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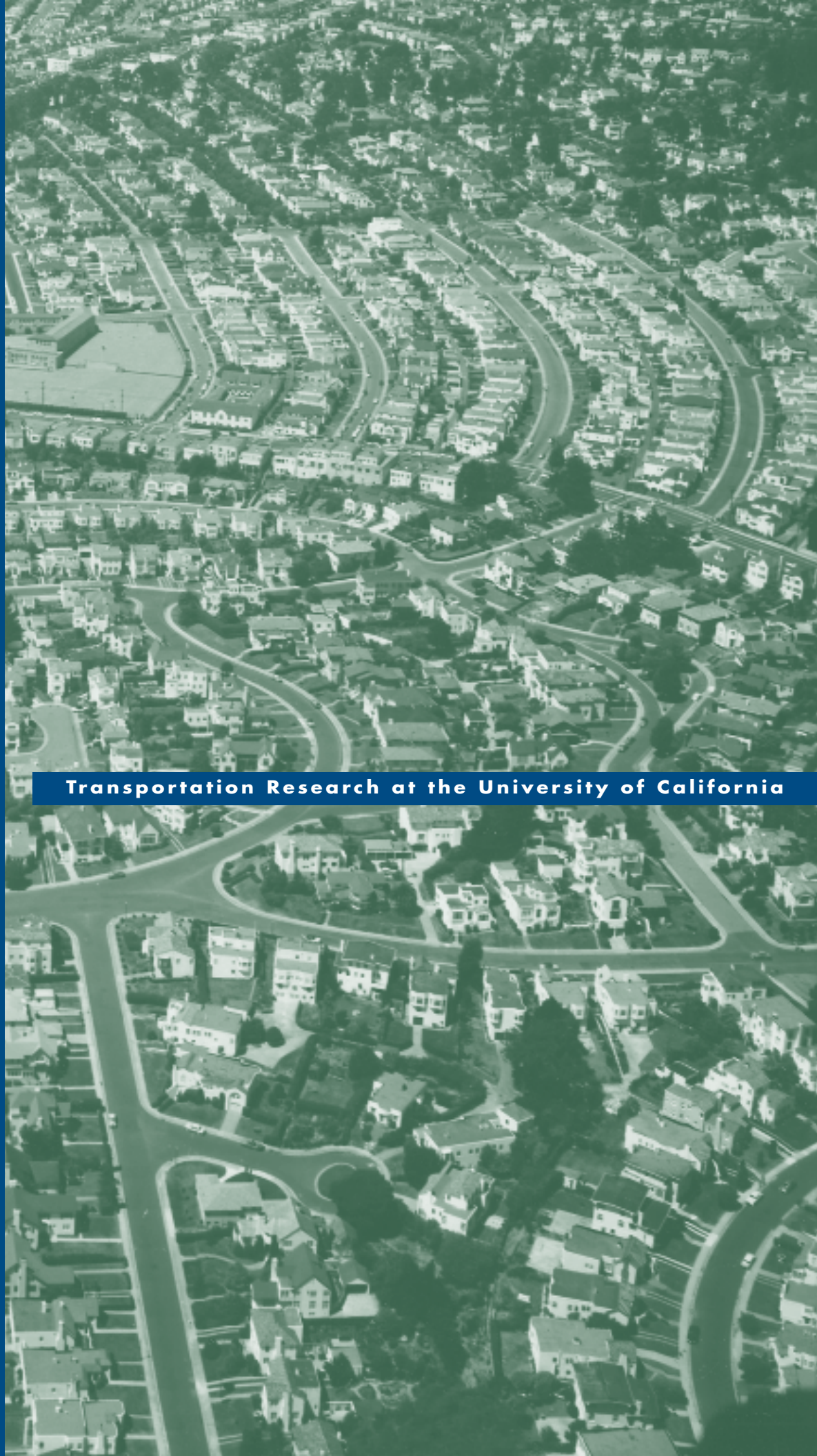

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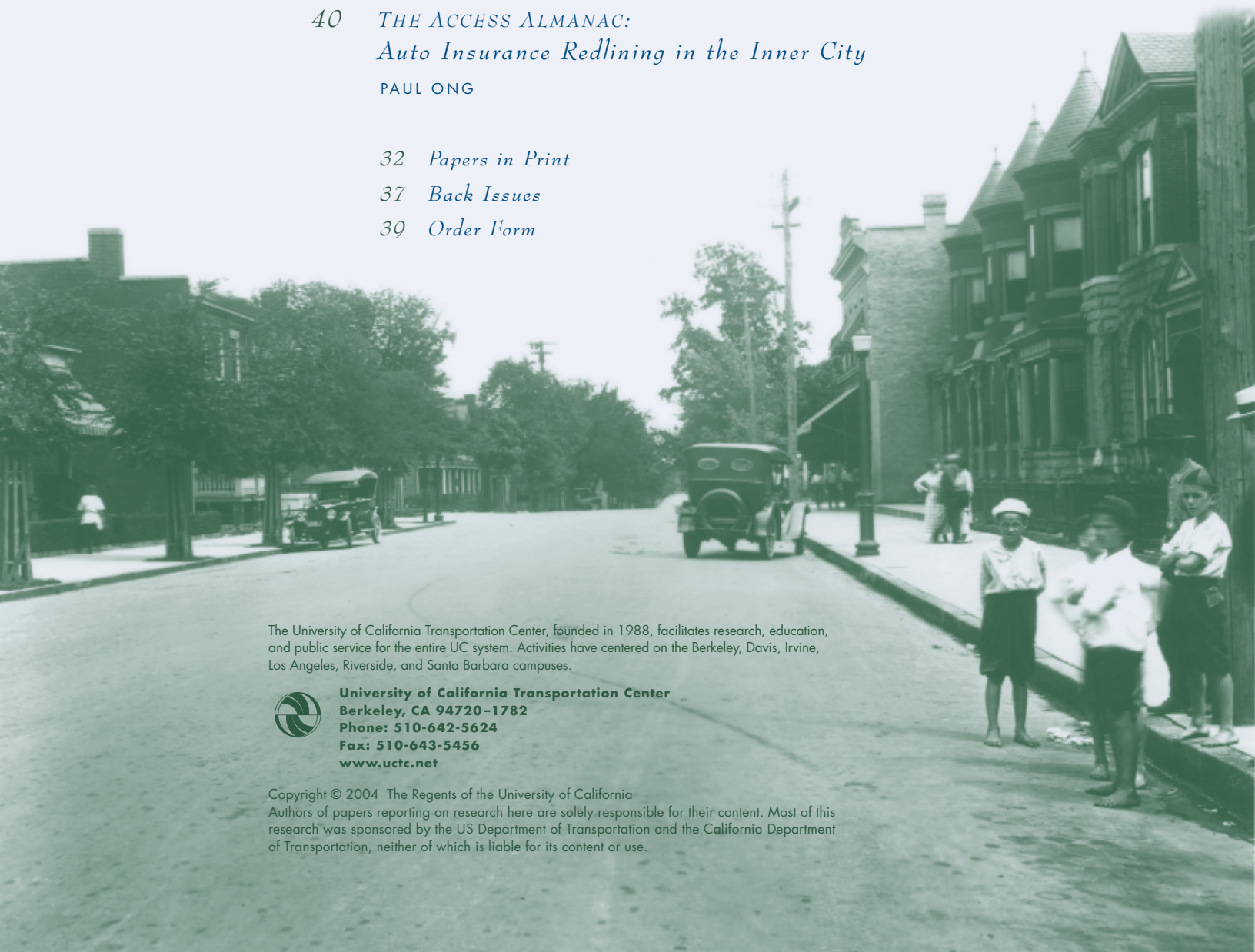

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Shuttles for the First and Last Mile

TRANSIT OPERATORS faced with sharp revenue shortfalls due to the economic downturn have reduced or eliminated feeder bus services. Feeder services often carry only five to ten passengers per run, with costs in the range of $6 to $10 per one-way trip, and so are prime targets for cost-cutting measures. Trunk line routes, in contrast, carry two to three times more riders.

What happens when feeder services disappear or are sharply cut back? Some former users are able to walk to the trunk line bus or rail service, and some can drive to a station, park, and ride transit the rest of the way. But many others, no longer able to navigate their first and last mile on a shuttle, give up and drive to work instead, adding to the traffic load on city streets and freeways.

In some communities, innovative shuttle services are filling the gap. Recent studies have identified over 150 such services currently operating in the Bay Area alone. These Bay Area shuttles carry more than eight million riders a year. Employer-operated services connect park-and-ride lots and rail stations to the workplace; cities run shuttles for commuters, school children, hotel visitors, and shoppers; transit agencies operate special services in partnership with major employers. While a few of the employer-operated shuttles are only for that company's workers, most shuttles are open to the public and free of charge.

Some communities pay for their shuttles through public-private partnerships, with the city contributing some funds and private sector members paying fees. The community shuttles all started as demonstration projects supported by grants; once the service proved successful, permanent public and private financing was secured. Business improvement districts have been a common mechanism for levying the assessment on local businesses. In contrast, single-employer shuttles are mostly self-financed, and many of them originally started as traffic mitigation required as a condition of development approval. Over the years, employees have come to view the shuttles as a valuable benefit. Employers, in turn, see them as a way to enlarge the labor pool accessible to the worksite while keeping traffic manageable and community relations positive.

Shuttle providers in the Bay Area report hourly costs of $50 to $60, about half that of the larger transit operators in the Bay Area and roughly the same as the lowest-cost public providers. Operating and administrative costs typically run $2 to $5 a ride. Providers hold down costs by keeping administrative expenditures low, making cost-effective equipment purchases or leases, and contracting for maintenance, in some cases with the local bus operator's union employees. In a few cases the transit operator also provides drivers, but most shuttle services hire their own. Wages for drivers are somewhat lower than the union average, but in most cases are at or above union starting salaries.

In some instances, shuttles have allowed employers to reduce the amount of parking they'd otherwise need. The daily cost of providing a parking space in a surface lot ranges from $8 to $15 in most parts of the Bay Area, so employers can save money if they provide shuttle services rather than free parking. Indeed, many employers would find it less expensive to give their workers a free monthly transit pass *and* free shuttle rides than a free parking space. Unfortunately, most local parking codes fail to take into account this cost-saving, traffic-reducing strategy.

Shuttles are an innovation that clearly deserve more consideration, not only as a way to solve the first and last mile access problem but also to save money and reduce traffic. Possibilities for reforms of local parking requirements and further investigation of markets for shuttles would be high-payoff topics for investigation.

Elizabeth A. Deakin

People, Parking, and Cities

BY MICHAEL MANVILLE AND DONALD SHOUP

THE POP CULTURE IMAGE of Los Angeles is an ocean of malls, cars, and exit ramps; of humorless tract homes and isolated individuals whose only solace is aimless driving on endless freeways. From Joan Didion to the Sierra Club, LA has been held up as a poster child of sprawl. This is an arresting and romantic narrative, but also largely untrue.

To the extent that anyone has a definition of sprawl, it usually revolves around the absence of density, and Los Angeles has since the 1980s been the densest urbanized area in the United States. This would make it the *least* sprawling city in America. Compared to other US cities, LA also does not have inordinately high rates of automobile ownership.

These facts strike some as hard to believe, or perhaps false, and they haven't made much of a dent in the LA-as-sprawl idea. Clichés about Los Angeles-style sprawl die hard, partly because the definition of sprawl is so malleable (urbanist William Fulton now simply calls LA "dense sprawl"), and partly because the anti-urban stereotype about LA contains its own kernels of truth. After all, if density is a barometer for healthy urbanism, and Los Angeles is denser than cities like New York or San Francisco, then why are Manhattan and downtown San Francisco such vibrant places, and why is downtown LA comparatively lifeless?

Obviously there's no single answer to that question (and the question itself is rather prejudicial). But we think the differences between Los Angeles, New York, and San Francisco stem in part from the different ways they regulate downtown development, and in particular the way they regulate parking. Los Angeles is an example of density as a dilemma rather than a solution. Planners and urban critics who regularly call for increased density as a salve for city life should realize that without corresponding changes in parking requirements, increased density will compound, rather than solve, the problems we associate with sprawl. ➢

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Density within Regions and between Them

Before opening this discussion, we should make an important distinction. We are referring to the US Census Bureau's definition of "urbanized areas" rather than to the political boundaries of cities. So when we say that Los Angeles is denser than New York we are actually saying that the Los Angeles urbanized area, which is Los Angeles and its suburbs, is denser than the New York urbanized area, which includes not just New York City but its suburbs as well.

