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**Toll Roads:
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Toll Roads: a New Direction for US Highways?

ELIZABETH DEAKIN

A new generation of privately funded toll roads are being constructed in the US, mainly in fast-developing suburban areas. Tolls will only fund part of the cost and it is the supplementary funding and guarantees that make the road feasible. But will toll roads only be built in locations of high demand, not of the greatest need?

Toll financing is emerging as a major means of paying for new highways in the United States. Some 1200 miles (1900 km) of new toll facilities are under study, design, or construction, with some thirty-five projects in seventeen states. While toll roads are not new to the US – a number were constructed in the eighteenth and nineteenth centuries, and those built in the 1940s and 1950s serve today as the major interregional highways in many states – the current crop of projects will add as much toll mileage as the total opened in the previous thirty years (Sandlin, 1989). Furthermore, the new interest in toll roads has led Congress to lift a seventy-year prohibition against the use of federal funds for toll road construction; federally-assisted 'demonstration projects' in several states are now being planned.

Some observers believe the new toll roads are the wave of the future, offering a way out of financing binds facing most highway programmes. In addition, proponents note, toll roads offer a pathway for the introduction of new technologies, including tolling based on automatic vehicle identification and utilizing computerized billing systems. Because such systems would make it possible to implement both congestion pricing and weight-distance

pricing, the toll roads are seen as a route to lasting relief from congestion problems and highway maintenance difficulties.

The new toll roads do incorporate a number of innovations. Whereas the US toll roads of earlier decades were almost all state government initiatives, many of the new projects involve private sector organizations as key players in finance, implementation, and operation. A variety of arrangements sharing responsibilities for the facilities among land developers, state and local government, engineering firms, and financial institutions are being devised. New technologies being implemented on some of the new toll roads will provide for more efficient toll collection (non-stop toll assessment collected via a monthly bill), and possibly will open the way for more sophisticated road pricing.

The toll roads are not without their detractors, however. Some question whether toll facilities make sense in other than very limited circumstances. Others question whether they are equitable, or are conveniences for the well-to-do that leave the transportation troubles of the less favoured unaddressed. When the toll roads are implemented through public-private partnerships, concerns about whether the

public is getting a fair exchange or subsidizing special interests sometimes arise. When toll roads are built through special fast-track procedures that omit environmental reviews and public comment, their broader social acceptability comes under criticism.

The potential of toll roads as a transportation strategy thus is very much a matter deserving further consideration. This paper reviews the new toll road projects and assesses the pros and cons concerning their proliferation. The paper begins with a brief review of US toll road policy, then examines the renewed interest in toll road development. Concerns raised about tolls are examined next, followed by a discussion of possible future directions for toll road policy.

Toll Roads in the US: A Brief History

Tolls were first established in America in Colonial times, to fund early plank roads, and were employed on public facilities as early as the 1780s as a way of raising the funds to keep roads in repair. Toll road construction started a few years later, with the states granting charters or patents to private companies for turnpike construction and operation. By the 1820s thousands of miles of turnpikes had been completed; over 4000 miles (6400 km) of toll roads had been constructed in New York State alone, and another 3000 miles (4800 km) had been built in Pennsylvania. The opening of the Erie Canal in 1825 somewhat reduced traffic on the roads to the interior and ended New York's toll road expansion; but it was the coming of the railroads a few years later that marked the end of the early turnpike era (Crane, 1967). Overextended and under-financed, toll companies abandoned some roads and allowed many others to deteriorate. Eventually, most of the surviving roads were turned over to the public, primarily in corridors where local use was sufficient to justify the roads'

maintenance (which was provided, in most cases, through a combination of property taxes and required upkeep by abutting owners, although tolls did remain on some of the roads).

Another round of toll road development was undertaken in the mid-1800s. Most of these toll roads were built to provide access to rail heads. Recalling the failures of the early turnpikes, and faced with some abuses on the first of the roads built, the states soon required toll operators to maintain minimum operating standards and permit common carriage, and exercised approval over route location and access. Both to improve financial performance and to justify government control some states experimented with the use of a combination of private capital and public bonds (Schaevitz, 1988). Still, the use of tolls was not well regarded – tolls were seen both as anti-populist and inconvenient to collect – and in the period beginning in the 1860s and continuing into the early decades of this century, state and local governments bought up toll roads and converted them to free use. Roads were built or substantially improved mostly in cities, or over short distances connecting one town to its neighbour; general revenues provided the finances. In the countryside, however, the majority of roads were unpaved and rough, and for long distance travel, both passengers and goods moved by railroad.

