventually agree on. If we make it easier for people not to drive, everyone wins: those who can't drive certainly win; those who can drive but would rather not also win; and even those who would never do anything but drive still win, not least because the time they save on necessary driving can be put to other uses, including more driving if they choose. Freedom of choice is fundamental to the American creed—that includes the freedom to choose to drive but also the freedom to choose not to drive. And that freedom is what I love about Davis. ♦



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A sepia-toned historical photograph of a busy city street. In the foreground, a horse-drawn carriage is being led by a driver. The street is filled with pedestrians, many wearing hats. In the background, there are multi-story buildings with ornate architectural details. A sign for 'TOAST' is visible on the right side of the image.

TRENDS AND POLICY CHOICES

A Research Agenda

BY ELIZABETH A. DEAKIN

THE US FACES SIGNIFICANT challenges in transportation as its population grows and as it adapts its lifestyles to new technologies. Well-planned research will shed light on the issues while helping transportation systems contribute to a more productive economy, a stable and high-quality environment, and high quality of life.

Consider the following challenges:

A GROWING POPULATION

The US population continues to grow much faster than in other developed countries. The growth is uneven—little change in Midwestern states, explosive growth in the South and West. California alone expects to add ten million people by 2020, bringing its population to 45 million.

Nationwide, most growth will occur at the fringe of metropolitan areas. In California, just eight counties are forecast to account for more than sixty percent of the State's total population growth over the next twenty years.

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This population growth will affect every aspect of life, from jobs and housing markets to demands for public infrastructure and services to access to open space. Increased demands for transportation will require investment in new and improved facilities and services. To make those investments wisely, we need to better understand how growth will affect demand across modes and for both passengers and freight. We also need creative exploration seeking the best technology, operations, and management for moving people and goods efficiently and in ways that support high quality of life.

DEMOGRAPHIC CHANGE

Among the important population changes over the next 25 years will be the increased number of people over 65 years of age. Among these seniors, the fastest-growing group will be people over eighty. As Sandi Rosenbloom asserts elsewhere in these pages, despite declining vision and physical mobility, these older Americans will still be active, and most will still be driving. The need for strategies to support the travel of older Americans while providing safety for everyone is already pressing, and research to date has only begun to explore the issues and possible responses.

In fast-growing states the share of the population under eighteen will also increase. These younger Americans have busy schedules, but most cannot drive. In many areas the school buses that gave their parents a ride are no longer available, and parents provide most of their children's transportation, often with some difficulty. Improved transit, walking, and bicycling options offer promise for better, safer, more secure transportation for kids; but here too we have barely begun to understand the needs and to identify potential solutions.

NEW EMPLOYMENT PATTERNS

Global trade, newly developing market links with South Asia, growth in high-tech industries, and e-commerce are just a few of the changes in the economy that have altered the size, scope, and location of work over the past few decades. Trends and forecasts suggest that changes over the next two decades will be equally dramatic.

Among all industries, services are the fastest growing, though there are state and metropolitan differences in their relative importance. In California, services are expected to account for one job in three by 2008, with large increases in jobs at both the low and high ends of the pay scale. Like population growth, employment growth will occur mostly in metropolitan areas, largely in outlying regional districts, where transportation networks are comparatively sparse. Research is needed to explore

the application of new technologies, new operations and management systems, and new land use-transportation coordination.

Unemployment is often seen as an inner-city problem, but concentrations of unemployment occur in older suburbs and rural areas. Research on welfare-to-work and reverse commutes has paid off in identifying transportation strategies that help people find and keep employment, but more research will be needed as employment shifts continue.

CHANGING LOCATION PATTERNS

The decentralization of population and employment reflects complex interactions among land markets, development constraints, personal and corporate preferences, and transportation facilities and services. Land availability and affordability are two interrelated factors that could have major impacts on location choices and hence travel patterns over the next decades.