Without doubt, the *cities* of New York and San Francisco are denser than the city of LA. But sprawl is a regional attribute, and Los Angeles has much denser suburbs than New York or San Francisco. Indeed, the LA region's distinguishing characteristic may be the uniformity of its density; its suburbs have 82 percent of the density of its central city. In contrast, New York's suburban density is a mere 12 percent of its central city density, and San Francisco's suburban density is only 35 percent of the city's. New York and San Francisco look like Hong Kong surrounded by Phoenix, while Los Angeles looks like Los Angeles surrounded by . . . well, Los Angeles.

In other words, Los Angeles is a dense area without an extremely dense core, while New York and San Francisco are less dense overall but enjoy the benefits of very dense core areas. It's worth asking why that is. It may be that uniform density across an urbanized area is a result of the inability to have a very dense core. Or it may be that high uniform density precludes having a lively downtown. We don't have definitive answers to these questions, but we can highlight the tremendous deadening effect that parking regulations have on LA's Central Business District.

Parking and the Central Business District

A successful Central Business District (CBD) combines large amounts of labor and capital on a small amount of land. CBDs thrive on high density because the prime advantage they offer over other parts of a metropolitan area is *proximity*—the immediate availability of a wide variety of activities. The clustering of museums, theaters, restaurants, and offices is the commodity a downtown can offer that other areas cannot. Yet downtowns have long been plagued by questions about access, for they can either thrive on or be destroyed by congestion. In order to thrive, a CBD must receive a critical mass of people every day but do so without clogging itself to the point of paralysis. One way to do this is to require off-street parking spaces. Off-street parking can reduce the cruising for parking that often strangles the streets of CBDs, but parking requirements have high costs.

It's not hard to see how a conventional parking lot can undermine a CBD's success; a downtown surface lot often has a very high and very visible opportunity cost. Instead of a building teeming with activity there is an expanse of asphalt with one employee manning a booth; where there could be something there is instead not much. But even when off-street parking is dressed up or hidden—when it is placed underground, or in a structure that has retail uses at the street level—it is inimical to density. Because land is most expensive in the CBD, off-street parking is also most expensive there, and constructing it uses up capital that could otherwise be invested more productively. More important, if off-street parking is *required*, as it is in many cities, then it becomes rational for firms to locate in places where land is less expensive, meaning it becomes rational to locate outside the CBD. A parking requirement applied uniformly across a city implicitly discriminates against development in the CBD, because the burden of complying with the requirement is greater in the CBD than almost anywhere else.

A Tale of Two Parking Requirements

The impact of parking requirements becomes clearer when we compare the parking requirements of our three cities. New York and San Francisco have strict limits on how much parking they allow in their CBDs; Los Angeles, however, pursues a diametrically opposing path—where the other two cities limit off-street parking, LA requires it. This requirement not only discourages development in downtown Los Angeles relative to other parts of the region but also distorts how the downtown functions.

Take, for example, the different treatment given by Los Angeles and San Francisco to their concert halls. For a downtown concert hall, Los Angeles requires, as a minimum, *fifty times* more parking than San Francisco allows as its maximum. Thus the San Francisco Symphony built its home, Louise Davies Hall, without a parking garage, while Disney Hall, the new home of the Los Angeles Philharmonic, did not open until seven years after its parking garage was built. ➢

Disney Hall

Disney Hall's six-level, 2,188-space underground garage cost $110 million to build (about $50,000 per space). Financially troubled Los Angeles County, which built the garage, went into debt to finance it, expecting that parking revenues would repay the borrowed money. But the garage was completed in 1996, and Disney Hall—which suffered from a budget less grand than its vision—became knotted in delays and didn't open until late 2003. During the seven years in between, parking revenue fell far short of debt payments (few people park in an underground structure if there is nothing above it) and the county, by that point nearly bankrupt, had to subsidize the garage even as it laid off employees.

The county owns the land beneath Disney Hall, and its lease for the site specifies that Disney Hall must schedule at least 128 concerts each winter season. Why 128? That's the minimum number of concerts that will generate the parking revenue necessary to pay the debt service on the garage. And in its first year, Disney Hall scheduled exactly 128 concerts. The parking garage, ostensibly designed to serve the Philharmonic, now has the Philharmonic serving it; the minimum parking requirements have led to a minimum concert requirement.

The money spent on parking has altered the hall in other ways, too, shifting its design toward drivers and away from pedestrians. The presence of a six-story subterranean garage means most concert patrons arrive from underneath, rather than outside, the hall. The hall's designers clearly understood this, and so while the hall has a fairly impressive street entrance, its more magisterial gateway is a vertical one: an "escalator cascade" that flows up from the parking structure and ends in the foyer. This has profound implications for street life. A concertgoer can now drive to Disney Hall, park beneath it, ride up into it, see a show, and then reverse the whole process—and never set foot on a sidewalk in downtown LA. The full experience of an iconic Los Angeles building begins and ends in its parking garage, not in the city itself.

Visitors to downtown San Francisco are unlikely to have such a privatized and encapsulated experience. When a concert or theater performance lets out in San Francisco, people stream onto the sidewalks, strolling past the restaurants, bars, bookstores and

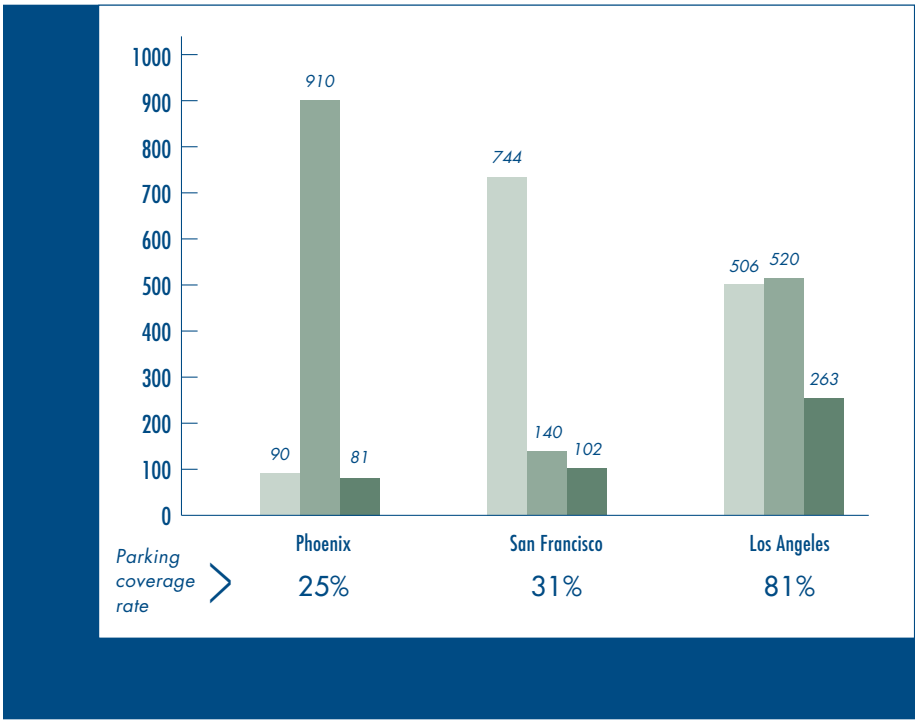
flower shops that are open and well-lit. For those who have driven, it is a long walk to their cars, which are probably in a public facility unattached to any specific restaurant or shop. The presence of open shops and people on the street encourages other people to be out as well. People want to be on streets with other people, and they avoid streets that are empty, because empty streets are eerie and menacing. Although the absence of parking requirements does not guarantee a vibrant area, their presence certainly inhibits it. "The more downtown is broken up and interspersed with parking lots and garages," Jane Jacobs argued in 1961, "the duller and deader it becomes … and there is nothing more repellent than a dead downtown."

The Density of Parking

In the end, what sets downtown LA apart from other cities is not its sprawl, or its human density, but its high human density combined with its high *parking* density. If you took all of the parking spaces in the Los Angeles CBD and spread them horizontally in a surface lot, they would cover 81 percent of the CBD's land area. We call this ratio—of parking area to total land area—the "parking coverage rate," and it is higher in downtown LA than in any other downtown on earth. In San Francisco, for instance, the coverage rate is 31 percent, and in New York it is only 18 percent.

The density of parking depends on both the density of jobs and the number of parking spaces per job. Consider the CBDs of Phoenix, San Francisco, and Los Angeles, which are roughly the same size. Why does Phoenix, which most people would consider the most auto-oriented of the three cities, have the lowest parking coverage rate, at 25 percent? Phoenix has the highest number of parking spaces per job, but also by ➢

Parking and jobs in the CBD



far the fewest jobs. It has a lot of parking for not many people, and for that reason many commuters to the Phoenix CBD drive alone to work. San Francisco, by contrast, has a lot of people and very little parking—a function of its ordinances that limit parking spaces. This helps explain why many commuters to downtown San Francisco walk, carpool, or ride transit—and contribute to a vibrant CBD by doing so. Although San Francisco has over eight times as many jobs as Phoenix, its parking coverage rate is only slightly higher, at 31 percent.

And what about Los Angeles? Downtown LA has more than three times as many parking spaces as Phoenix, but it also has five times as many jobs. Compared to San Francisco, LA has fewer jobs but more than twice as many parking spaces. As a result, its parking coverage rate, at 81 percent, is higher than both of the other cities combined. Los Angeles is both car-oriented *and* dense; it approaches the human density of San Francisco but dilutes it with the parking supply of a suburb. Any benefits Los Angeles might derive from its density are offset by its relentless accommodation of the automobile.

This car-oriented density creates something different from plain old sprawl. Los Angeles is dense and getting denser, but so long as its zoning assumes that almost every new person will also bring a car—and requires parking for that car—it will never develop the sort of vital core we associate with older urban centers. The need to house humans might push toward an increasingly dense center, but the zoning requirement to house cars pushes back, sending development outward. With off-street parking requirements, higher density simply brings more cars and more congestion, as well as increased disruptions in the urban fabric, with money directed away from buildings and toward parking lots.

Conclusion

"The right to access every building in the city by private motorcar," Lewis Mumford wrote in 1961, "in an age when everyone owns such a vehicle, is actually the right to destroy the city." Mumford meant not physical destruction, of course, but loss of the cohesion that can make a CBD more than the sum of its parts. Parking requirements go a long way toward making downtown LA little more than a group of buildings, each a destination in its own right, to be parked at and departed from, and not part of some larger whole. This missing sense of urbanity—subjective though that term may be—might explain why people often react with disbelief when they are told LA sprawls less than New York or San Francisco.

So what should we do? We could start by admitting that there is such a thing as too much parking. So long as we continue to make minimum parking requirements a condition of development, we subordinate almost every other function of our cities to the need for free parking. But free parking—indeed, parking in general—is not what makes cities great. It doesn't create Manhattan and it doesn't make downtown San Francisco. Urbanists who admire these cities should call for other areas to mimic not simply their density, but also their willingness to limit rather than require parking. Perhaps the simplest and most productive reform of American zoning would be to declare that all existing off-street parking requirements are maximums rather than minimums. From that point we could let the market take care of parking, and let city planners take care of the many vital issues that really demand their attention. ◆

Further Reading

William Fulton and Rolf Pendall. *Who Sprawls Most? How Growth Patterns Differ Across the US*. (Washington, DC: Brookings Institution) 2001.

Donald Shoup, "Truth in Transportation Planning," *Journal of Transportation and Statistics*, vol. 6, no. 1, 2003, pp. 1–16.

Donald Shoup, "The Trouble with Minimum Parking Requirements," *Transportation Research Part A: Policy and Practice*, vol. 33A, nos. 7/8, September/November 1999, pp. 549–574.

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The Price of Regulation

BY DANIEL SPERLING

AND ETHAN ABELES, DAVID BUNCH, ANDREW BURKE, BELINDA CHEN, KENNETH KURANI, and THOMAS TURRENTINE

THE ERA OF SOCIAL REGULATION began in the late 1960s. At first the focus was on safety and pollution, and later on energy use. Motor vehicles were the first and most prominent target. Now, forty years later, social regulation is firmly entrenched.

Regulators propose increasingly stringent technology-forcing rules on vehicles, expecting automakers to find a way to adhere to them. Automakers invariably resist, asserting economic hardship. Parts suppliers, trade groups, labor unions, consumers, environmentalists, and others intervene on one side or the other in a dance that proceeds through legislatures, courts, and the public arena.

What have been the effects of these social regulations? Have individual companies or entire industries suffered economic hardship? Have consumers been disadvantaged? ➢

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Remarkably, few efforts have been made to answer these questions. A new cohort of analysts is trying to specify costs, benefits, and risks of new regulations. President George W. Bush's controversial appointment of Professor John Graham, a risk-analysis expert from Harvard, to the Office of Management and Budget is accelerating this new scrutiny. Even in the most sophisticated analyses, though, rarely are long-term or secondary impacts considered.