The automobile changed this pattern. Initially a rich man's novelty, the auto by the end of World War I was fast becoming a middle-class household item, and interest in improved roads grew accordingly. Local road improvements were undertaken to facilitate the new vehicles and were justified as investments that would promote commerce. Financing for rural and intercity roads remained inadequate, however, and pressures mounted for the states to make improvements. Many states did so, expanding their highway programmes and creating roadway classification systems,

state-local improvement plans, and new funding mechanisms (including such innovations as fuel taxes and vehicle registration fees). But the efforts of the localities and some states were deemed insufficient to assure a truly interregional network of highways, and the Federal government was pressed to provide assistance and incentives.

Federal funding for highways began in earnest with the 1916 Federal Aid Road Act, which offered matching funds for postal routes in those states which had established professionally staffed highway departments and highway programmes. Shortly thereafter, the Federal Aid Highway Act of 1921 went considerably further, establishing the 'ABC' (primary/secondary/urban extension) road systems and accompanying funding formulas. The emphasis of this early legislation was on building a good network of interstate roads connecting all metropolitan areas, and, because tolls were seen as detrimental to that cause, the legislation provided 'that all highways constructed or reconstructed [with federal aid] be free from tolls of all kinds.' Although exceptions were soon introduced permitting toll bridges and tunnels, and subsequent modifications have been added, the basic ban has remained in effect ever since.

A combination of reasons was behind the toll ban, including negative experiences of earlier times, concerns about potential abuses, and an unwillingness to spend federal funds on facilities that already were tolled and thus arguably could pay their own way without additional aid. Nevertheless, when a new system of interregional roads was studied in the 1930s, tolls were considered; the conclusion was that traffic volumes, and thus toll revenues, would be too low on many stretches of the proposed road network to cover costs (Bureau of Public Roads, 1939; Gifford, 1983). Thus, as finally authorized in 1944 as the Interstate Highway System, the network of trans-continental roads was to be toll-free.

The Great Depression had taken a toll of its own on highway programmes, slowing investments drastically. However, it did produce one notable exception to the federal ban on toll road financing: the Pennsylvania Turnpike (which did not, however, receive federal highway funds). Grants and revenue bonds were obtained from unemployment relief agencies; the bonds were absorbed, in time, by private interests. Costs were saved by using an abandoned rail right of way and its partially bored tunnel. Even though the times were hard – the road opened in 1940 – it was an immediate success.

The federal ban on tolls did not apply to highways not built or rebuilt with federal aid, and states were free to proceed with toll facilities on their own. Following World War II, a number of them did so. They were encouraged, no doubt, by Pennsylvania's success; but they also were spurred on by the recognition that then-available public funds were inadequate to finance both ABC roads and the proposed Interstate system. By the time the Interstate Highway Act of 1956 provided funds for construction, some twenty states had completed or authorized nearly 3,000 miles (4,800 km) of toll roads built to (more or less) Interstate standards.

Unlike the turnpikes of the 1800s, those of the 1940s and 1950s were built almost entirely by state agencies (either special purpose toll road authorities or the state highway departments). A wide variety of financing mechanisms was used: bonds secured only by tolls, bonds backed by the state's full faith and credit in addition to toll revenues, bonds supplemented by motor fuel credits, bonds backed by highway funds if needed, and direct subsidies from state and local government were among the variations utilized. Most, but not all, of the facilities proved successful financially, although several would not have done so had tolls been the sole source of payback (Wilbur Smith, 1977). Nearly all were authorized with provisions that tolls should

be set so that the roads would be self-financing, retiring the bonds with reasonable interest and providing for operating and maintenance costs, but not make a profit. In most cases, tolls were to be removed once the bonds and interest had been paid off, although many states also had provisions allowing pooling of indebtedness, so that as long as new projects were added tolls could remain (Crane, 1967; CBO, 1985).

