

provision of possible excess capacity and the ability to convert it rapidly to other uses if it is not required illustrate the pragmatism and willingness to proceed by trial and error that are required of a government that wishes to implement such an innovative scheme.

If central area roads are underutilized, it is likely that parking facilities are also. At present, no information is available on parking utilization in Singapore. In general terms, however, it seems clear that a traffic restraint scheme should be coordinated with a policy that regulates the supply of parking.

Since one of the alternatives open to motorists who formerly drove through the restricted zone is to drive around it, some congestion on bypass routes was to be expected. In Singapore it was possible to solve this problem, to a large extent, by adjusting the timing of traffic lights. Elsewhere, it would be necessary to examine the extent to which road improvements on bypass routes might be required.

SUCCESS OF SCHEME

How well does the scheme work? As noted before, data were being collected before implementation and are still being collected on travel behavior, traffic performance, business activity, and the environment. The World Bank will analyze these data to produce a comprehensive statement of the impacts of the scheme. Preliminary

conclusions that can be drawn at this point indicate that the scheme has been very successful in reducing traffic congestion in the restricted zone during the hours of restriction. Benefits have accrued to some car drivers and to bus riders, and the central area has been improved for pedestrians and vehicle users alike. The administration and enforcement of the scheme proved to be manageable. To a considerable extent, this has been due to the care devoted by the Singapore government to the design and preplanning of the scheme and to the gradual implementation of complementary transport policies and the publicity that preceded the scheme.

Overall, this type of scheme clearly has considerable promise as a component of an urban transport policy. It is flexible enough to be tailored to the needs of a wide variety of cities, creates revenues, and requires little capital to implement. It seems possible that an area license policy might be a way to break the spiral of increasing congestion and decreasing public transport service by creating a situation in which public transport can operate more efficiently and give better service. As Singapore government officials have pointed out, however, success requires a fundamental restructuring of the public's attitudes toward the ownership and use of the private automobile. It also requires policy makers who are imaginative and innovative in developing urban transport strategies.

Supplementary Licensing: An Evaluation

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The Greater London Council (GLC) recently published the results of a study on supplementary licensing (1), a proposed new method of traffic restraint that would require drivers of certain vehicles to purchase special licenses to use their vehicles at specified times in designated areas. The study, conducted by officers of the GLC, the U.K. Department of the Environment, the Metropolitan Police, and the London Boroughs Association, considered the proposal as a means of providing traffic restraint in inner London; reviewed the effects of a number of alternative schemes on traffic patterns, on the environment, and on the social and commercial framework of London; and determined the practical requirements of these alternatives. This article summarizes the methods used and the results obtained; a fuller description can be found in the technical report of the study (2).

Traffic restraint is being seriously considered as a vital part of an integrated transport policy in most cities in the United Kingdom, although the needs and objectives differ from city to city. As a result, considerable effort has been spent in designing restraint methods that are flexible (to meet differing and changing needs); efficient (so that undue restriction is avoided); selective by type, area, and time of journey; fair and acceptable to the community at large; simple to administer and enforce and not open to abuse; and easy to understand and to follow for both casual and regular travelers.

Parking controls have been the most widely used form

of restraint, and at present they form the mainstay of the GLC's restraint policy (3). However, parking controls do not operate on through traffic and are only fully effective on terminating traffic if control can be imposed on the operation of all parking spaces. Figure 1 demonstrates the effect of these limitations in central London. Although parking controls have reduced the amount of peak-period traffic that uses on- and off-street public parking facilities in central London by 30 percent in the last 12 years, traffic that uses private parking facilities and through traffic have both doubled. Supplementary licensing has often been advocated as a method for imposing controls on such traffic (4, 5, 6), and one or two cities, such as Valletta, have for some time operated simple schemes in which the annual license is more expensive for vehicles used in the city. A detailed study has been conducted for Caracas, and a complex scheme is being implemented in Singapore. However, neither of these proposals provided sufficient information to determine the effects of introducing supplementary licensing in a city the size of London.

The GLC study was designed to determine which alternative schemes might be appropriate for inner and central London, what their effects would be, whether they would be practicable, which would be the most satisfactory alternative, and how soon it could be introduced.