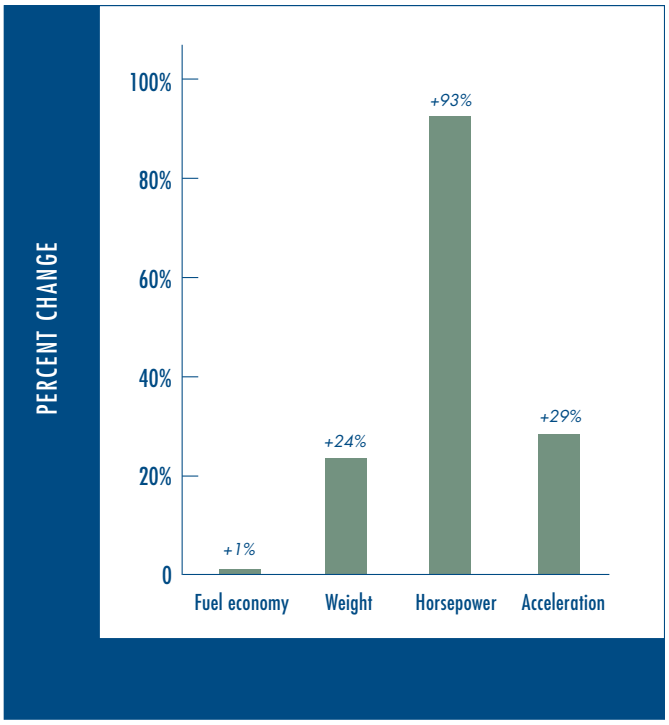
California is now expanding the regulatory arena with the US's first-ever rules to reduce greenhouse gas emissions from vehicles. Sensitive to criticism about economic impacts of regulations, the California Air Resources Board asked a group of us at UC Davis to analyze historical effects of previous social regulations as a means of guiding it along this new regulatory path.

The challenge was more daunting than we initially imagined. We soon found that little is known about the effects of previous regulations—even direct cost impacts. What we do know and can state with confidence is that vehicle emissions and safety have improved dramatically—and that government regulations have played a central role in these improvements. Today's vehicles emit 90 to 99 percent less pollution than pre-control vehicles of the 1960s and are far safer, thanks to government-mandated changes.

Fuel consumption improvements have been more modest and the role of government more controversial. Fuel economy standards adopted in 1975 required automakers to increase fuel economy in cars from unregulated rates of about 15 mpg to 18 mpg in 1978, and then to 27.5 mpg by 1985 (with a separate set of less stringent standards applied to pickups, minivans, and SUVs). Automakers met these initially aggressive standards through the early 1980s, responding to steep increases in fuel economy standards and fuel prices. Since then overall fuel economy of cars and light trucks has not improved at all—though not for lack of technical improvements. Tremendous improvements were made in engine efficiency and lightweight materials during these last twenty years, but the *efficiency* improvements were not used to improve fuel *economy*. Instead, they were used to increase horsepower and size, improve acceleration, and add energy-consuming accessories such as all-wheel drive and air conditioning (see Figure 1). If performance and size had been held constant from 1985 to 2001, fuel economy would have improved over twenty percent. Instead it improved not at all.

An important first observation is that the automotive industry is highly innovative, perhaps more than ever, and that government rules strongly influence and direct those innovations.

FIGURE 1 Percent change from 1981 to 2003 in average vehicle characteristics



Source: US EPA (Hellman and Heavenrich, 2003)

But how those innovations are used is part of a more complex story related to market dynamics, consumer behavior, and company positioning.

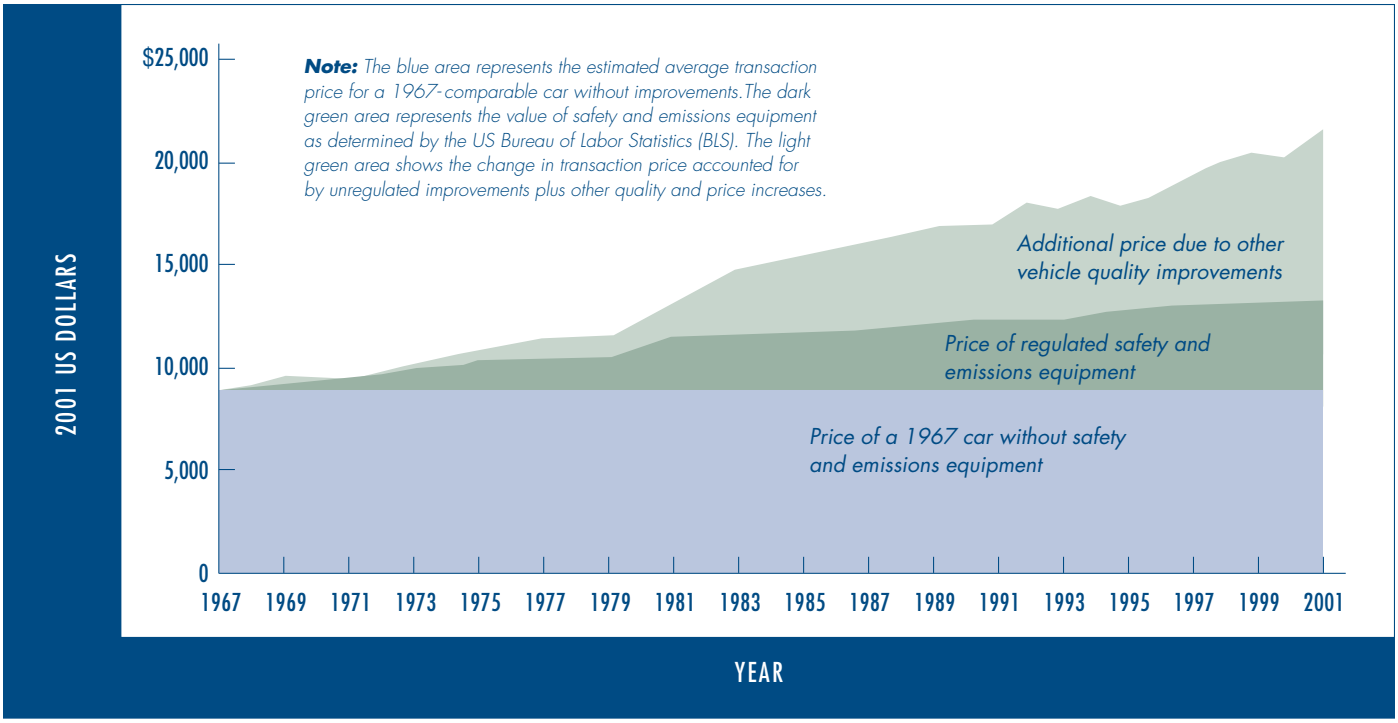
Therein lies our challenge: how to untangle and understand the effects of government regulations on automakers and consumers. We have made an effort to do so.

Our principal finding, elaborated below, is that the costs resulting from efforts to improve safety and emissions are significant, but represent only a modest part of overall vehicle cost increases. Further, vehicle regulations had little discernible effect on industry performance and activities. The cost increases have been largely accommodated within normal business and market planning processes of companies.

Are Costs of Regulation Large?

Government regulations to improve safety and reduce air pollutant emissions and oil use have indeed added significant cost to vehicles. Our best estimate is that regulatory requirements caused one-fifth to one-third of vehicle price increases between 1967 and 2001 (see Figure 2)—accounting for one-eighth to one-fifth of the total price of new vehicles. Other changes—improvements in reliability, durability, "fit-and-finish"

FIGURE 2 Regulatory-induced costs in the price of cars, 1967–2001



Source: BEA and BLS data as reported in Ward's (annual)

quality, and power, along with the addition of many new accessories—incurred much greater costs and were responsible for a larger proportion of increased vehicle prices.

These cost estimates are based on two sets of government data: annual estimates of the cost of "quality improvements" to vehicles by the US Bureau of Labor Statistics (BLS), and vehicle price estimates by the US Bureau of Economic Affairs (BEA). Both sets of data, especially BLS data on costs, are subject to large uncertainty. Better cost data are not available because companies treat costs as confidential and the complexity of vehicles makes it difficult for those outside the companies to estimate costs of components and subsystems.

The sales-weighted average price of vehicles sold in 1967 was estimated to be $3,200 in current dollars, including a very tiny amount (about $11) for regulated quality improvements (for safety and emissions). The price of that car, adjusted for inflation, would be $9,120 in 2001 dollars, as indicated in Figure 2. But the actual 2001 price (from BEA) was $21,600. Hence, quality improvements and other cost factors between 1967 and 2001 account for $12,480 of the price of the 2001 car.

Separately, Ward's Automotive Yearbook, using BEA and BLS data, estimates the total price of improvements due to regulations for 2001 cars to be $4,020. Dividing $4,020 by $12,480 provides the estimate that regulations accounted for about one-third of the price increase between 1967 and 2001.

We believe this estimate of regulatory costs is high. Based on our detailed analyses of emission costs and a review of safety costs, summarized below, we believe the cost of emissions and safety regulations to be considerably less than $4,020 per vehicle, closer to $2,500 (about $1,000 for emissions and less than $1,500 for safety). If it is $2,500, regulations would account for one-fifth of price increases and about one-eighth of the total vehicle price. Moreover, the 1967 car would be entirely unacceptable in today's world, regardless of regulations. Some environmental, fuel economy, and safety improvements would have been made anyway, with corresponding costs. In fact, as noted below, demand for safety now far outpaces regulatory requirements.

In any case, virtually all analyses of benefits resulting from emissions and safety improvements—measured as health impacts of air pollutant emissions and the value of lives saved, injuries avoided, and property damage averted—find that the benefits are worth much more than $2,500, or even $4,000. ➢

A Closer Look at Emission Control Costs

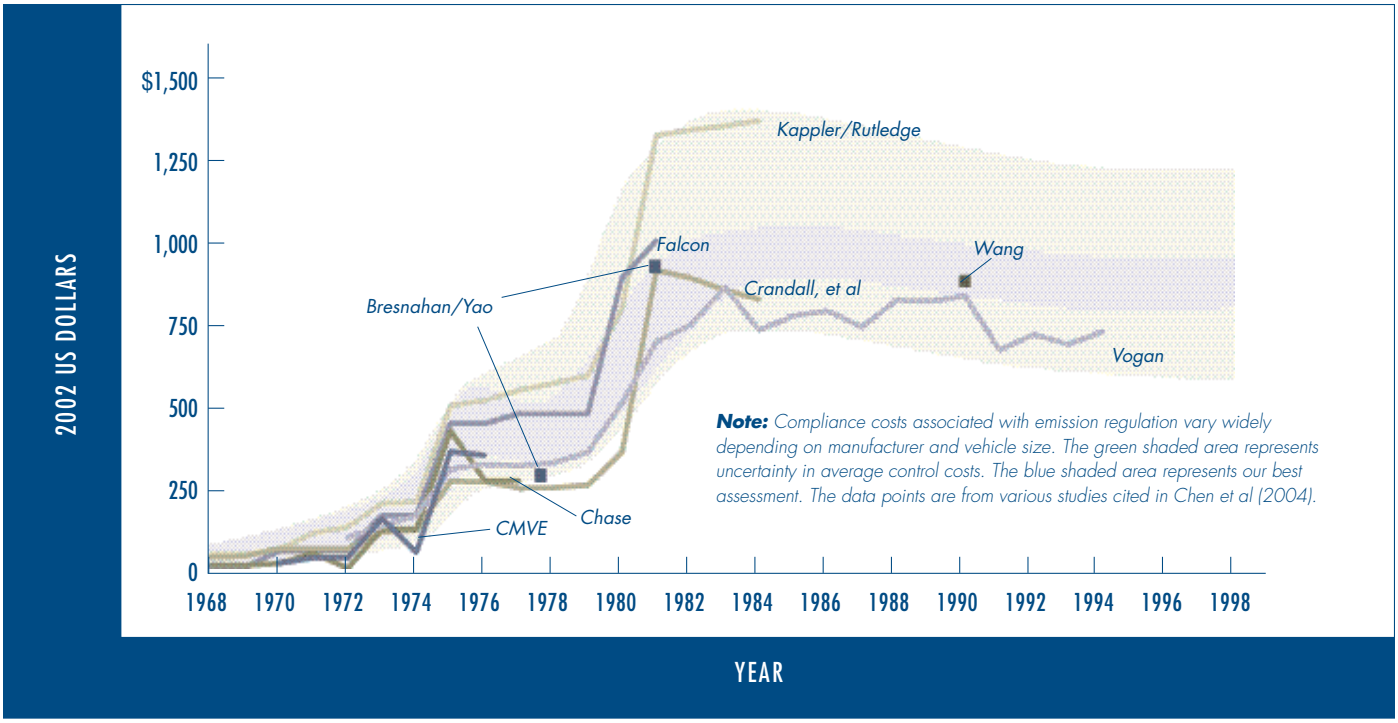
To test the credibility of these aggregate regulatory cost estimates, and to understand better the nature of these costs, we conducted a detailed analysis of emission control costs. We found that emission control costs per vehicle peaked in the early 1980s and only now are starting to reach those earlier cost levels—but with far greater effectiveness in reducing emissions.