Once Interstate funding with its 90 per cent federal match became available, tollway building slowed to a near-halt. However, to avoid duplication of facilities (which most of the states would have been unwilling to do, in any event), the 1956 Act permitted many of the toll roads to be designated as Interstates, although federal funds could not be spent on these roads until the tolls were removed. Compensating the states for toll facilities made part of the Interstate system was a major issue of the times, and several studies considered early removal of tolls from the designated facilities via federal reimbursement of construction costs (but failed to come to a resolution). Eventually, some 2,700 miles (4,300 km) of tollways were incorporated into the Interstate system.

Over the years, the Congress made several additional exceptions to its no-toll policy. In addition to toll bridges and tunnels authorized in the 1927 Act, approaches to toll roads on the Interstate system were authorized for federal funding, as were projects designed to upgrade toll roads to Interstate standards. Other projects were granted exceptions on a case by case basis, mostly when unusual conditions could be shown.

Despite these exceptions, toll-free operation remained federal policy (and that of many states). By the mid-1970s, however, it was clear to many that the policy might need to be reconsidered. Rapid growth in auto use, sharp inflation in highway construction costs, and reduction in fuel tax

receipts as vehicles became more energy-efficient were combining to produce severe shortfalls in highway funding. On many toll roads, substantial operating and maintenance expenses were being toll-financed; removal of tolls would mean covering these costs from other sources already stretched thin. Studies in a number of states with toll facilities indicated that unless tolls were continued, major new sources of funds would be needed to replace the lost revenues (Wilbur Smith, 1977).

Pressed by the states, Congress in 1978 allowed federal maintenance and rehabilitation funds to be expended on toll segments of the Interstates. The funds were restricted to those states which signed agreements requiring toll removal upon retirement of bonded indebtedness. However, Congress also adopted provisions allowing tolls to be continued (or introduced) in return for 'payback', without interest, of federal funds (with the paid-back monies credited to the state's federal-aid balance.) While some states nevertheless chose to remove tolls – the most recent being Connecticut, whose Turnpike (I-95) became toll-free in late 1985 after heated controversy over back-ups and accidents at toll booths – others (Indiana, Maine, Virginia) decided that payback of federal funding was the preferable course of action. Still others put off the question for a time by obtaining permission to issue new bonds to pay for tollway upgrading and expansion.

During this period, acceptance of toll financing appears to have grown substantially. Surveys in several toll states found that toll continuation, with facility rehabilitation and upgrading, was preferred by voters over the possible options (Weustefeld, 1988). Even states without toll facilities undertook studies of tolling – for example, Arizona investigated the feasibility of building new facilities as toll roads, while Wisconsin assessed the

possibility of converting existing Interstates to tollways in order to pay for maintenance (CBO, 1985.) And while some highway users continued to oppose tolls except in limited circumstances (Hanson, 1986), by the mid-1980s the American Association of State Highway Officials had adopted a policy supporting the use of tolls at the states' option and without loss of federal aid, not only on new facilities but also, if needed, on existing ones (Francois, 1985).

Finally, federal law itself was changed. Following several studies of toll financing (for example CBO, 1985), and under pressure to use all reasonable means to halt widespread infrastructure deterioration (National Council on Public Works Improvement, 1988) the Congress enacted, in 1987, legislation permitting federal aid, at a 35 per cent matching ratio, to be used on a small number of toll road demonstration projects. Additional demonstration projects were authorized the following year. The federal government clearly was following the states' lead, however, since a number of states had by that time already undertaken a new round of toll road planning and construction.

The Renewed Interest in Toll Roads

As the preceding discussion indicates, the renewed interest in toll roads has been expressed in several ways. Although official policy at the federal level and in many states still calls for eventual toll removal, most states with tolls have shown strong desire to continue them, and even some states without tolls have expressed interest in their use as a means of financing highway expansion and improved maintenance.