ALTERNATIVES CONSIDERED

Congested conditions occur throughout an area within 10 km of the center of London in the peak periods; between the peaks, congestion is less severe in inner London but is more acute in the 24 km² of central London. Central London was therefore an obvious candidate for control, and a boundary route that could take the diverted through traffic appeared possible. It was decided to consider control in inner London as well; in selecting a boundary for such an inner area a compromise had to be found between the needs to identify an adequate boundary route and to limit the area of control. Figure 2 shows the boundaries of the areas selected.

Control of the morning peak period (8:00 to 10:00 a.m.) would not solve the worst traffic problems in central London, which occur during the day, and might cause additional congestion after 10:00 a.m. On the other hand morning peak control would be less expensive and would present fewer problems to residents and activities in the area than all-day control. Both these options were considered for each area but it was decided not to consider controls before 8:00 a.m. or after 6:00 p.m. or on weekends, since traffic flows are generally lighter at these times and public transport provides a less satisfactory alternative.

Automobiles were obvious candidates for control since they represent at least two-thirds of the traffic stream in the central area. However, it was decided that special consideration should be given to residents of the area since they would have to buy licenses to make any journey from home. Commercial vehicles form about one-fifth of the traffic stream and add considerably to congestion and pollution, but many of them play an important economic role. The study therefore considered alternatives that charged and excluded them.

A previous study (7) suggested an optimum charge for automobiles in central London of 50p to 60p per day (except where otherwise specified, all prices in this paper are stated in 1973 pounds). This study considered a range of 20p to £1.20 per day, with charges at two and three times this level for large commercial vehicles (when they were charged) and the possibility of lower rates for residents. Charges of one-fourth and one-half of these levels were tested for the inner area.

In all, six combinations of area, time of control, and level of charge (listed in Table 1), together with variations for commercial vehicles and for residents, were tested against a base situation. This base situation could itself be affected by other restraint policies, as well as by policies on public transport and road construction. To simplify the study it was decided to compare the alternative forms of control with a base situation in which only currently committed road schemes were executed and current levels of parking control and bus priority were maintained. The traffic analysis was based on current estimates of the demand for travel and the values of time and labor costs in 1980.

ESTIMATED EFFECTS

Supplementary licensing would have direct effects on private traffic, public transport, and the environment and indirect effects on different social groups, commerce, revenue, and other restraint policies. In order to estimate these, use was made of four traffic models that considered control of the central area and the inner area and peak-hour and all-day control.

Traffic Analysis

Supplementary licensing would influence demand for

travel by all modes by introducing an increase in the cost of some journeys by cars and commercial vehicles. The study therefore had to use a model that incorporated an explicit demand-cost relationship, as well as to estimate the distribution of effects on a network. Few operational models do this; the one used, CRISTAL, was developed by the Transport and Road Research Laboratory to fill this gap (8). It specifies demand between pairs of places by five modes (car, bus, rail, taxi, goods vehicle) in terms of generalized cost, assigns these trips to a symmetrical ring and radial network, and calculates cost based on the flows on individual links. Calibrated to 1970 conditions in Greater London and equipped with predictions for 1980, it permitted a comparison of the overall restraint effects of the alternative schemes. However, it was unable to distinguish between different categories of automobile users (such as residents and nonresidents), and it was unable to indicate the precise geographical distribution of the changes in traffic patterns on London's irregular road network.

To overcome the first of these deficiencies and to test the sensitivity of some of CRISTAL's basic assumptions, such as cost elasticity and time values, two single-link models were used, one developed by the Transport and Road Research Laboratory (9) and the other by the GLC (10). The second deficiency was overcome by testing the restrained effects from CRISTAL on the London road network. In this procedure a trip matrix developed by the GLC (11) was factored by a matrix of restraint factors obtained from CRISTAL and assigned incrementally using a procedure and network developed for the inner London bus priority model (12).

Using these four models it was possible to obtain estimates of the degree of restraint imposed on a number of different classes of user and the effects of these on the road system and on public transport. Some of the more important results are presented below. All the results are subject to some error, because assumptions had to be on the basis of limited information. In particular, little is known of the response of motorists to substantial increases in travel costs or of the extent to which employers would continue to subsidize their employees. The single-link models allowed some sensitivity tests to be conducted; where a range has been placed on the result it is indicated below.