The availability of land for development is determined not only by physical suitability (e.g., floodplains and slide zones might be considered unsuitable or too costly for housing), but also by local government policies on land protection, subdivision control, zoning, and development fees. Where land availability is restricted, land and housing prices (as well as commercial development prices) tend to be pushed upward. Developers may then turn to neighboring jurisdictions having fewer restrictions. Such spillover appears to be happening in many of the major metropolitan areas of the US. One result is increased commuting across metropolitan borders, with long commutes especially for first-time home buyers. Another result is the loss of farmland and habitat in outlying areas.

Some metropolitan areas and a few states are attempting to redirect growth to existing urban and suburban communities through strategic investments in infrastructure, including highways and transit, as well as through policy interventions such as fast-track approval for infill housing, transit-oriented development incentives, public-private development partnerships, and urban growth boundaries. The various strategies have received research attention in the last few years but findings are still tentative, and much more work remains to be done.

CHANGING TRAVEL PATTERNS

Profound changes in personal and household travel have occurred over the past two or three decades. Among the most important are growth in nonwork travel and heavy increases in auto ownership and use.

Between 1969 and 1995, work-related travel fell from 36 percent to 18 percent of all trips nationally. In part, this is an ➤

accounting artifact: a trip home from work with a side stop at the store is counted as a trip from work to store plus a second trip from store to home. But with nonwork travel now accounting for 82 percent of all trips nationally, it's clear that Americans are making huge numbers of trips for shopping, recreation, personal business, and social activities.

The growth in nonwork travel largely explains the rapid increases in per capita and per household VMT, since most of these trips are made by car. Growth in auto use also reflects increasing numbers of driver licenses, a willingness to continue to drive well into old age, near-ubiquitous auto availability, the location of activities in patterns that depend on cars for access, and the ease and convenience of auto trips compared to most other travel options. Transit, in the meantime, has lost market share, although gains have been seen in some markets. Transit use is especially prevalent among lower-income households in urban areas and among new arrivals to the US.

Understanding consumers' travel patterns is a first step toward developing good transport services and is especially critical when considering policies intended to alter travel choices (e.g., bus rapid transit, employer transit-pass subsidy programs, parking charges or discounts). Unfortunately, many metropolitan areas are hampered by lack of data. National travel surveys are too sparse to provide usable data for metropolitan planning unless the metro area has paid for a larger sample; many areas have lacked the resources or foresight to do so. This is a matter for which not only is more research needed, but also where better data must be developed to support the research.

CHANGING PATTERNS OF FREIGHT TRANSPORT

Freight transportation is critical to the economy but remains almost hidden from sight in most surface transportation policy arenas. Both truck and rail freight have undergone changes of revolutionary proportions over the last three decades. Deregulation was coupled first with containerization and consolidation innovations and then with just-in-time production processes and advanced logistics systems. Reflecting these changes as well as the changes in the nation's economy and patterns of growth, trucking has gained market share for intercity transport, especially for higher-value shipments. Rail continues to carry bulky and lower-value items, but has captured a significant market share in some areas by handling multimodal shipments. Air freight has also grown, as has intermodal truck-air transport. Water ports have been heavily affected by shifts in US trade partners as well as by the vast increase in ship size.

Security concerns and the disruption caused by the threat of terrorism have pointed out vulnerabilities in current practices.

Research can trace how changing patterns of economic activity, production processes, and patterns of demand affect freight transport. Work also is needed to help manage costs, efficiency, safety, and security.

NEW TECHNOLOGIES

Electronics and telecommunications innovations are transforming social and economic activity. New technologies that are smarter, more efficient, and friendlier to the environment than current ones are also transforming transportation.