Existing toll roads are being widened and upgraded in many areas. But perhaps more notable is the recent surge of construction of new toll facilities on new rights of way, servicing urban and suburban areas (rather than the intercity service provided by earlier toll roads). Among the states with recent or

planned toll road projects of this sort are Virginia, Florida, Texas, Colorado, and Illinois, all toll states, and California, where only toll bridges have heretofore been accepted. The projects include the following (Harris County Toll Road Authority, 1988; CBO, 1985; Schaevitz, 1988; Greene, 1986; Sandlin, 1989):

- In Houston, Texas, the 22 mile (35 km) Hardy Toll Road and the 88 mile (140 km) Sam Houston Tollway (formerly the West Belt) are the products of the Harris County Toll Road Authority, created in 1983 after voters approved the issuance of \$900 million in bonds for building toll roads.
- In suburban Chicago (DuPage County), the 17 mile (27 km) North-South Tollway will open in 1990. It is being constructed by the Illinois State Toll Highway Authority and is being financed with the support of existing tollway revenues.
- In the Virginia suburbs of Washington, DC, the 12 mile (19 km) Dulles Toll Road, built on federal land leased at very low cost and opened to the public in 1984, is to be widened from four to six lanes and extended another 17 miles (27 km). As authorized by recent state legislation, the extension will be privately owned and operated, but will be subject to state regulatory control. A substantial part of the cost of the facility will be covered by land dedications and other contributions from developers who would benefit from the improved access to their properties.
- In the Denver, Colorado area, the E-470 project is a proposed 48 mile (77 km) belt which would serve the planned new airport to the east of the city. A consortium of four local governments and major land developers who collectively control about half the required right of way have sponsored the planning to date; funding of the facility would be from a combination of tolls, developer contributions, and possibly tax funds, although voters rejected the

taxing proposals initially set forth.

- In Orange County, California, 70 miles (112 km) of tollway are being proposed for three corridors, with total costs of some \$2 billion. Legislation recently enacted by the state requires that the facilities be built to state standards and operated as public roads. About half of the costs would be covered by impact fees collected on all properties in benefit districts established by a joint powers agency of thirteen jurisdictions; additional land dedications from developers also seem likely.

These projects, along with others planned or under construction in Florida, Texas, Virginia, and a few other states, illustrate several characteristics common in the new toll road boom. First, the toll projects are located in fast-developing suburban areas. In these areas, existing roads often are heavily congested, and in many cases the highway network is sparse. Since public funding for highways is oversubscribed, most new road projects in such areas would be many years from development via conventional public financing; toll financing offers the ability to proceed more rapidly.

A second feature of the new roads is that their tolls will fund only a portion of costs. While some of the projects are expected to attract high volumes of traffic from opening day, traffic on others is expected to grow as land made more accessible by the tollways develops. For many of the projects in the latter situation, developer contributions will help carry the costs. Dedications of right-of-way, development impact fees, participation in special taxing districts, and donated interchange costs are among the methods of support for these roads, in addition to tolls. Some of the projects also have state or local government backing in the form of toll pooling, bond guarantees, or tax contributions. Pledges of privately held real property as collateral for loans and value capture commitments (in which a portion of increased property value or

income would be shared) are other financing schemes that have been proposed but have not yet found wide acceptance (Schaevitz, 1988).

The availability of supplementary funds and guarantees, whether from developers or from government, explains why the toll roads can go ahead despite costing more than comparable toll-free facilities. Toll collection has been estimated to add 5–10 per cent to capital costs and perhaps 7 per cent to operating costs, in addition to the relatively high costs of borrowed funds (which add 5–25 per cent, depending on interest rates and pay-back period) (CBO, 1985). Quite simply, many of these roads would not be considered safe investments were they solely dependent on tolls for their financing; the supplementary funds and guarantees make the road feasible.

In seeking funds and backing from a variety of sources, the new tollways are a departure from past practices only in the extent to which they rely on developer participation, since as noted earlier, the roads of the 1950s and 1960s also benefited from government support. Even the developer participation aspect might best be thought of as continuing the trend toward public-private finance of highways and other infrastructure needed to support growth, in which numerous projects have received partial financing from developer exactions, impact fees, and contributions (Deakin, 1989).

Also extending past practice, most of the new toll roads are public facilities. Most, indeed, are being developed and built by public entities, and even those which would be privately operated (including Dulles) are eventually to become public roads. Moreover, the legislation authorizing the new projects, like that for the older toll roads, calls for toll removal once the facilities are fully paid for.