Net Benefit to Travelers

The initial comparison of alternatives was based on estimates from CRISTAL of the net gain that resulted from savings in travel time and cost and from losses to those who no longer traveled, excluding the costs of administering the scheme. The results are presented in Figure 3, which indicates that the greatest benefit is obtained from alternative B (see Table 1) but that alternatives C and D, with morning peak control in the inner area, only reduce the benefits slightly. Other alternatives (A, E, and F) produce substantially less benefit.

The optimum charge appears to be about 60p/automobile trip for all alternatives, which is equivalent to a charge of 75p/automobile/d. Sensitivity tests indicate that the optimum is in fact in the range of £25 million to £38 million/year. (The optimum charge at 1975 prices is in the range of £1.00 to £1.25/d.) The CRISTAL run used for further analysis was slightly sub-optimal and represented the results that would be produced by a charge in the range of 60p to £1.00/automobile/d.

Traffic Effects

Table 2 indicates the estimated effect of a charge of

Figure 1. Automobiles entering central London in the morning peak, 1962 to 1974.

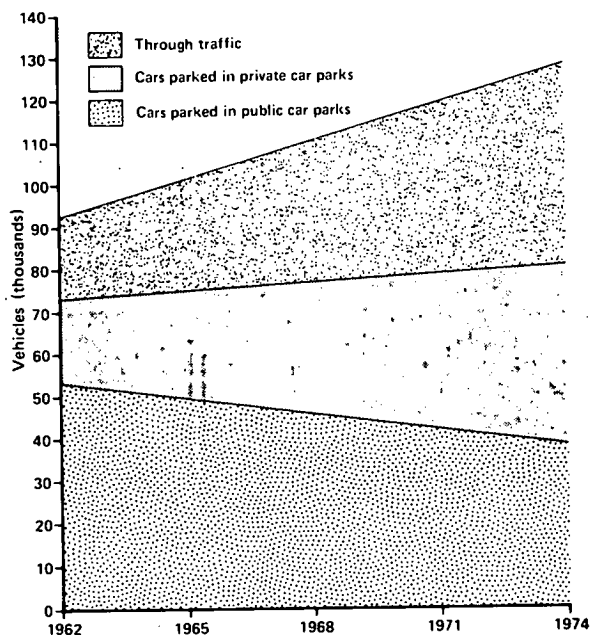


Table 1. The six main alternatives.

Alternative	Area Controlled	Time of Control	Range of Charge/Car/d ^a
A	Central	8:00 to 10:00 a.m.	20p to £1.20
B	Central	8:00 a.m. to 6:00 p.m.	20p to £1.20
C	Central Inner	8:00 a.m. to 6:00 p.m. 8:00 to 10:00 a.m.	20p to £1.20 5p to 30p
D	Central Inner	8:00 a.m. to 6:00 p.m. 8:00 to 10:00 a.m.	20p to £1.20 10p to 60p
E	Central Inner	8:00 a.m. to 6:00 p.m. 8:00 a.m. to 6:00 p.m.	20p to £1.20 5p to 30p
F	Central Inner	8:00 a.m. to 6:00 p.m. 8:00 a.m. to 6:00 p.m.	20p to £1.20 10p to 60p

^aHigher charges for commercial vehicles; lower charges for residents.

about 60 p to £1.00/automobile/d in the central area (alternatives A and B) on peak-hour flows at four locations. These correspond to reductions in vehicle-kilometers of 37 percent in the central area and 11 percent in the inner area. Addition of control in the inner area (alternatives C through F) was found to impose slightly greater restraint on radial traffic in the inner area and to remove the increase in orbital traffic that resulted from central-area control. However, analysis of the effects on London's road network indicated that the increased orbital traffic would only present local problems on the central-area boundary route. This surprising result occurs because much of the boundary route accommodates both radial and orbital traffic, and reductions in the former provide capacity for increases in the latter.