These cost estimates are subject to considerable uncertainty. There are no accepted methods for determining how to allocate research and development and factory retooling expenditures, for instance. Consider also that some components, such as electronic fuel injection with microprocessors, were developed initially to reduce emissions, but are now used to improve performance and energy efficiency as well as emissions. Moreover, costs vary depending on vehicle weight, engine design, and engine calibration, as well as by manufacturer. Plus, cost data are closely guarded by companies.

A number of analysts have made cost estimates of emission control systems, each using a different method (Figure 3). Each study found that the cost per vehicle for emission control jumped dramatically, first in 1975, when oxidation catalysts were introduced to meet tightened hydrocarbon and carbon monoxide standards; and again in 1981, this time when three-way catalysts and electronic controls were introduced to meet more stringent nitrogen oxide standards. Costs subsided into the early 1990s, as continuing improvements were made in design and manufacturing.

New standards adopted in 1990 by California and the US EPA required further emission reductions and a new set of technological innovations, reversing nearly a decade of declining per-vehicle costs. The net result of this intermittent tightening of emission standards is that today's vehicles are about $1,000 more expensive (in retail prices) than they would be if emissions were not controlled. This per-vehicle cost increment is roughly the same as in the early 1980s when emission standards were far less stringent.

FIGURE 3 Emission control equipment costs, 1968–1998



Source: Chen et al, 2004 (based on cited studies)

A Closer Look at Safety Regulations and Costs

Safety regulations also led to major changes in vehicles. Consider airbags, the most costly change. After years of deliberation, a passive restraint standard was adopted in 1984, requiring that all new 1990 cars be equipped with airbags or an equally effective technology. Automakers once again resisted and won a series of reprieves until 1991. Legislation was passed in that year effectively mandating the use of dual airbags on all vehicles sold in the US beginning with 1998 cars and 1999 light trucks.

The delays in adopting and enforcing passive restraint rules was principally tied to arguments over airbag costs, with automakers claiming they were onerously high. In the 1970s and early 1980s, cost estimates ranged from $200 to $2,000 (in 2002 dollars) for a vehicle airbag. Varying assumptions about production volume, cost improvements, and cost allocation methods led to these dramatically different numbers. On average, automaker estimates were about 2.5 times higher than regulator and insurance company estimates. For early airbags sold in low volume, the costs clearly were high. For instance, Ford offered airbags on 1987 and 1988 Tempos and Topazes as an option for $1,233 (2002 dollars), but sold only about 13,000 and reported large ➢

financial losses. By 2000, volume was dramatically higher and costs had fallen accordingly. An analysis of a driver-side airbag on a 2000 Ford Taurus found that the cost was about $190 (2002 dollars) at a production volume of 250,000 units. Costs had dropped dramatically from ten years earlier.

Doubling these estimated costs to reflect retail prices and adding in passenger-side airbags and other safety features is unlikely to boost the average safety cost per vehicle much beyond $1000.

Costs had dropped so much that by the early 1990s demand for airbags was outpacing regulatory requirements. Indeed, today's vehicles are ringed with a variety of additional airbags not required by any government rules. Airbags are now more a response to market demand than to regulatory requirements.

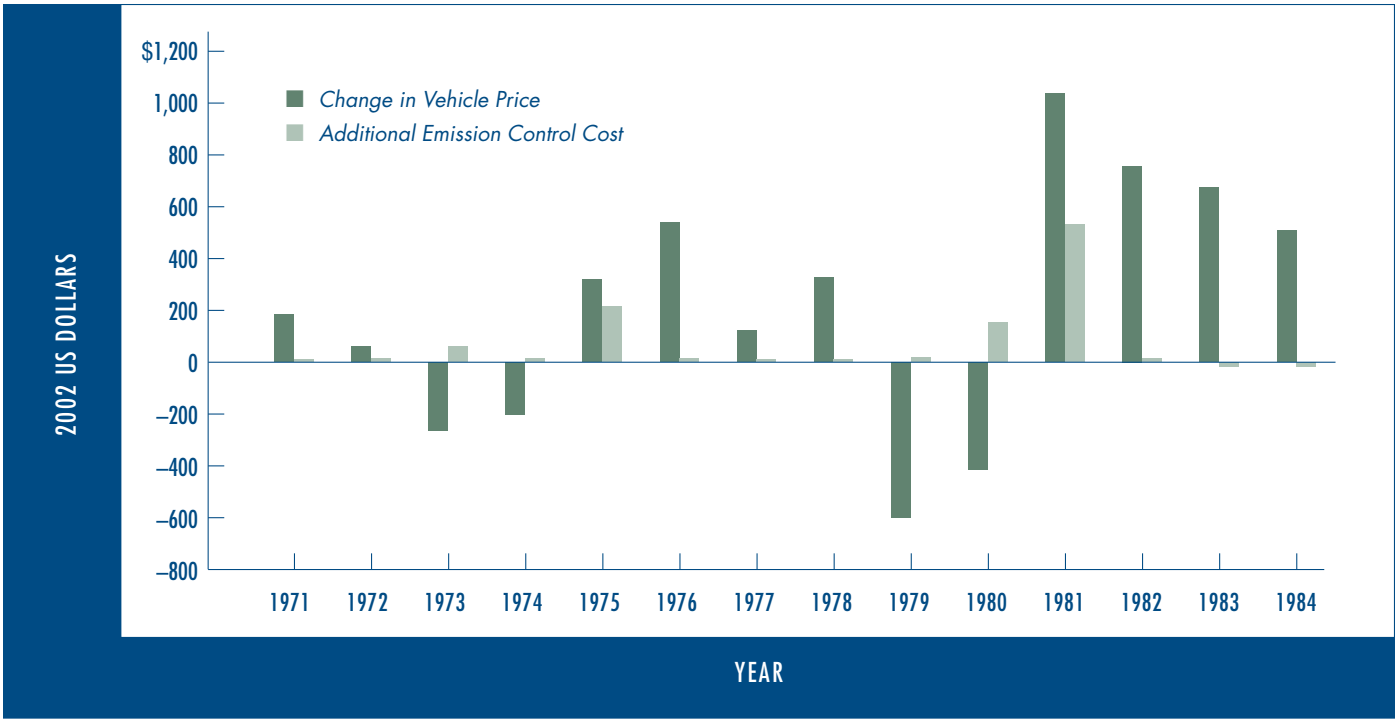
Effect on Industry Structure and Vehicle Markets

Though regulations imposed considerable costs on automakers, they had little effect on the structure of the industry and did not seem to distort markets in unintended ways. It is true that much has changed in the automotive world in the past few decades. In the 1960s, the three domestic car companies accounted for ninety percent of the market; they now account for sixty percent, and their products have changed significantly. Large station wagons, once ubiquitous on suburban streets, virtually disappeared around 1980; minivans emerged as a new vehicle class soon after; sport utility vehicles increased their share from near zero in the early '90s to almost twenty percent in 2002; and in the early years of this century, a variety of crossover car-truck models was launched. Regulations seem to have played only a minor role in market shifts.

We found only two instances when regulations altered the mix of vehicles. The first was in the late 1970s and early '80s. Subcompact and compact cars increased from one-fourth of all cars in 1970 to almost half in 1981. During this period, stringent emission and fuel economy standards came into effect. But at the same time fuel prices more than quadrupled and were expected to continue increasing. Fuel economy standards and large fuel price increases played important synergistic roles in the shift to smaller cars, but we found no evidence that aggressive new emission standards had an effect.

The second time regulations affected vehicle mix was the transition away from cars in the 1980s and '90s. In 1980, cars accounted for eighty percent of light duty vehicles; by 2001 the share was less than fifty percent, the remainder being light trucks. In 1980 most light trucks were pickups; by 2001, SUVs were the largest light truck category, accounting for twenty percent of all light duty sales. Regulations played some role in this shift, though no rigorous analysis has been conducted. Emission and safety standards were less stringent for light trucks than for cars throughout this period, and perhaps played some role in encouraging a shift to light trucks. But the more important effect

FIGURE 4 Change in vehicle price vs. change in emission control costs, US, 1971–84



Source: Chen et al, 2004

was corporate average fuel economy (CAFE) standards. Lenient CAFE standards for light trucks, along with dropping fuel prices, encouraged manufacturers to emphasize minivans in the 1980s and then SUVs in the 1990s.

In any case, other policy and market factors played an even stronger role in the emergence of light duty trucks. Perhaps the strongest of these other factors was the huge profitability of SUVs in the 1990s. SUVs and large pick-up trucks were far more profitable during this era than cars, an outcome of industry dynamics and protectionist policy (as well as emission, energy, and safety standards). Japanese and European automakers did not have large markets for light trucks in their home countries and thus were slow to enter this market, and protectionist US policies aimed at light truck imports further inhibited them.

These two cases highlight the rare but influential cases where government regulations and related policies have impacted the mix of offerings by automakers. It is instructive to note that in each case, government regulations and policies were operating in unison with changes in fuel prices. During the shift to small cars, fuel prices were soaring. During the shift to light trucks, fuel prices were dropping.

How Industry Responds

Another way to look at regulation-induced costs is from the automaker's perspective. During the past forty years, three high-cost technologies were introduced as a direct result of regulatory requirements: oxidation catalysts around 1975, three-way catalysts around 1981, and air bags in the 1990s. In none of these cases, nor any other, did automakers experience large cost shocks.

Even during those times when large new emission and safety costs were imposed, as when catalytic converters and air bags were introduced, prices for particular models and even vehicle classes fluctuated both up and down—with little relationship to the new regulation-induced costs (see Figure 4).

Consider, for instance, that in only a few years over the past 35 have increases in emission costs exceeded the change in vehicle price. The response of automakers in 1975 and 1980–'81 is instructive, since this is when emission control costs increased most sharply—$300 to $500 per vehicle in a single year. Figure 4 compares emission costs to vehicle price for these periods. Despite the cost shocks, in both of these time periods, vehicle prices increased considerably more than emission control costs. In general, in most years, the effects of emission standards on ➢

vehicle prices cannot be detected. More broadly, we found that the imposition of emissions and safety standards had little effect on vehicle prices.

Prices ≠ Costs

One of the most important insights we gained in studying industry behavior is that the relationship between pricing and costs is quite complex. Many considerations factor into pricing, in addition to cost. These include image, where some models have exceptional image appeal or provide a halo for the company. While most discussions of regulation impacts have focused on production costs, price is also influenced by legacy costs, market share concerns, and vehicle image. Regulation costs turn out to be a small consideration in this mix of variables, and one faced equally among manufacturers. In 2000, a fully loaded Lincoln Navigator was estimated to earn as much as $15,000 profit per vehicle. A single factory, where the large Ford Expedition and Navigator SUVs were assembled, generated $2.4 billion in after-tax profits in 1998, one third of the company's entire profit for the year. Similarly, while it cost Ford about the same amount to build their Taurus sedan as their full-sized pickup, they priced the pickup $5000 higher. Sometimes vehicles are priced lower, for instance to lure new buyers to entry-level vehicles in the hope they will become loyal to the brand and later buy more profitable models. High-fuel-economy vehicles are often priced lower as well, to allow the company to sell more high-profit, gas-guzzling luxury cars and still meet CAFE standards.

Legacy costs also affect pricing. The historical US companies—General Motors, Ford, and Chrysler—have many older manufacturing plants, longstanding labor contracts, and large numbers of retirees. They are burdened by the high cost of health insurance and pensions for these many retirees, find it difficult to dispose of outdated facilities, and are limited by labor contracts that require them to continue paying laid-off workers. As a result, these three companies have a large incentive to maintain their market share, and they price their product accordingly—that is, low enough to ensure high sales. The large incentives to buyers of new vehicles—averaging over $3000 in recent years for the Detroit companies—is largely a result of this legacy.

In summary, *vehicle pricing is only loosely connected to costs*. Automakers are constantly readjusting their vehicle mix, vehicle options, pricing, and financing incentives in response to a variety of market and external conditions. As a general principle, automakers try to recover costs as quickly as possible. But in the end, the cost of complying with regulations appears to play a minor role in the automotive business.