While overcoming financing shortages is probably the major motivation for the new projects, toll roads also have attracted

interest because of the speed with which they can be implemented, often three to five years faster than would be possible with conventional funding. Time savings result primarily from not having to wait in line for limited public monies, but other sources of time savings may be available in some cases. For example, on some projects, time savings have been attributed to the use of private contractors instead of government work crews, along with avoidance of certain work rules which would apply if federal funds were used. More often, the major additional time savings appear to result from not having to comply with federal planning and environmental review standards. Indeed, in some states, removal of federal mandates means that essentially no formal environmental review must be carried out, since there are no parallel state requirements. The toll projects in Illinois, Texas, and Colorado are among those where a considerably lower level of public scrutiny and environmental review apply; indeed, delays due to environmental requirements are partly behind the decision to convert the Illinois and Texas projects from federal-aid to toll roads, and freedom from federal environmental requirements has been cited as a major 'advantage' for the proposed toll project in Denver (Sandlin, 1989). (The California and Florida projects are required to meet substantial state requirements for environmental review, so the absence of federal regulation is less relevant.)

A final factor cited in favour toll roads is their better quality of service, in particular, higher levels of pavement quality, snow clearance, police patrol, and roadside services and lower accident rates than comparable roads (CBO, 1985; Wuestefeld, 1988). Evidence for the most part supports these claims, although there are exceptions. For example, while some have argued that there is no theoretical reason why toll roads should be better maintained than their toll-free counterparts (see, for example, Geltner

and Ramaswamy, 1987), empirical studies indicate that toll facilities are generally kept in better condition than non-toll routes (US Department of Transportation, 1987) – producing perhaps a five per cent savings in costs for vehicle maintenance (CBO, 1985). This probably reflects the combined availability of dedicated revenues for routine maintenance together with bond resolutions requiring reserves to support major maintenance projects.

Toll Roads and Congestion

Economists have long argued that tolls are a highly rational way to manage highway congestion. Congestion, they argue, is a classic "tragedy of the commons" (Hardin, 1968); the apparently free good is over-consumed, leading to harm to all. By pricing peak period travel to reflect the scarcity of roadway capacity, the argument continues, demand and supply would be brought into balance, revenues needed to improve services would be generated, and societal welfare would greatly increase (Smeed Committee Report, 1964; Zettel and Carll, 1964; Vickrey, 1967; Walters, 1968; Small, 1989).

It has been suggested that the new interest in toll roads may open up opportunities to implement congestion pricing (Poole, 1988; Partington, 1988; Small, 1989). Although the possibility of peak/off-peak toll differentials has been studied for at least one area (Small *et al.*, 1989), congestion pricing is decidedly not an explicit objective of the new toll projects; the tolls are seen merely as mechanisms for self-finance. Indeed, to the extent that congestion on the tollways has been considered, it is congestion at toll booths that has been the focus. The use of non-stop, automated toll technologies is being planned for several of the new facilities as a way of reducing collection delays, following its success in several applications (see, for example, Foote, 1981; Catling and Harbord, 1985).

Automated toll technologies would make the eventual implementation of congestion pricing technologically feasible and relatively straightforward. Whether political acceptance would follow is the larger issue. Previous attempts to implement congestion pricing in the United States have been unsuccessful (Higgins, 1986), and while growing congestion coupled with continuing difficulties in raising revenues for transportation may lead people to reconsider all options, concerns still persist. Recently, for example, a California legislator who had been one of the leaders in a move to double the state fuel tax stated his opposition to further price increases proposed to reduce congestion and improve air quality, which he implied would 'bring pain to people' (Gibbs, 1989). Since most legislation authorizing tolls makes it explicit that they are to be set to cover costs, additional action may be needed to proceed with pricing for demand management, and may be difficult to obtain.

Acceptance of tolls as congestion prices also may depend on the magnitude of the tolls and the availability of alternatives for those who would be 'tolled off'. To cover costs, tolls of 5–10 cents a mile would be needed on most new facilities, even with other funding sources (CBO, 1985) – tolls sufficient to act as congestion prices on at least some facilities (Small *et al.*, 1989). However, in areas of heavy demand, congestion prices as high as 65 cents a mile might be needed to avoid congestion. Such charges arguably would be regressive, although proponents have shown that revenues could be used in a variety of ways that offset the regressive effects (for example by expenditures for transit, or on uses that benefit each person equally) (Small, 1983; Small *et al.*, 1989). In addition, traffic diverted to alternate routes could result in worse overall congestion, unless revenues were spent on improvements and expansions, or pricing were implemented there, too – policies well beyond those

legally available or actively discussed at the current time.