It was estimated that these changes in flow would result in increases in peak-hour speed of 40 percent in the central area and 15 percent in the inner area, although some parts of the inner area would experience a reduction in speed. Total peak-period queue length was estimated, by using the detailed assignment model, to fall by 85 percent in the central area and 30 percent in the inner area; the reduction in the central area represented an 80 percent reduction in the number of congested junctions.

Environmental Implications

One of the main reasons for introducing traffic restraint is to reduce the effects of traffic on the community in terms of noise, pollution, danger, and disruption of residential and shopping areas. The extent to which these effects could be reduced was tested in the study by reassigning the trip matrix to a much coarser road network from which roads passing through identified environmental areas had been removed. In the time available only one such assignment was conducted; it used flow changes from alternative B and indicated that, even with the removal of 27 percent of the central-area network, traffic intensity—expressed as total travel (vehicle-kilometers) divided by total road length (kilometers) of the network—would be on average 14 percent lower than before the introduction of supplementary licensing. In the inner area, understandably, similar improvements would not be achieved, because traffic

Figure 2. The central and inner areas of London.



reductions would be lower. Even so, a 15 percent reduction in the tested road network would produce only an 8 percent increase in average traffic intensity.

All-day control in the central area would thus enable the most environmentally sensitive roads in the central area to be closed to through traffic and would permit similar treatment for many roads in the inner area. Further improvement in the inner area would require inner-area control, but it would probably be sufficient to restrict this to the peak periods, since traffic levels are much lower in the off-peak period. The same cannot be said of central-area control; since traffic levels in the central area are similar throughout the day, restriction of controls to the peak period would remove the opportunity for most of the environmental improvements to be made.

Social Effects

One criticism often leveled against control by pricing is that it may cause greater hardship to lower income groups. The impact of supplementary licensing on different income groups depends on their levels of automobile ownership and automobile trip making in the controlled area, the extent to which they will benefit from improvements in the bus service, and the possibility of using surplus revenue from the scheme to help meet their transport needs. Income-based data from the 1962 London Traffic Survey (13, 14) on trip rates and automobile ownership indicated that supplementary licensing would have a greater direct impact on higher income groups if it were restricted to the central area but would affect all groups equally if it were extended to the inner area.

Figure 3. Benefits of different licensing schemes.