How Consumers Respond

The mantra for automakers is that consumers rule; but little is understood about consumer demand for environmental attributes of vehicles. Surveys show strong citizen support for policy to control air pollution, but how might citizen concern for air pollution evolve into consumer demand for cleaner vehicles? And how might even more abstract environmental and energy concerns—for energy security and climate change—evolve into stronger buyer demand? The conventional wisdom is that consumers have not and will not pay extra for environmental benefits. But the answers are entangled in deeper values related to consumer sovereignty, collective choice behavior, and concern for environmental quality that varies across regions, social groups, and even nations. These values, beliefs, and behaviors are not well understood.

The analytical difficulty is that vehicle buyers have rarely been offered the choice between products differentiated *only* by levels of performance on environmental measures. During the

massive switch to unleaded gasoline in the 1970s, for example, most consumers could not choose which new car or truck to buy based on their "preference" for leaded fuel or the effectiveness and maintenance cost of their car's emission system. If they preferred leaded gasoline, their only choice was not to buy a new vehicle.

In other cases, distinct environmental attributes, such as low emissions, were simply never marketed, even in the case of cars versus light trucks. For over thirty years, no one—not federal or state governments, not environmental advocacy groups, and certainly not motor vehicle manufacturers—sought to actively market cars and trucks to the public based on the fact that light-duty trucks were allowed to pollute more than cars. (Rules now require all light duty vehicles in California to meet the same standards, with similar national rules to take effect soon.)

Initial evidence from the hybrid vehicle phenomenon suggests that a large proportion of buyers are attracted by the overall package of fuel efficiency, low emissions, and advanced technology. Many hybrid vehicle buyers have zeroed in on the hybrid vehicles without much thought about other options, scarcely considering other vehicles—which explains why so many Prius buyers are willing to wait several months for delivery. They have ignored other comparable vehicles with good gas mileage such as the Toyota Echo and Corolla. In household interviews, these buyers talk as much about social change as they do the vehicle. In their minds, they are buying a stake in a better future and contributing to social change. To what extent might the advent of hybrid vehicles, in many ways the first opportunity to buy an attractive "environmental vehicle," trigger a shift in buyer behavior and attitudes toward environmental attributes?

Lessons Learned

Regulations to improve vehicle safety and environmental and energy performance do impose additional costs, but these costs are neither permanent nor cumulative. As with any new product or technology, with time and experience engineers learn to design products to consume less space and materials, perform more efficiently, and simplify manufacturing. This has been the experience with semiconductors, computers, cell phones, DVD players, and microwave ovens, as well as catalytic converters and airbags—and will certainly be so with future technologies such as fuel cells.

Negotiations between government agencies and automakers resulted, even in the most extreme cases, in companies being able to accommodate new requirements within the normal routine of business.

Tightened emission and fuel economy standards had an important secondary effect: they motivated development of an impressive array of new and improved technologies with multiple benefits—from electronic controls to sensors and better batteries. Indeed, a strong case can be made that adoption of aggressive emissions, energy, and safety requirements in the 1970s aided the domestic auto industry by forcing it to innovate earlier than it would have otherwise, giving it time to respond to newly competitive foreign car makers.

Conclusions

The era of vehicle regulation is short, but rich in experience. Government regulations in California, the US, and elsewhere have played a large role in the evolution of vehicle technology. Vehicles are now much safer and lower emitting, and they consume less fuel than several decades ago.

Given the large role of regulations and the prominence of public debates over vehicle regulation, it is remarkable how little the automotive industry was disrupted—largely a testament to the ingenuity and talent of automotive engineers.

The few exceptions and their relatively modest perturbations perhaps prove the rule. The two most prominent disruptions relate to stringent emission and fuel economy standards in the 1970s. One effect was to give expanding Japanese automakers the opening to crack the US market more quickly than they would have otherwise. Of course the standards also prodded Detroit automakers to move from their oligopolistic and relatively lethargic behavior of the 1960s and become more innovative. The other major effect was the shift to light trucks, minivans, and SUVs, encouraged by the less stringent CAFE, safety, and emission standards applied to light trucks.

One explanation for the modest effect on markets and industry structure is that other factors—rising and falling fuel prices, increasing competition from Japanese and European automakers, increasing affluence, and shifting consumer desires—swamped regulatory effects. Consider, for instance, that vehicle prices increased much faster over the past decades than did costs associated with regulations, reflecting considerable improvements in vehicle quality and performance.

The other explanation for the modest effect of regulation is that automotive companies have evolved a sophisticated array of advertising, marketing, financing, and pricing tools. Automakers use these marketing and financing tools to adjust to changes, whether imposed by government or external market conditions. And finally, in the long term, they draw on their robust R&D capabilities to innovate their way through ➢

regulatory challenges—building vehicles that are more durable, reliable, safer, and environmentally benign.

The challenge for government regulators as they formulate new regulatory initiatives is to find that tension point where technological challenges are not disruptive. Easier said than done, though it has been accomplished to date with pollution and safety regulation. The new and perhaps more imposing challenge—especially in a political sense—is greenhouse gas emissions.

The past is a guide to the future, not a predictor. In the past, automotive markets and the automotive industry may not have been perturbed because the companies were all so large and integrated, and the barriers to entry so great. Will the industry of the future remain dominated by six to ten large, fully integrated, hundred-billion-dollar-plus behemoths? There is some evidence that the automotive industry of the future will be more fragmented, with more models, more personalizing of vehicles, and a shift away from massive assembly plants to smaller plants that assemble modules built by suppliers. More speculatively, there may also be a trend toward local mobility companies that lease and manage vehicles provided to users. If the industry does become more fragmented, then the standard technology-forcing regulatory processes of the past could indeed have a chilling effect. Or not. In any case, regulators should remain observant in monitoring industry and market changes to determine if different approaches are warranted.

So far, though, our overall findings are that regulatory actions have not distorted or perturbed automotive markets and industry structure much over the last few decades. ◆

This article is based on a set of reports commissioned by the California Air Resources Board as background for designing greenhouse gas emission standards for vehicles as required by California law AB 1493.

FURTHER READING

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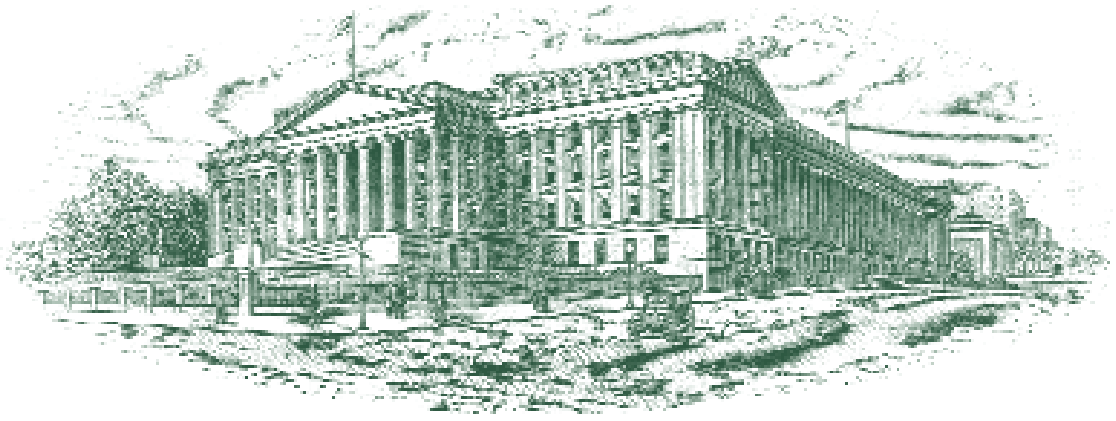
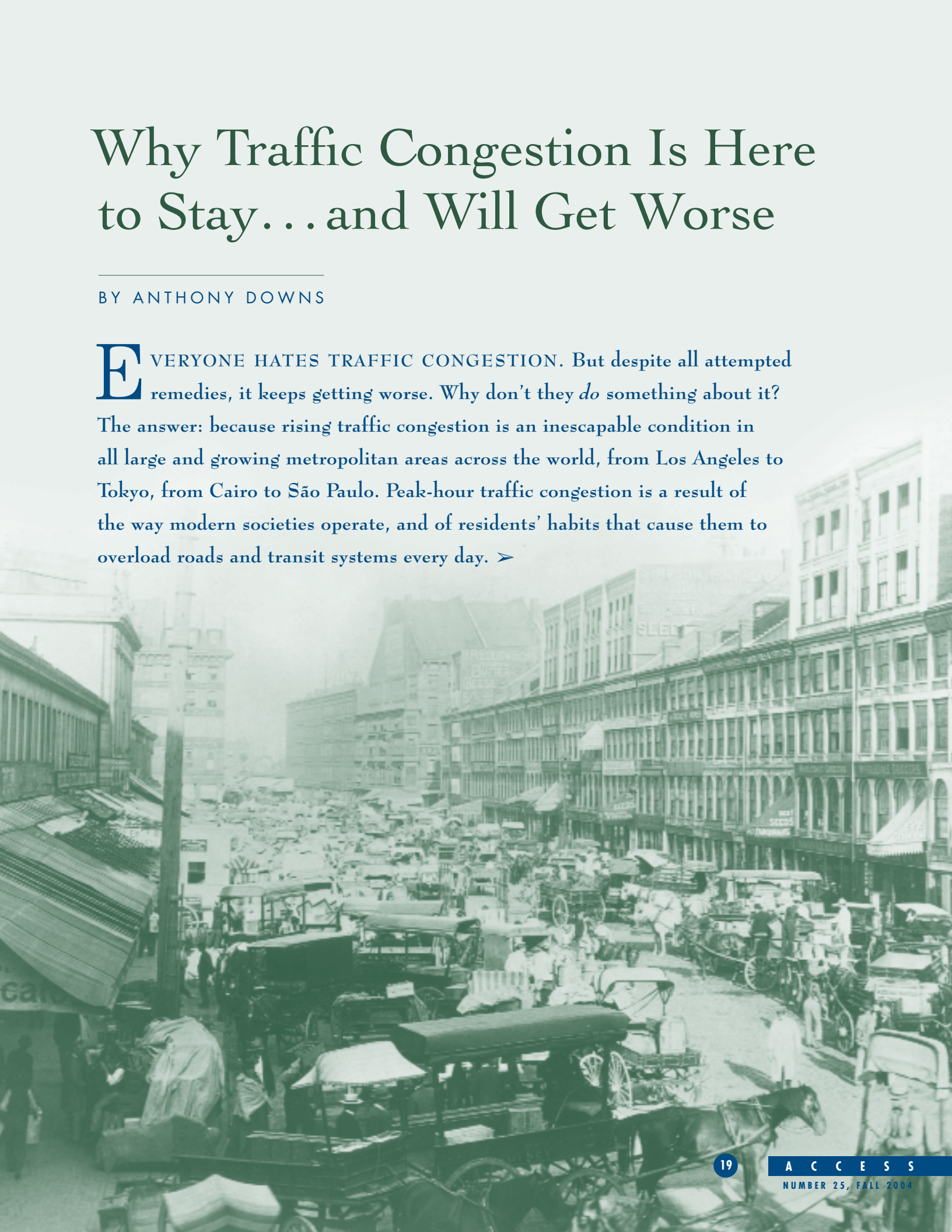


Why Traffic Congestion Is Here to Stay. . . and Will Get Worse

BY ANTHONY DOWNS

EVERYONE HATES TRAFFIC CONGESTION. But despite all attempted remedies, it keeps getting worse. Why don't they *do* something about it? The answer: because rising traffic congestion is an inescapable condition in all large and growing metropolitan areas across the world, from Los Angeles to Tokyo, from Cairo to São Paulo. Peak-hour traffic congestion is a result of the way modern societies operate, and of residents' habits that cause them to overload roads and transit systems every day. ➢



Traffic congestion is not essentially a problem. It's the solution to our basic mobility problem, which is that too many people want to move at the same times each day. Efficient operation of the economy and our school systems requires that people go to work, go to school, and run errands during about the same hours so they can interact with each other. We cannot alter that basic requirement without crippling our economy and society. This problem marks every major metropolitan area in the world.

In the United States, the vast majority of people wanting to move during rush hours use private vehicles, for two reasons. One is that most Americans reside in low-density settlements that public transit cannot serve effectively. Second, for most people private vehicles are more comfortable, faster, more private, more convenient in trip timing, and more flexible than public transit. Therefore, around the world, as household incomes rise, more and more people shift from less expensive public modes to privately owned cars and trucks.