Over the next two decades, the locations of businesses and households may be altered as telecommunications options improve. Already, businesses have become less dependent on physical proximity as electronic links have become reasonable alternatives to face-to-face communications. Freight carriers are heavy investors in new technologies and will increasingly use them to operate just-in-time, overnight, and same-day services. Individual travelers are using new technologies to pay tolls and fares electronically and to find the best routes to their destinations. And although full-time telecommuting is relatively rare, telecommunications systems do enable many workers to work at home at least part time.

Further changes are in the offing. Advanced traffic-management systems could increase road capacity while improving safety and respecting other objectives such as pedestrian comfort. Electric and hybrid vehicles, now only a tiny portion of the fleet, also could take off in the next two decades. Not only would that transform the debate over emissions and petroleum dependence, it also would challenge the gas-tax financing of highways.

Much work remains to be done on these promising technologies. But implementation will depend on public and private decisions about the technologies' desirability and usefulness. So it's critical to conduct research on potential demand for new technologies and on institutions, policies, and organizations needed for their deployment.

CONCERN FOR THE ENVIRONMENT

Environmental considerations both constrain transportation actions and offer important possibilities for environmental enhancement. Air and water quality, greenhouse-gas emissions, noise, endangered species and habitats, wetlands, parks and historic sites, agricultural land conservation, and community impacts are among the key factors that transportation planners



must consider in designing projects. The nation has made substantial progress on some of these matters, but much more remains to be done. For example, largely due to technological improvements in vehicle emissions controls and regulation of industrial sources, air pollution has been substantially reduced nationwide, even with massive growth in activity. However, recent research suggests that we need to know much more about the toxicity and relative potency of various air pollutants, about air pollution modeling and forecasting, about modal emissions—how emissions vary with speed, stops, accelerations, etc.—and about the costs and benefits of various emission-control strategies.

Similarly, progress has been made and there is reason to believe we can further improve water quality, wetlands protection, habitat, and general ecological health through careful design, construction, and management of transport facilities. Well-designed transportation projects can provide scenic views, enhance roadside ecology, recycle materials, calm traffic in

neighborhoods, and reduce pollution. However, to accomplish this, more research is needed on issues ranging from ecosystem-scale impacts and opportunities presented by road systems to better understanding how road chemicals affect plants and wildlife. In addition, land use itself is increasingly seen as an environmental issue. Among the salient topics are the effects of transportation investments on land use, including induced demand, support of infill and other private investments, and the effects of land use patterns on travel demand (e.g., sprawl and auto dependence; jobs-housing imbalance and congestion; compact growth as a means of facilitating walking, biking, and transit use). All of these areas require research support.

EQUITY AND PARTICIPATION

TEA-21 called for increased opportunity for citizen participation. Concerns that minority and low-income populations are frequently underrepresented in public policy forums have led to directives to increase planning and outreach activities. ➤



TEA-21 assigned significant planning and decision authority to metropolitan planning organizations (MPOs), in partnership with state transportation agencies, strongly signaling a shift in federal policy toward an expectation of greater involvement of stakeholders. Federal law and regulations also acknowledge the need to involve private sector interests (shippers, freight carriers, port users, etc.), which have been underrepresented in the past as well.

How is this being accomplished? New planning approaches encompass greater stakeholder and community involvement, and have broad scopes to better address interrelated land use, transportation, and economic investment issues. Agencies are testing public-private partnerships. Researchers and planners are developing methods for measuring performance of transportation projects from an equity perspective and for assessing their effects on diverse communities. But far more work remains. We know little about the efficacy of various planning approaches in improving transportation choices, increasing customer satisfaction, or improving system performance. Questions

about distribution of costs and benefits are not well answered by available methods. Impacts of alternative policies and investments on freight transport are poorly understood.

ISTEA and TEA-21 vastly altered the institutional arrangements and policy objectives for surface transportation, but few studies have examined how the new institutional arrangements are performing. What MPOs have done with their new authorities is not well documented or evaluated. Few studies have examined what makes a public-private partnership for transportation planning a success—or a failure. How to integrate decision-making across disciplines (transport, environment, development) requires more work and best practices need to be identified and documented.