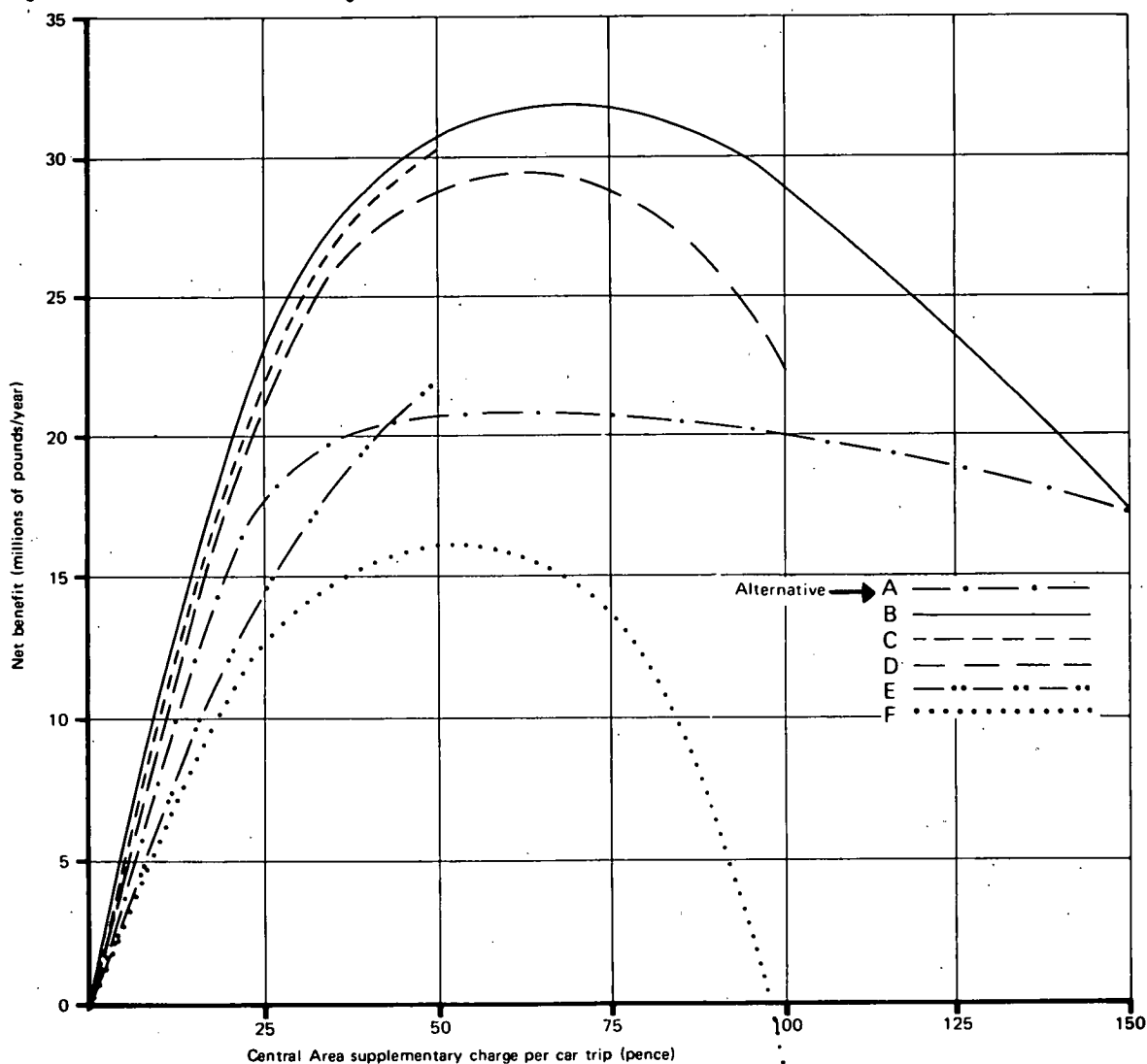


Table 2. Estimated changes in peak-period flows under alternatives A and B.

Type of Flow	Entering Central Area	Entering Inner Area	Orbital Outside Central Area	Orbital Outside Inner Area
Private cars/h	-45	-30	+20	No change
Commercial vehicles/h	-20	No change	+10	+10
Bus passengers/h	+45	+30	Insignificant	Insignificant
Rail passengers/h	+5	+5	Insignificant	Insignificant

However, the same information indicates that higher income groups would tend to gain more from increases in automobile speeds, particularly if they were less ready to switch modes. Trip rates by bus were also slightly higher for higher income groups in 1962, although the pattern may well have changed since then. Although this analysis was not conclusive, it appeared on balance that control restricted to the central area would not favor the higher income groups to any considerable extent. If control were to be extended to the inner area, lower income automobile owners would be more heavily penalized. In either case, of course, those without an automobile available would benefit.

Other groups that might suffer unduly are residents and the disabled. The study report (2) recommended that the disabled should be exempt and considered the possibility of lower rates for residents. The argument in favor of lower charges for residents is that they would otherwise be charged for all automobile journeys during the day and that any resulting reduction in the population of the controlled area would be undesirable; the argument against exempting them is that they would then be encouraged to make additional automobile journeys. On balance, the recommendation was for a lower charge. It was realized, however, that the strength of both arguments would be greater if there was inner-area control, since the resident population and its contribution to traffic flow would be greater and a compromise would be harder to reach.

Another criticism of supplementary licensing on equity grounds is that drivers subsidized by their employers would be shielded from the full effects of restraint. Surveys conducted recently show that up to 55 percent of automobile journeys in London are subsidized and that subsidy is most frequently given not because the automobile journey is important to the employer but simply as a fringe benefit to the employee. Interviews with employers indicated that in many cases they would be reluctant to pay their employees' supplementary licensing charges; their stated sensitivity to the license fee suggested an elasticity of demand somewhat higher than that assumed in this study.