With 87.9 percent of America's daily commuters using private vehicles, and millions wanting to move at the same times of day, our basic mobility problem is this: the road system does not have enough capacity to handle peak-hour loads without forcing people to wait in line for limited road space. "Waiting in line" is the definition of congestion.

There are four possible ways any region can confront this challenge. However, three of them are politically infeasible or physically or financially impossible in the US. These four ways to reduce traffic congestion are:

1. Charge peak-hour tolls. Congestion would plummet if people had to pay to enter major commuting roads during peak hours. If tolls were set high enough and collected electronically with "smart cards," the number of vehicles could be reduced to the point that everyone could move at high speed. That would allow more people to travel per lane per hour than do now under heavily congested conditions. That's why transportation economists have long recommended this tactic.

Many Americans would reject the peak-hour tolls solution, for two reasons. Using such tolls would seem to favor wealthier or subsidized drivers and to harm poor ones. The former could travel whenever they wanted to, but many of the latter would be forced off main roads during peak hours. Therefore, many Americans would resent such tolls out of the belief that they would be disadvantaged by them.

The second drawback is that people think of such tolls as "just another tax," believing that gasoline taxes already pay for roads. For both these reasons, few politicians advocate tolls. The limited road-pricing schemes that have been adopted in Singapore, Oslo, and London affect congestion only in crowded downtowns, which is not the kind of congestion most Americans experience.

2. Greatly expand road capacity. The second approach to reducing congestion is to build enough additional road capacity to simultaneously accommodate all drivers who

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want to travel at peak hours. But this "cure" is totally impractical and prohibitively expensive. We would have to turn much of every metropolitan region into a giant concrete slab, and the resulting huge roads would be grossly underutilized in noncommuting hours. Although there are many occasions when adding more road capacity is a good idea, no large region can afford to build enough to completely eliminate peak-hour congestion.

3. Greatly expand public transit capacity. The third approach is to expand public transit capacity enough to shift so many people from cars to transit that there would be no more excess demand for roads during peak hours. A major reason this approach isn't feasible is that a very small percentage of commuters today use transit. Even if the nation's existing transit capacity were increased fourfold *and* fully utilized, morning peak-hour transit travel would rise only to 11 percent of all morning trips. That would reduce private vehicle trips by only 8.8 percent—hardly enough to end congestion. Moreover, such a quadrupling of transit capacity would be extremely costly.

4. Live with congestion. There is only one feasible way to accommodate excess demand for roads during peak periods: by having people wait in line, or in other words, by accepting traffic congestion. Congestion is an essential mechanism for coping with excess demand for road space. We need it! Peak-hour congestion is the balancing mechanism that makes it possible for Americans to pursue goals they value, such as working while others do, living in low-density settlements, and having many choices of places to live and work. ➢

Traffic congestion is not essentially a problem. It's the solution to our basic mobility problem.

Triple Convergence

The least understood aspect of peak-hour traffic congestion is the Principle of Triple Convergence. It works because traffic flows in any region's overall transportation networks almost automatically form self-adjusting relationships among different routes, times, and modes. Triple Convergence is the complex process of adaptation through which the various sectors of the metropolitan system adapt to changes in other sectors—specifically to changes in locations, times, and modes of travel.

The Principle of Triple Convergence is best explained by a hypothetical example. Visualize a major commuting freeway so heavily congested each morning that traffic crawls for at least thirty minutes. If that freeway were magically doubled in capacity overnight, the next day traffic would flow rapidly because the same number of drivers would have twice as much road space.

But very soon word would get around that this road was uncongested. Drivers who had formerly traveled before or after the peak hour to avoid congestion would shift back into that peak period. Drivers who had been using alternative routes would shift onto this now convenient freeway. Some commuters who had been using transit would start driving on this road during peak periods.

Within a short time, this triple convergence upon the expanded road during peak hours would make the road as congested as before its expansion. Experience shows that peak-hour congestion *cannot* be eliminated for long on a congested road by expanding that road's capacity if it's part of a larger transportation network.

The Principle of Triple Convergence does not mean that expanding a congested road's capacity has no benefits. After expansion, the road can carry more vehicles per hour than before, no matter how congested it is, so more people can travel on it at one time. Also, the periods of maximum congestion may be shorter, and congestion on other routes may be less.

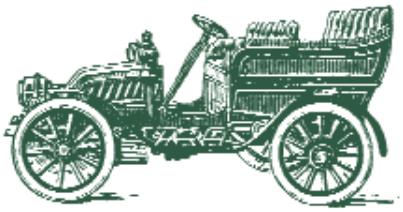
This principle greatly affects how other congestion remedies to traffic congestion will work in practice. One example is staggered work hours. In theory, if a certain number of workers are able to commute during less crowded parts of the day, it will free up space on congested roads. But once traffic moves faster, other drivers from other routes, other times, and other modes will shift onto the improved roads during peak hours.

The same thing will happen if more workers become telecommuters and work at home, or if public transit capacity is expanded on routes paralleling a congested freeway. This is why building light rail systems or subways rarely reduces peak-hour traffic congestion. Such congestion did not decline for long in Portland, where the light rail system doubled in size in the 1990s, or in Dallas, where a new such system opened. Only road pricing or higher gasoline taxes are exempt from the principle of triple convergence.

A ground transportation system's equilibrium can also be affected by big changes in the region's population or economic activity. If a region's population is growing rapidly, as in Southern California or Florida, any expansions of major freeway capacity may soon be swamped by more vehicles generated by the added population.

Shifts in economic activity also affect regional congestion. During the Internet and telecom boom of the late 1990s, congestion in the San Francisco Bay Area intensified immensely. After the "bubble" burst in 2000, congestion fell markedly without any major change in population. Thus, severe congestion can be a sign of strong regional prosperity, just as reduced congestion can signal an economic downturn.

Why has congestion increased almost everywhere?



The most obvious reason is population growth. More people mean more vehicles. But total vehicle mileage has grown much faster than population, in part because a combination of declining real gas prices (corrected for inflation) and more miles per gallon caused the real cost of each mile driven to fall 54 percent from 1980 to 2000! That helped raise the percentage of US households owning cars from 86 percent in 1983 to 92 percent in 1995.

Furthermore, American road building lagged far behind increases in vehicle travel. Urban lane-miles rose by 37 percent vs. an 80 percent increase in vehicle miles traveled.

Another crucial factor contributing to more traffic congestion is the desire of most Americans to live in low-density settlements. Past studies have shown that public transit works best where (1) gross residential densities are above 4,200 persons per square mile, (2) relatively dense housing is clustered close to transit stations or stops, and (3) many jobs are concentrated in relatively compact districts. But in 2000, at least two thirds of all residents of US urbanized areas resided in settlements with densities of under 4,000 persons per square mile. Those densities are too low for public transit to be effective. Hence their residents are compelled to rely on private vehicles for almost all of their travel, including trips during peak hours.

Can Anything Be Done to Slow Future Increases in Traffic Congestion?

The best way to answer that question is to examine the major remedies that are often proposed. Here are eleven possible solutions:

1. Build more roads. Highway advocates claim we need to build more roads and expand many existing ones, but opponents say we cannot build our way out of congestion because more highway capacity will simply attract more travelers. Triple Convergence shows this is true for already-overcrowded roads. But large projected population growth means that we will need a lot more lane miles just to cope in growth areas. However, building roads will not eliminate current congestion, nor prevent it from arising on new roads.

2. Use peak-hour road pricing. This tactic is not politically feasible if we try to put tolls on all major commuter lanes. But so-called HOT lanes (High Occupancy Toll) can increase traveler choices by adding some new toll lanes to existing freeways while leaving current lanes free of charge. This allows anyone who needs to move fast on any given day to do so, without forcing all low-income drivers off the highways during peak periods. But HOT lanes will work only if accompanying lanes remain congested. So HOT lanes do not eliminate congestion; they merely increase movement choices for drivers.

3. Use ramp-metering, allowing vehicles to enter freeways only gradually. This has improved freeway speed during peak hours in Seattle and the Twin Cities, for example, and could be much more widely used.

4. Use intelligent transportation devices to speed traffic flows. Technologies such as electronic coordination of signal lights on local streets, variable signs about traffic conditions, one-way street patterns, Global Positioning Systems in cars and trucks, and radio broadcasts of current road conditions already exist and can be effective tools on local streets, arteries, and freeways. But they will not end congestion. ➢

5. Create more HOV lanes. High Occupancy Vehicle lanes have proven successful in many areas such as Houston. More regions could use HOV lanes effectively, if they add lanes rather than convert existing ones to HOV use, which only reduces the road's capacity.

6. Respond more rapidly to accidents and incidents. Roving service vehicles guided by television and electronic surveillance of road conditions can help reduce congestion delays.

7. Adopt "parking cash-out" programs. Demonstration programs have shown that if firms offer to pay people a stipend for shifting to carpools or transit, significant percentages will do so, thus reducing the number of cars on the road. However, this tactic does not prevent the offsetting consequences of triple convergence.

8. Restrict the outward movement of new development. Urban growth boundaries that severely constrain far-out development may reduce total driving at the edges of a region. However, it takes very large percentage increases in peripheral densities to cause significant declines in regional average driving distances. Moreover, shorter driving distances may not reduce congestion because higher densities concentrate more vehicles in smaller areas. Also, constraining outward movement of growth might cause housing prices to rise sharply, penalizing renters and prospective new home buyers.

9. Require higher densities in both new and established areas. Proposing to raise densities in existing neighborhoods will arouse opposition from current residents. Most suburban governments are politically dominated by homeowning voters who do not want changes they suspect might reduce the market values of their homes, and they usually oppose more multi-family housing and higher-density single-family units.

Few US regions have succeeded in notably raising densities. The Portland, Oregon, region has had the nation's most stringent urban growth boundary for over twenty years, plus rapid population growth. Yet in 2000, its urbanized area had a relatively low density of 3,340 persons per square mile.

10. Cluster high-density housing around transit stops. Transit-Oriented Developments (TODs) permit more residents to commute by walking to transit, thereby decreasing the number of private vehicles on the roads. A detailed analysis of how many TODs would be necessary to shift a significant percentage of auto commuters to transit shows that (1) the number within each region would have to be very large, (2) the residential density within each would have to be several times greater than the average central city density in the fifty largest urbanized areas in 2000, and (3) the percentage of workers living in the TODs who commute by transit would have to be at least triple the 10.5 percent average for central cities in 2000. Moreover, the shift of TOD residents from private vehicles to transit would soon be offset by the Principle of Triple Convergence.

11. Give regional transportation authorities more power. Congress has sponsored Metropolitan Planning Organizations to coordinate ground transportation planning over all modes in each region. If MPOs had more technical assistance and power, more rational systems could be created.

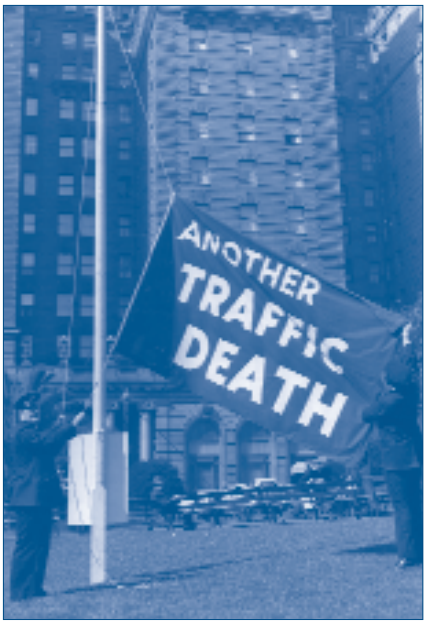
Conclusions

Peak-hour traffic congestion in almost all large and growing metropolitan regions around the world is here to stay. Indeed, it is almost certain to get worse during at least the next few decades, mainly because of rising populations and wealth. This will be true no matter what public and private policies are adopted to combat congestion.

This outcome should not be regarded as a mark of social failure or wrong policies. In fact, traffic congestion reflects economic prosperity. People congregate in large numbers in those places where they most want to be.

The conclusion that traffic congestion is inevitable does not mean it must grow unchecked. Several policies described here—especially if used in concert—could effectively slow congestion's growth. But, aside from disastrous wars or other catastrophes, nothing can eliminate traffic congestion from large metropolitan regions here and around the world. Only serious recessions—which are hardly desirable—can even forestall its increasing.

So my advice to traffic-plagued commuters is: relax and get used it. Get a comfortable air-conditioned vehicle with a stereo system, a tape deck and CD player, a hands-free telephone, perhaps even a microwave oven, and commute daily with someone you really like. Learn to make congestion part of your everyday leisure time, because it is going to be your commuting companion for the foreseeable future. ◆



Further Reading

Anthony Downs. *Still Stuck in Traffic.* (Washington D.C.: Brookings Institution) 2004.