A possible pathway toward congestion pricing, for high-demand tollways, may be to establish one set of tolls during peak periods and another, lower, set off-peak, perhaps with higher rates on the more congested links as well. While full congestion prices may not be feasible, the gradual introduction of peak/off-peak pricing strategies, already widely used in the US telephone and electricity industries, may help develop consumer understanding and acceptance for the pricing concept.

Concerns About Toll Roads

Broader use of tolls is not occurring without controversy. For example, when the tollways open up new areas for development and match developers' contributions with public funding, questions are raised: should scarce public funds be used to support projects to facilitate new growth, when existing areas need relief? What about areas not affluent enough to obtain private sector contributions and in need of public investments in highways to attract development?

Likewise, the notion of tollways as an escape route from environmental controls and public scrutiny is raising concerns. Considered by some a plus for getting the roads built fast, the loss of federal oversight on environmental matters is seen as the 'downside' by others (Sandlin, 1989.) Caught unprepared for the first few projects, environmental groups plan to exercise greater vigilance in the future. And they take comfort in the analyses that suggest that vehicle miles of travel are cut down by the tollways' higher cost.

Prospects

Unless major new sources of funding for highways are developed – a prospect that is by no means certain, in view of federal

deficits and strong competition for available funding – tolls seem likely to be a valuable alternative for future highway finance in the United States. Many roads that are currently tolled seem likely to remain so, and tolls will be used on some new facilities. Whether tolls also will be accepted as a way to help finance currently 'free' facilities remains to be seen, however, as both public law and public attitudes seem to be reluctant to accommodate this change.

Because of the borrowing required, tollways are more expensive to construct and operate than public roads funded by pay-as-you-go fuel taxes, particularly when interest rates are high. Relatively few new facilities will be able to pay for themselves through tolls alone, at least in initial years, and widespread use of public-private partnerships involving developer contributions and impact fees, benefit assessments, and privately financed interchanges in conjunction with fuel taxes, sales taxes, and/or government guarantee of bonds seems likely. At present, it also seems likely that most of the roads will be publicly owned, and that many will involve commitments for free operation after the facilities have been paid for. Yet if past experience is any indication, continuation of the tolls will be found to be needed for expansions and upgrading and to assure adequate maintenance, so toll removal may not in fact occur.

Implementation of toll roads is most likely in growing but not yet fully built-up areas, especially where tollways can serve as relief routes for congested, but toll-free, facilities (the availability of which helps dampen the concern that toll facilities are elitist). Moreover, toll roads seem likely to be of greatest interest to areas where concerns about traffic have led to extensive use of exactions or imposition of growth controls. Under these conditions, developer dedications of right-of-way (either voluntarily or as a condition of development) lower pay-back costs of the

tollway and provide a simplified decision process about routing.

Tollway construction will not be met with uniform approval, however. The possibility that toll roads partly financed by development interests in affluent suburbs will be given priority over public facilities in less favoured areas will be one concern. Environmental considerations also will be at issue, at least in those states where toll roads have been a way around federal environmental requirements. Yet the likelihood of this setting a nationwide trend seems slim. In states such as California, state requirements offer similar, and perhaps stronger, protections. And even in the states where environmental requirements are relatively few, political action seems likely to bring environmental considerations into decision-making.

Toll roads may offer some opportunities for congestion relief by allowing highway capacity to be expanded faster and farther than would be possible using public funds alone. Whether they also will offer possibilities for true congestion pricing remains to be seen. A first test will be whether toll road operators are willing to implement differential prices peak and off peak. Even so, it would be a large leap indeed from peak load pricing on tollways to congestion pricing on the roads currently most troubled by congestion – existing 'free' highways and arterials. Whether that leap will be aided by experience on tollways will be interesting to watch over the next decade.

REFERENCES

- Bureau of Public Roads (1939) *Toll Roads and Free Roads*. Washington, DC.
- Catling, Ian and Harbord, B. J. (1985) Electronic road pricing in Hong Kong, 2: the technology. *Traffic Engineering and Control*, 26, pp. 452-65.
- Congress of the United States, Congressional Budget Office (CBO) (1985) *Financing of U.S. Highways*. Washington, DC.