Effects on Commerce and Industry

The possibility of exempting commercial vehicles was considered, but tests using CRISTAL indicated that the 20 percent reduction indicated in Table 2 might be converted to a 35 percent increase in the flow of commercial vehicles entering the central area if they were exempted. On these grounds it was recommended that they should be charged. The impact of controls on commercial activities was estimated by calculating additional costs and benefits at existing automobile and commercial vehicle trip rates. For offices, the additional costs, compared with such other costs as rents and salaries, would be insignificant. For shops, places of entertainment, and hotels, additional costs would also be small by comparison with existing costs, but there would be an effect on the customers. In the case of hotels and entertainment, this would also be small because the majority of their customers use public transport or travel outside controlled hours. For shops, the study estimated that 20 percent of business was automobile-borne and that, of the third of these who might no longer use cars, most would change to public transport. Thus the percentage of customers affected would be no more than 7 percent, and any reduction in business would be much lower than this.

The effect on industry would be greater, since its traffic-generation rate is higher than that for offices and its other costs are lower. Even so, those companies

that use a few vehicles intensively would benefit. The greatest effect would be felt by wholesale markets, and the study recommended exclusion of two of these, Spitalfields and Bermondsey, from the controlled area.

Revenue

Supplementary licensing would itself produce a new source of revenue; in addition it would increase public transport revenue by increasing patronage but would lead to a reduction in fuel tax revenue. The net effect of these was estimated to produce increased revenue of £36 million/year for alternative A, £55 million for alternative B, and between £69 and £81 million for alternatives C through F.

Implications for Other Restraint Policies

The introduction of supplementary licensing would change the requirements for other controls on commercial vehicles and for parking controls. There would still be a need for bans on certain commercial vehicles, but controls could well be simpler than they are at present. Parking patterns would change considerably. The study estimated that occupancy of parking spaces at the end of the morning peak in the central area would fall from 70 percent to about 40 percent and that there would clearly be opportunities for widespread removal of meters and temporary parking lots and for encouraging the closing of private parking lots. On the other hand, there would be greater need for home-based parking for residents. Outside the controlled area there would be an increased demand for parking, and controls would have to be imposed to regulate this.

PRACTICAL REQUIREMENTS

To be successful, a supplementary licensing scheme would require adequate procedures for license issuing and enforcement, some traffic management measures (including new signs), and additions to public transport services to accommodate additional demand. License issuing and enforcement methods are dealt with in detail in the technical report (2) and are summarized below.

License Issuing

The main findings concerning license issuing were that

1. Daily and monthly licenses should be available for automobiles and commercial vehicles; licenses for longer periods should be available for residents and exempt users.
2. There should be no discount for monthly licenses.
3. Daily licenses should be available on the day or in advance from retailers and vending machines.
4. The total cost of issuing licenses would be as shown in Table 3.

Enforcement

The main findings concerning enforcement were that

1. Enforcement would be needed for through traffic, hence for moving vehicles. This should be feasible, but detailed methods would require further study. They would almost certainly involve stopping vehicles that do not have valid licenses, since fixed penalty procedures would not otherwise apply.
2. Enforcement for moving vehicles would cost up to twice as much as that for parked vehicles, but if the latter were used it should, for reasons of equity, be

extended to vehicles parked in private parking lots.

3. Costs would be dependent on the level of enforcement adopted and the level of compliance achieved, but they could occur as shown in Table 3.

4. The requirements for an enforcement staff would be considerable, ranging from 100 for alternative A to 1000 for alternatives E and F; this would be one of the major problems in introducing a scheme. These figures compare with a current staff of 700 wardens in the central area.

Traffic Management Measures

Signs would be required to provide advance warning of the controls, to indicate the boundary, and to remind those in the area of the controls. No detailed designs were put forward, but it was clear that costs would be relatively small. Some traffic management measures would be needed to relieve overloaded junctions on the boundary route; again these were not designed in detail, but approximate cost estimates were made. The equivalent annual cost of these measures would not exceed £1 million.

Public Transport Service Requirements

The increased passenger demands for public transport indicated in Table 2 would to some extent be met by the existing fleet size, partly as a result of the reversal of the current decline in patronage and partly, in the case of buses, from increased bus size as the existing fleet is replaced and from increased efficiency as a result of faster running speeds on less heavily trafficked roads. For example, of the estimated 43 percent increase in demand for bus seats entering the central area, 4 percent could be provided for by using the spare capacity in the existing fleet resulting from declining patronage, 13 percent by using the spare capacity produced by larger bus size, and 13 percent by increased bus speeds. The remaining 15 percent would be provided for by 11 percent

Table 3. Annual costs and benefits for the six alternatives.