THE GAP BETWEEN needed highway-construction funds and gasoline-tax revenues threatens to widen further. Hybrid vehicles are a reality; alternative fuels are on the horizon; and the gasoline tax—long the workhorse of highway finance in the United States—will inevitably decline in importance. So the search is on for new funds. Can the private sector help fill the gap?

Only a few privately financed highways have been built in the US in the past half century. Among them, California's State Route 91 (SR 91) in Orange County stands out as one of the mature examples. It began as something of a public policy long shot. In 1989, when state legislators debated a bill to allow a limited number of private highway franchises, even the bill's supporters doubted it had a real chance of passage.

THE PRIVATE SECTOR'S ROLE IN HIGHWAY FINANCE:

LESSONS FROM SR 91

BY MARLON G. BOARNET AND JOSEPH F. DIMENTO

The Democrat-controlled state legislature favored expanding the gasoline tax instead. A transportation summit that convened leaders from both parties in the legislative and executive branches settled on a compromise that included a nine-cent gas-tax increase and allowed up to four private highway demonstration projects.

Rather than designate specific projects or routes as potential private franchises, the legislation encouraged private enterprisers to be innovative. Profits from the franchises would be capped at predetermined rates of return, but otherwise private entities were to enjoy broad leeway to locate, finance, and operate their roads as they saw fit. Toll rates, in particular, were not regulated except as would be required by limits on the rate of return. Private highway projects had to conform to the usual elements of state law that pertained to public highways, such as environmental clearance, but otherwise the private sector was allowed latitude to innovate in project specification, design, financing, and operation.

SR 91 surfaced early as a prime candidate for private franchising. The Orange County Transportation Authority (OCTA) had planned to build high-occupancy vehicle

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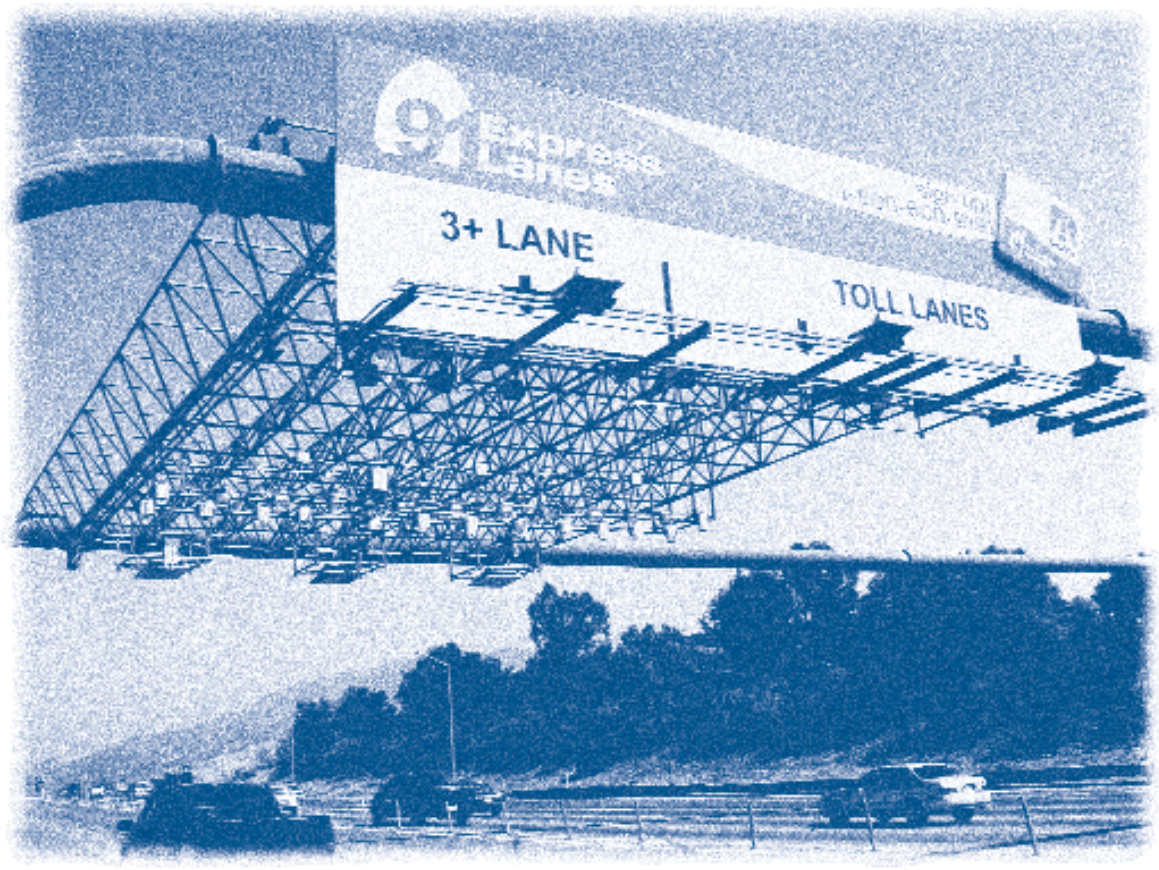
lanes (carpool or HOV lanes) in the median of the existing highway connecting the fast-growing suburbs of Riverside County to job centers in Orange County. But funds for the project were not available from traditional public-sector sources, so Orange County transportation officials were receptive to private-sector interest in the project. The California Private Transportation Company (CPTC), a limited partnership formed by subsidiaries of several corporations involved in highway construction, proposed private toll lanes for the median of SR 91. A 35-year franchise was approved in 1990, and the privately owned facility opened on December 27, 1995. The ten-mile-long toll lanes paralleled the most heavily congested portion of the approximately thirty-mile-long corridor from Riverside into northern Orange County.



The SR 91 toll lanes were innovative in several respects. They were the first US implementation of peak/off-peak road pricing (often called congestion pricing). The lanes have no toll booths; all tolls are collected electronically. While detailed financial information on the privately held CPTC has not been released to the public, experts generally agree that toll revenues likely met the private firm's expectations. In the third year of operation (1998), the CPTC's annual report noted that toll revenues covered all operating costs and all debt service except a subordinated loan which did not have to be paid in the near-term and which was less than ten percent of the project cost. ➢

Shifting Public Perception

In the first few years after SR 91 opened, the lanes were viewed by many as a net public benefit. Early public opinion polls showed a majority of SR 91 drivers supported the peak/off-peak pricing scheme. A study conducted by Edward Sullivan at California Polytechnic State University in San Luis Obispo showed dramatic reductions in peak-period travel times. Travel time for the eastbound afternoon peak trip on an 18-mile portion of SR 91 that included the toll lane corridor dropped from seventy minutes in June 1995 to just under thirty minutes in June 1996. Also, average peak-period travel speeds on the eastbound free lanes more than doubled as traffic diverted to the toll lanes.

Yet by the late 1990s the public mood regarding the toll road had shifted. The franchise agreement contained a "non-compete" clause that forbade public agencies from increasing highway capacity within a one-and-a-half-mile-wide corridor on either side of the toll lanes for the life of the franchise agreement. During franchise negotiations in 1990, the non-compete area was considered essential to providing CPTC some assurance that their investment would not be subject to unanticipated competition from future free highway projects. Such non-compete clauses were part of most discussions and much received wisdom about highway franchising at the time. In the late 1990s, the California Department of Transportation (Caltrans) wanted to add merging lanes between the free

lanes on SR 91 and the newly completed Eastern Transportation Corridor, a separate toll road built by a public agency. Caltrans justified the need for the new lanes based in part on accident rates and a wish to improve safety. According to the franchise agreement, safety concerns could override the non-compete provision. Yet Caltrans' safety analysis was disputed, and the safety claims and competing public and private interests were hotly debated. In the course of that debate public opinion turned against the toll lanes. What had once been viewed as a source of needed congestion relief was now viewed by many as contributing to congestion or, worse, unsafe conditions.

The debate was resolved when OCTA purchased the toll lanes from CPTC in early 2003 (for $207.5 million dollars). The lanes are now operated by OCTA, which still charges peak/off-peak tolls. But the non-compete clause was eliminated, and the issue of public mobility competing with private profit-making interests has receded. What had been one of the nation's most visible examples of a privately owned toll road is now owned and operated by a public agency.

Lessons for Private Highway Finance

The SR 91 experience, seen in the context of a decade of highway privatization worldwide, provides at least four lessons for transportation agencies looking for alternative sources of highway finance.

1. Private-sector funding may work, but only as part of a public-private highway financing partnership. SR 91 was possibly a best-case option for wholly owned private franchising. The corridor cuts through a canyon in the Santa Ana Mountains, and there are few if any good alternative routes between Riverside and Orange County. Traffic demand was high and congestion was severe. Because the lanes were built in the median of a public highway, right-of-way was owned by OCTA and could be leased to CPTC. (The lease price for the right-of-way was a dollar a year.) OCTA had obtained environmental clearance for carpool lanes before franchising discussions began, so at the outset the project had already cleared environmental approval hurdles, typically a source of substantial uncertainty in highway projects. The combination of high travel demand in a congested urban area with low right-of-way costs and minimal difficulties with environmental clearance is unlikely to happen in other projects. Most experts believe that other projects might face high right-of-way costs, uncertainty of public or environmental approval, and uncertainties of travel demand that would preclude an acceptable rate of return.

Instead of imagining that private financing will substitute for public financing, transportation officials should view private involvement as a supplemental source of investment. In such circumstances, public and private investment would be combined. Merged funds can narrow the gap for projects that are too expensive to build with limited public funds, but that are also too expensive or too risky for private investors. Sharing risk and reward between the public and private sectors will be complex, and balancing public and private interests will be more difficult than in purely private franchises. Yet the future of private involvement in highway finance in the United States almost certainly will be in the context of public-private partnerships, rather than in wholly private highway franchises.

2. Balancing public and private interests will be fundamental. The SR 91 franchise was eventually undone by conflicts between public- and private-sector interests. Such conflicts are probably inevitable, and transportation officials must become adept at ➢

It is important to define what happens when unanticipated circumstances cause one of the parties to question the original agreement.

Sharing risk and reward between the public and private sectors will be complex.

balancing competing public and private interests. Yet such conflicts will be difficult to predict fully in advance.

The SR 91 franchise, when granted in 1990, had a 35-year term, typical of private toll road franchises. It is difficult to anticipate urban growth patterns, changing travel demand, shifting political winds, and technology changes over such a time period. While understanding future possibilities at the time of the initial franchise agreement is desirable, it is even more important to define what happens when unanticipated circumstances cause either the private participant or the public sector to question the continuing wisdom of the original agreement. In short, public-private franchise agreements should contain within them the terms of the contract's "undoing" should such undoing become necessary.

One lesson is that strict non-compete clauses are too inflexible to balance public and private interests over a span of decades. Instead, public-private highway agreements must articulate methods for balancing competing and evolving interests. One tool that can help, but that has been rarely if ever used in the US highway sector, is least-present-value of revenue (LPVR) franchise bidding. The LPVR concept was developed through research conducted by Eduardo Engel, Ronald Fischer, and Alexander Galetovic. The idea is that highway franchises can be auctioned by allowing private entities to bid on the present value of the toll revenue stream they would collect over the life of the project. The bidder proposing the lowest present value of toll revenues, or LPVR, wins the franchise. The LPVR becomes, in effect, an estimate of the value of the franchise. If the parties wish to end the franchise, the LPVR provides a benchmark assessment of the fair value to the private entity. While we do not suggest that LPVR auctions be adopted in exactly that fashion in the US, the benefit of assessing franchise value at an initial stage can be useful should contract renegotiation become necessary. Public-private highway franchise agreements can adopt both LPVR methods and more general institutional designs that provide a basis for negotiating the end to or major modification of agreements if circumstances require that.

3. The public sector must be institutionally strong. Some assume that private sector involvement can compensate for a weak public sector. In highway finance, nothing could be further from the truth. The complicated nature of public-private highway partnerships requires a well-trained, well-staffed, institutionally strong public-sector partner. Transportation agency employees will need new skills to be able to partner with private entities in complex highway finance projects. This includes skills in project finance, not traditionally at the forefront of the "pay-as-you-go" financing philosophy that has characterized the gasoline-tax era. Institutional design will also require careful thought. Several rules of thumb adapted from other regulatory environments should be examined. These include shielding regulators from direct political pressure, providing buffers that reduce the risk of industry capture, and balancing the need for commitment with the need for flexibility in the face of changing circumstances. The regulatory environment for public-private highway partnerships will be complex, and transportation agencies will have to learn from other fields, such as electricity and telecommunications, where similar complexities have been more common.