- Crane, Stuart R. (1967) Federal Financing for Toll Projects Incorporated in the Interstate Highway System. Dissertation, Indiana University Graduate School of Business.
- Deakin, Elizabeth (1989) Suburban traffic congestion. *Transportation Research News*, January.
- Foot, Robert S. (1981) Prospects for non-stop toll collection using automatic vehicle identification. *Traffic Quarterly*, 35 (3), pp. 445-60.
- Francois, Frank (Executive Director, American Association of State Highway and Transportation Officials) (1985) Keynote Address. Workshop Presentations, Meeting of the International Bridge, Tunnel and Turnpike Association, New Orleans, LA, April 14-16.
- Geltner, David, and Ramaswamy Rohit (1987) Economic Efficiency Implications of Optimal Highway Maintenance Policies for Private vs. Public Highway Owners. Paper Prepared for the Transportation Research Board 66th Annual Meeting, Washington, DC, January.
- Gibbs, Walt (1989) Stricter laws urged in bid to clean air, *San Francisco Examiner*, October 8, pp. B-1 and B-8.
- Gifford, Jonathan (1983) An Analysis of the Federal Role in the Planning, Design, and Deployment of Rural Roads, Toll Roads, and Urban Freeways. Department of Civil Engineering, University of California, Berkeley.
- Greene, Sharon (Orange County Transportation Commission) (1986) Presentation at the Panel U.S. Counties - New Force in Toll Facilities, Workshop Presentations, Meeting of the International Bridge, Tunnel and Turnpike Association, Orlando, Florida, April 20-22.
- Hanson, Daniel (President, American Road and Transportation Builders Association) (1986) Keynote Address. Workshop Presentations, Meeting of the International Bridge, Tunnel and Turnpike Association, Orlando, Florida, April 20-22.
- Hardin, Garrett (1968) The tragedy of the commons. *Science*, 162, pp. 1243-48.
- Harris County Toll Road Authority (1988) *The Sam Houston Tollway and the Hardy Toll Road*. Houston, Texas: Public Information Office.
- Higgins, Thomas (1986); Road pricing attempts in the United States. *Transportation Research A*, 202A (2), pp. 145-50.
- National Council on Public Works Improvements (1988) *Fragile Foundations*, Final Report to the President and Congress.
- Partington, Peter R. (1988) Road Pricing - An Idea Whose Time Has Come? Paper Presented at the 67th Annual Meeting of the Transportation Research Board, Washington, DC, January.
- Poole, Robert W., Jr (1988) Resolving gridlock in Southern California. *Transportation Quarterly*, 42 (4), pp. 499-527.
- Sandlin, Nina (1989) Pay as you go. *Planning*, July, pp. 18-22.
- Schaevitz, Robert C. (1988) Private Sector Role in U.S. Toll Road Financing - Issues and Outlook, *Transportation Research Record*, No. 1197. Washington, DC: Transportation Research Board, pp. 1-8.
- Small, Kenneth (1983) The incidence of congestion tolls on urban highways. *Journal of Urban Economics*, 13, pp. 90-111.
- Small, Kenneth *et al.* (1989) *Road Work: A New Highway Pricing and Investment Policy*. Washington, DC: Brookings Institute.
- Smeed Committee Report (1964) *Road Pricing: The Economic and Technical Possibilities*. London: HMSO.
- US Department of Transportation (1987) *The Status of the Nation's Highways: Conditions and Performance 1987*. Washington, DC.
- Vickrey, W. (1967) Optimization of traffic. *Journal of Transportation Economics and Policy*, 1, pp. 123-36.
- Walters, A. A. (1968) *The Economics of Road User Charges*. Baltimore: The Johns Hopkins University Press.
- Wilbur Smith and Associates (1977) *Toll Financing: A Supplemental Resource for Transportation Needs*. Prepared for International Bridge, Tunnel and Turnpike Association, April.
- Weustefeld, Norman (1988) Public Attitudes Toward Toll Roads: A Forty-Year Perspective and Look to the Future. Paper presented at the Conference, Paying the Toll: National Perspectives on Toll Road Development, University of California, Irvine, CA, November.
- Zettel, Richard M. and Carll, Richard R. (1964) The basic theory of efficiency tolls: the tolled, the tolled-off, and un-tolled, *Highway Research Record*, No. 47. Washington, DC: Highway Research Board, pp. 46-65.