Costs and Benefits	Cost of Alternative (£ millions/year)					
	A	B	C	D	E	F
Net benefit to travelers	21	32	31	28	21	13
Costs						
License issuing	1	2	4	4	6	6
Enforcement	2	3	5	5	7	7
Public transport operation	2	2	3	3	3	3
Traffic management	1	1	0	0	0	0
Net overall benefit	15	24	19	16	5	-3
Possible error (±)	3	4	5	5	7	7

Table 4. Evaluation of six alternative schemes.

Measure of Performance	Effect on Alternative					
	A	B	C	D	E	F
Quantifiable net gain	Moderate positive	Substantial positive	Substantial positive	Moderate positive	Negligible positive	Moderate negative
Financial balance	Moderate positive	Moderate positive	Moderate positive	Moderate positive	Moderate positive	Moderate positive
Equity effects	Slight negative	Greater negative	Greater negative	Greater negative	Greatest negative	Greatest negative
Assistance to environmental improvements	Limited positive	Substantial positive	Considerable positive	Considerable positive	Considerable positive	Considerable positive
Assistance to improvements in bus reliability	Considerable positive	Considerable positive	Greater positive	Greater positive	Greater positive	Greater positive
Scale of staffing requirements	Sizable negative	Substantial negative	Greater negative	Greater negative	Greatest negative	Greatest negative

more buses. The estimated increase needed in the bus fleet would be 2 percent for Greater London as a whole, representing an increase of up to 450 staff members. This, like the provision of enforcement staff, would add to the existing problem of obtaining this type of staff in London.

EVALUATION

A scheme like supplementary licensing has implications too wide ranging to be assessed simply by a cost-benefit appraisal. Factors that could not be accounted for in this way include the impact on different groups in society, the effects that cannot readily be quantified (e.g., environmental implications), and the cash transfer questions of interest to the agencies involved. The study therefore evaluated the alternatives against six criteria—their quantifiable costs and benefits, their financial implications, their effects on society and commerce, and three factors that could not be quantified: environmental effects, effects on bus reliability, and the problems of staffing the additional buses and the enforcement agency. Table 4 summarizes this evaluation.

Cost-Benefit Assessment

The alternatives were rated by comparing quantifiable net benefits (Figure 3) with quantifiable costs. This assessment is presented in Table 3, which also indicates the possible error as calculated from the sensitivity tests.

Financial Assessment

All alternatives would produce at least sufficient revenue to cover operational costs.

Equity Assessment

The rating in this case was based on the effect on lower income groups, residents, and commerce. Lower income groups would suffer least with peak-period control in the central area, because essential journeys could generally be made at other times; the greatest hardship would come from inner-area control, particularly if it were introduced all day. The effects on residents and on commerce would follow a similar pattern; extensions to inner-area control would involve far more residents and industrial undertakings.

Environmental Assessment

The study found that considerable environmental gain through the closure of certain roads to through traffic could be achieved with central-area control but only if it

were imposed all day. Inner-area control during the peak would add substantially to these effects in the residential areas around the central area. It should be pointed out, however, that these gains are not wholly compatible with those quantified in Table 3. Much of the environmental gain would be obtained in place of speed improvements for private automobiles; it is assumed that the benefit to the community of using traffic reductions in the former way would be considered to be greater.

Bus Reliability

The effects on bus reliability could not be quantified but were considered an important benefit to be gained by traffic restraint. The ratings shown in Table 4 indicate the estimated effects of the alternatives on traffic congestion in general.

Staffing Problems

Staffing problems would be largely dependent on the size of the controlled area and on the length of the controlled period. Estimated requirements for bus operation and enforcement combined ranged from 500 to 1400 additional staff members, compared with an existing total of some 20 000.