4. High-occupancy vehicle lanes (carpool lanes) provide an early opportunity to pioneer some public-private highway partnerships. Cash-strapped metropolitan transportation

agencies will increasingly face difficulties funding needed highway projects. Proposed carpool lanes, typically adjacent to unpriced highway lanes, provide an opportunity to involve the private sector. Public cost sharing will often be needed to lower private investment to levels that allow profitability. The publicly provided right-of-way for the SR 91 toll lanes was one form of public cost-sharing. Yet public-sector officials should carefully consider what they get in return for sharing the cost. One benefit public-private partnerships can provide is expensive infrastructure that would not otherwise be viable, especially in urban areas where land and right-of-way are becoming increasingly costly. While such ideas go beyond carpool lanes, unfunded carpool lane proposals on existing public rights-of-way will likely be the first opportunities to explore these new partnerships.

Conclusion

Public-private highway partnerships have much to offer cash-strapped transportation agencies, and SR 91 provides lessons in both opportunities and pitfalls inherent in those projects. Private sector involvement may be of particular interest in periods when public sector economic conditions are uncertain yet growth is rampant. As gasoline tax revenues are increasingly stretched, agencies that innovate will be best able to meet the public's demand for mobility.

Yet public-private highway partnerships will be complex, and transportation officials should be pragmatic while learning from the SR 91 experience. Non-compete clauses such as were used for SR 91 will continue to be controversial, especially in regions where highly motivated voters are forced either to pay the toll or use lanes with poor service even where government can improve service. Private sector involvement also brings the calculation and balancing of costs and benefits into the realm of hard-nosed financial analysis. This does not necessarily mean that environmental and social factors are ignored. Rather, it can mean that they are more rigorously quantified, allowing for better informed decisions on alternatives.

In many urban areas, public funds will prove insufficient for needed transportation improvements. If current highway finance trends continue, some future choices will be between involving the private sector or foregoing needed infrastructure projects. Of course the private sector will only be interested in helping finance highway projects to the extent that there are profit-making opportunities; yet experiences in other countries suggest that private interests are willing to invest in infrastructure. Such investments require difficult decisions about cost sharing and the division of risks and rewards between the public and private sectors.

Are transportation agencies ready to partner with the private sector? Unfortunately, the answer is often "no." Agencies that have been construction managers will have to become regulators in a complex environment. This will require new skills, changes in agency culture, and a willingness to seek practical solutions in an often ideologically charged environment. State transportation departments should nurture officials who are schooled in the complex regulatory, financial, and legal skills that will be needed for public-private highway partnerships. The main lesson from the SR 91 project is that private sector involvement in highway finance is not simple or predictable; nevertheless public officials should plan now for the day when such involvement can provide revenue that would otherwise not be available for needed infrastructure projects. ◆

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Auto Insurance Redlining in the Inner City

BY PAUL ONG

ONE OF THE MOST CONTROVERSIAL issues related to automobile insurance is the accusation of "redlining," or charging higher premiums in low-income, minority neighborhoods. Insurance companies base premiums on accident rates, which are higher in some neighborhoods. However, *why* those neighborhoods experience higher risks may not be part of the equation.

Traffic volumes vary across the urban landscape. Some areas are exposed to disproportionately high levels of externally generated trips. These increase accident frequencies in those areas, exposing local residents to higher-than-average chances of involvement in a crash. Insurance companies compensate for the higher accident rate by charging residents higher insurance premiums.

Figure 2 summarizes traffic-density statistics in three zones in Los Angeles. Citywide averages have a value of 1. The street network downtown is nearly twice as dense as the citywide average, while in the outer ring it is below average. Traffic volume is even more unequally distributed, with downtown having over twice the number of vehicle miles per square mile. Despite higher housing density downtown, the number of vehicles per household is lower than in the inner ring and local residents are less likely to commute longer distances. The outer ring has a lower vehicle density, reflecting the lower housing density. The average commute distance of inner-city residents is only three-quarters the distance of those in the outer ring. The data, then, show that higher traffic levels in downtown are not generated by local residents.

Figure 3 summarizes statistics on accident rates. The dark bars show that the accident rate per vehicle mile increases with traffic density. The odds of an accident occurring per vehicle mile in the downtown area is over one and a half times higher than in

FIGURE 1 Los Angeles city and analysis zones

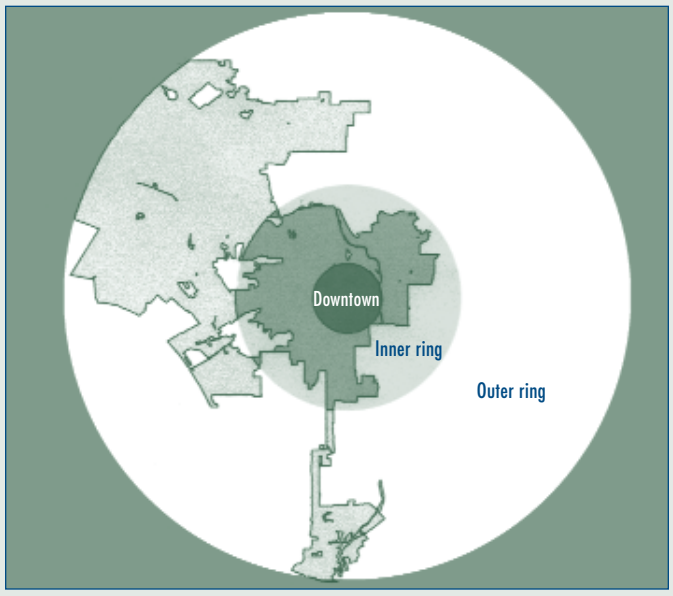
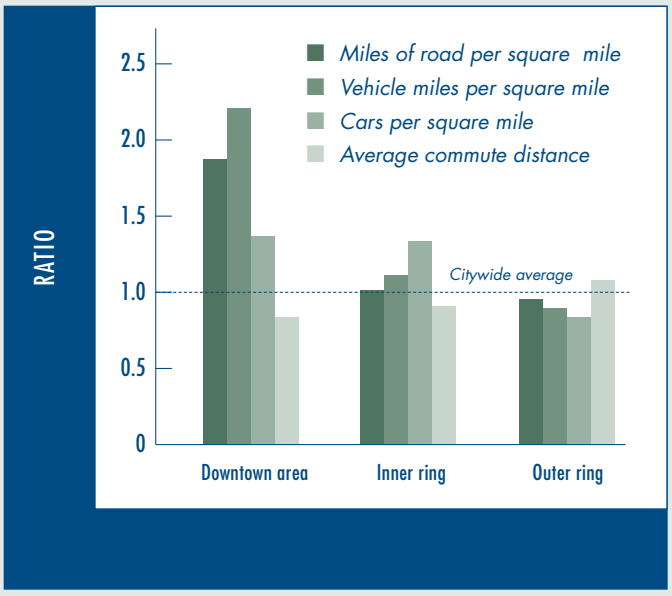


FIGURE 2 Traffic density relative to city average



the outer ring. Traffic density is considerably higher in the downtown area; the number of accidents per square mile is over four times higher than in the outer ring. The geographic disparity in the number of accidents per vehicle by place of residence is nearly as large. The statistics do *not* mean that the number of accidents per neighborhood car is several times higher in the inner city than in the suburbs; accidents may involve local cars or cars from elsewhere. However, the risk of having an accident is higher in the downtown area, and local residents spend a disproportionate amount of their driving time on these streets, so the odds are stacked against them.

Figure 4 summarizes insurance claim rates and premiums as a percent of the citywide average. The bodily-injury claim rates are highest in the inner city and lowest in the outlying suburbs, reflecting the spatial pattern of accident rates. The higher claim rate in downtown is tied to a higher accident rate; in turn, higher insurance premiums are tied to the higher claim rate. This is consistent with the insurance industry's assertion that premiums are based in part on an area's accident rates. Figure 4 quotes insurance premiums for hypothetical individuals with the same coverage and the same driving record; differences reflect variation associated with location only. It may be economically rational for insurance companies to charge according to risk, but this practice imposes a financial burden on even good drivers in the inner city.

One of the societal consequences of the above findings is that disadvantaged people bear a disproportionate share of the economic burden generated by the region's traffic. The disparities in premiums coincide with the socioeconomic geography of Los Angeles, summarized in Figure 5. Low-income, minority neighborhoods are heavily concentrated in the inner city around the downtown area. Insurance premiums are tied to actuary rates, but our analysis reveals that the high accident and claim rates in these neighborhoods are associated with externally generated traffic. These inequalities are embedded in the city's spatial structure and in institutionalized practices. ◆

I am indebted to Hyun-Gun Sung for his assistance in assembling the data.

FIGURE 4 Premium and claim rates relative to city average

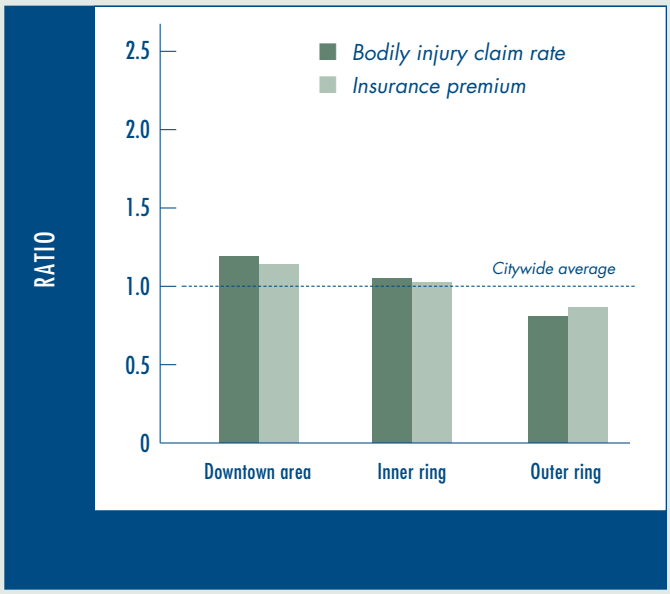


FIGURE 3 Accident rates relative to city average, 1994–2002

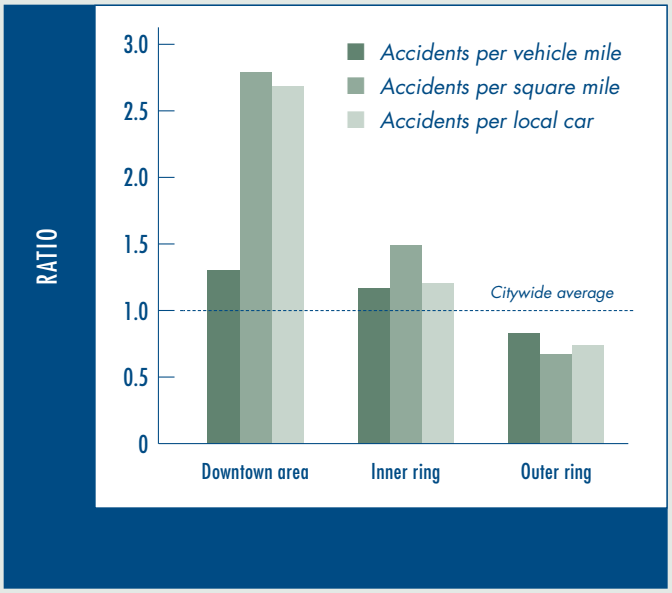
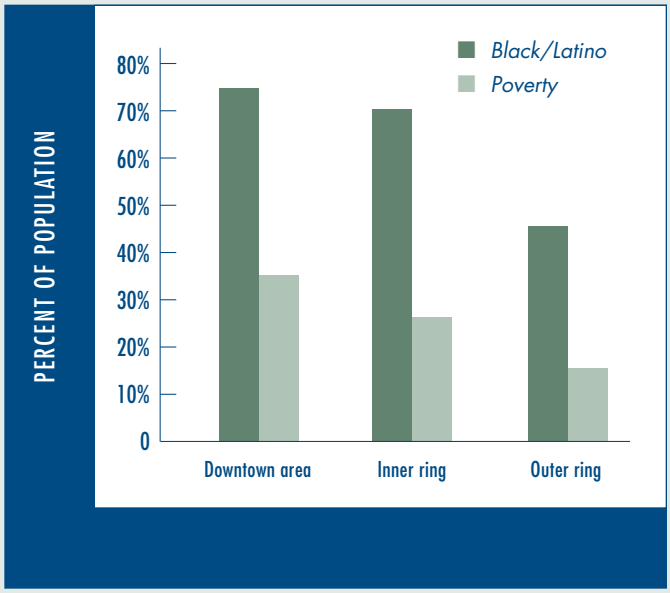


FIGURE 5 Racial distribution and poverty



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