THE FINANCING DILEMMA

Funding shortfalls challenge the ability of transportation agencies to provide for current and projected mobility and access needs of the nation. The shortfalls are felt at every level

of government, for capital projects as well as for operations and maintenance.

Possible ways to address the financing dilemma are to raise the gas tax, expand the use and “transportation capture rate” of other taxes (e.g., sales taxes, property taxes, excise fees), raise fares and fees, and increase private sector provision of transportation infrastructure and services. While these mechanisms are fairly well understood, there remain opportunities to further develop innovative methods of finance for transportation facilities and services and to find ways to provide transportation better/cheaper/faster. Research also could help identify and understand the conditions under which the public would support higher taxes and fees, and about the benefits as well as the costs of such higher expenditures.

GETTING RESEARCH DONE

Transportation has been spending a far smaller fraction of its resources on research than have other sectors of the economy. There is some reason to think that the low rates of research expenditure are in part responsible for the lack of innovation in some of our transportation business practice. Research needs to be done and disseminated widely if new ideas are to emerge and take root.

Funding for research—and for the data that researchers need—should be seen as an investment in better transportation systems. A mixed portfolio of transportation research should be the rule. Increasingly, the questions that need to be addressed are multidisciplinary. For example, we need science research on pollutant toxicity and potency, engineering research on improving traffic operations, and social science research evaluating the performance of programs and planning approaches, and designing and analyzing policy alternatives. Some of the work can be short term, but other issues require longer term and higher risk research.

University programs are a valuable resource for the conduct of research. University research orientation and capacity varies considerably, and some transportation programs are focused primarily on undergraduate education and technical assistance projects while others educate both undergrads and grad students and carry out both basic and applied research. Funding for transportation centers has been invaluable at building both kinds of programs and attracting high-quality students and faculty into transportation. Many university transportation centers have good relations with their state DOTs, MPOs, transit operators, local transportation agencies, and the private sector, and at least some of their work is carried out in cooperation with them.

But some independent research is also critical. For example, federal funding has allowed faculty members to do evaluation research on organizational design, policy design, and business practices. Independent evaluation of such topics can help elected officials improve public policy and help public agencies improve performance. Independent research is also the source of many innovations and inventions. A sound research program needs to allow researchers to develop new ideas on their own at least some of the time.

To sum up, we need more research on changing demographic, economic, and environmental conditions and their implications for transportation, more policy research, more evaluation research, and better data to support these efforts. New competitive research initiatives and a rejuvenated and better funded program of university research would pay off in better transportation outcomes. ♦

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Transportation Costs and Economic Opportunity Among the Poor

BY EVELYN BLUMENBERG

A widely cited report says transportation costs are increasing and comprise a much larger share of expenditures in lower- than in higher-income households. The report, *Transportation Costs and the American Dream*, published by the Surface Transportation Policy Project in 2001, blames automobiles and says that rising transportation costs are hindering home ownership. However, the facts do not support this conclusion.

Expenditure data from the Bureau of Labor Statistics’s (BLS) Consumer Expenditure Survey reveal that low-income households actually spend slightly *less* than high-income households on transportation, a pattern that has held since the early 1980s. Figure 1 shows the distribution of expenditures for all households and compares them with households in the bottom income quintile. The graph shows transportation expenses are, indeed, a significant expenditure for everyone, but that low-income households spend a slightly smaller percentage on transportation than all households (and a higher percentage on housing).

This finding is underscored in Figure 2, which shows transportation expenditures as a percentage of total expenditures by income quintile. Transportation comprises 17 percent of the total expenditures among households in the lowest income group, a figure surprisingly similar to, albeit less than, that of higher income groups, which spend between 18 and 21 percent on transportation.

As Figure 3 shows, the percentage of low-income households with at least one vehicle increased steadily from 58 percent in 1984 to 65 percent in 2001. For most of this period, low-income households spent less and less on transportation. Although in recent years transportation expenditures have increased, they remain lower today than they were in 1984.

These figures are based on expenditure data. One could argue that income, rather than expenditures, is a more appropriate basis, since some low-income families incur debt, so their expenditures exceed their incomes. Expenditure data do not account for debt, but in the Consumer Expenditure Survey,

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FIGURE 1

Major consumer expenditures

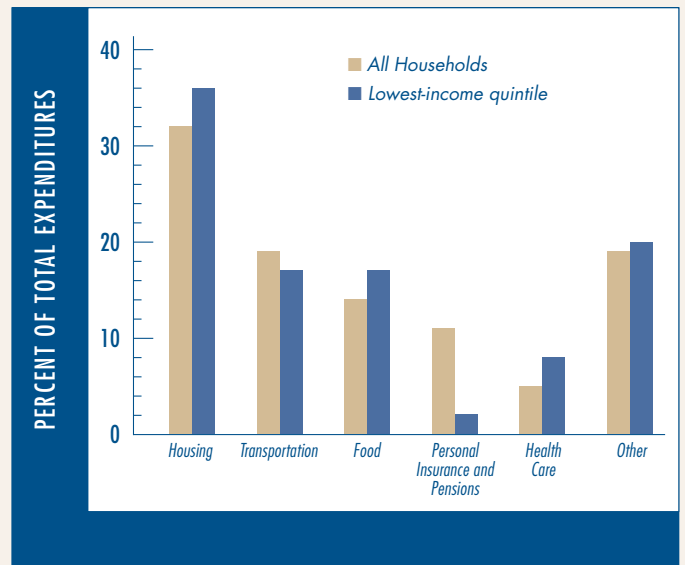


FIGURE 2

Transportation as percentage of total expenditures

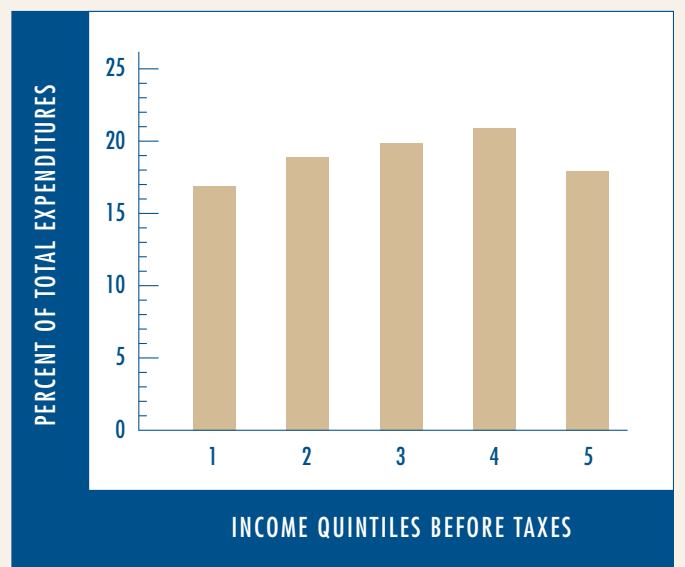
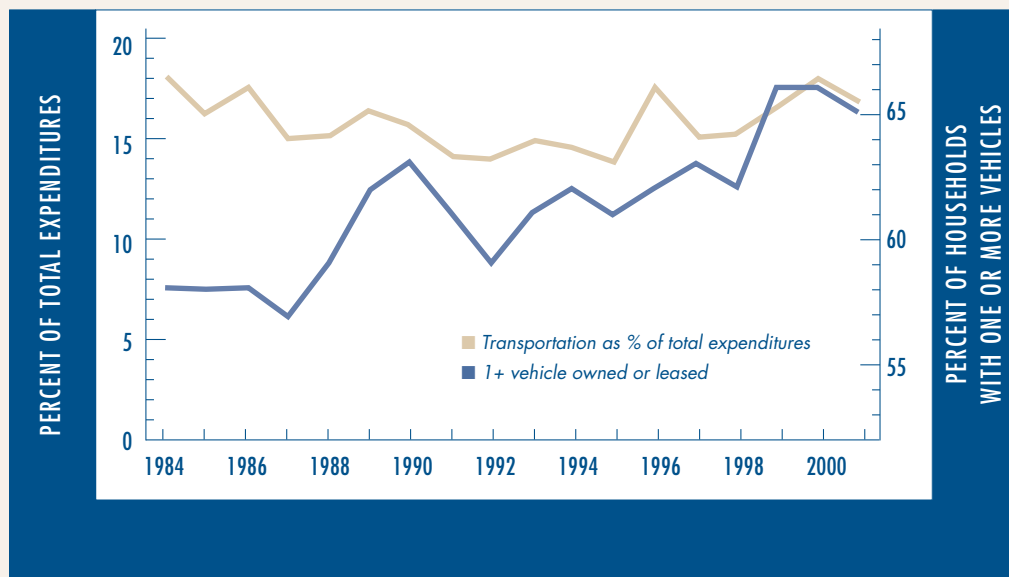


FIGURE 3

Transportation expenditures and auto ownership of lowest-income quintile, 1984–2001



Source of figures:
2001 Consumer Expenditure Survey

neither do income data. This is because, according to the BLS, households consistently underreport their income. As a consequence, total expenses for the bottom income quintile in BLS data are approximately 240 percent greater than total post-tax income. Obviously, it is not possible for expenditures to exceed income by nearly two and a half times.

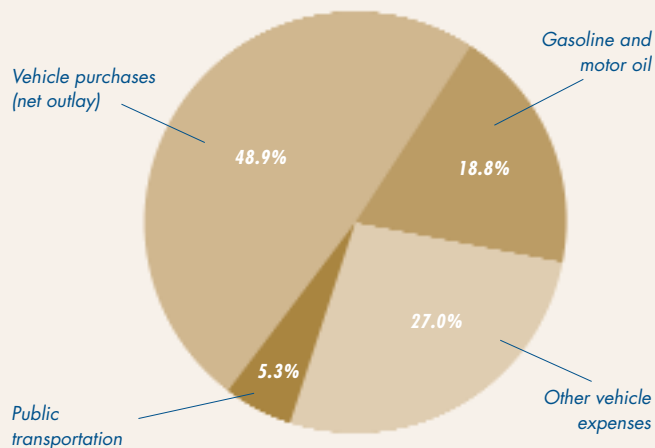
Figure 4 shows that the vast majority of transportation-related expenses are associated with cars. This is no surprise, since most low-income adults travel in cars (76 percent of all trips by those with incomes of less than \$20,000). In 2001, on average, poor households spent \$3,200 on transportation, including only \$405 (or just over five percent) on public transportation.

Are transportation costs—particularly costs associated with automobiles—a major barrier to economic opportunity among the poor? Simple cost comparisons fall short of answering this question. The fact that low-income households spend, on average, \$3,000 a year on vehicle-related expenses does not, by itself, suggest a problem. We cannot separate the costs of automobiles from their benefits; and cars provide benefits, particularly in auto-oriented metropolitan areas. And transportation costs cannot be separated from housing location decisions. Households make trade-offs between housing and transportation costs that include time costs—yet another dimension that gets lost in a simple comparison of expenditures.

There’s no question that if low-income families spent less on transportation, they could spend more on other things such as

FIGURE 4

Transportation expenditures of households in the lowest-income quintile



housing, food, and health care. But one cannot draw conclusions regarding the burdens of transportation costs without also considering the benefits of transportation expenditures. Claims that excessive transportation costs and, more specifically, automobile ownership are directly responsible for reducing home ownership among low-income households are not supported by the data. ♦



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