SUMMARY

Not all the criteria are best satisfied by the same alternative. Greater environmental improvement would be gained by adding inner-area peak-period control, but for most other considerations central-area control alone would be preferable. Peak-period control in the central area would involve fewer staffing problems than all-day control but would provide little environmental relief. The study concluded that all-day control in the central area would be the most efficient form of control, unless environmental gains from the extension of control to the inner area in the peak could be shown to outweigh the reduction in other benefits and the increased staffing problems.

Charges higher and lower than the assumed optimum (i.e., in the range of 60p to £1.00/automobile/d) were assessed on the same basis, weighing reduced equity problems for a lower charge against greater environmental improvements and other benefits for a higher charge. The study concluded that a charge in the range of 60p to £1.00/automobile/d would be the most suitable (£1.00 to £1.25 at 1975 prices), but that there would be some justification for a higher charge.

ACKNOWLEDGMENT

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Updating the London Supplementary Licensing Study

This brief paper describes developments since the original licensing study was published in March 1975.

PUBLIC CONSULTATION

Supplementary licensing would require new national legislation; before deciding whether to seek such legislation, the GLC mounted a public consultation exercise from March to June 1976. The public was consulted both on supplementary licensing and on a proposal to tax private parking spaces.

Under the latter scheme, owners would be charged

perhaps \$12/week (£6) for every space they wished to retain; operational spaces—at a rate of 1 space/1.1 km² of floor area, with a minimum of 10—would be free of tax. It was estimated that such a tax could reduce the 51 000 private parking spaces in central London to between 25 000 and 35 000. This, together with intensified control of on-street and public off-street parking could reduce vehicle travel by about 15 to 20 percent, compared with 37 percent for supplementary licensing (1). It would not, however, reduce through traffic, and, unless the road capacity released were to be used for other purposes, through traffic would probably increase. These

arguments were set out in the consultation document, but press coverage concentrated on supplementary licensing as the more controversial proposal.

In the consultation process, a set of pamphlets describing the two measures and setting them in the context of the GLC's overall transport policy was published (2), and members of the public, interested organizations, and local authorities were invited to submit their comments. Two specific questions were asked: Should the GLC have powers to charge people to drive in congested areas? and Should the GLC have powers to control the use of private parking lots in offices?

Apart from 691 preprinted forms returned by members of the Royal Automobile Club opposing all forms of traffic restraint, the number of responses was relatively small. There were 78 responses for supplementary licensing and 138 against, and 69 responses for the parking tax and 49 against.

The specific criticisms of supplementary licensing were that greatly improved public transport would be needed (88 responses), that it would hit the lower income motorist (30), that it would not allow for those with special needs (56), that it would congest the boundary route (22), that it would be difficult to administer (26), and that it would be difficult to enforce (38).

THE GLC's DECISION

In their report to the GLC, the officers noted that the proportions of responses in favor of both measures were reassuring, since there is usually a tendency for only those opposed to a measure to register their views. They also pointed out that the supplementary licensing study had indicated that there should be no problems in providing sufficient capacity on public transport or on the boundary route or in setting up an adequate administration system.

They acknowledged that there was some merit in the other three arguments against supplementary licensing. On the question of the effect on the lower income motorist, however, they pointed out that the poorest third of Greater London residents made only 12 percent of the daily automobile journeys to Central London and that these represented only 2 percent of all journeys by all modes. They argued therefore that the minority being disadvantaged would be small and that the mobility of poorer residents as a whole, who are three times more likely to use a bus than an automobile, would be greatly increased.

On the question of provision for those with special needs, they noted that it would be possible to provide more exempt licenses, at an increased administrative cost, but that it would be virtually impossible to overcome all the problems of meeting special needs. On the question of enforcement, they acknowledged that difficulties would occur but pointed out that enforcement needs were bound to increase as restrictions on the private automobile were intensified.

The GLC decided in July 1975 not to proceed with supplementary licensing but to seek legislation to allow it to tax private parking spaces. The reasons it gave for rejecting supplementary licensing were the adverse effect on the lower income motorist and on those with special needs and the problems of enforcement. Particular concern was expressed over the possible effect on smaller businesses, industry, and those traveling to or from work at times when public transport was not available. The GLC asked, however, for information on similar schemes being considered or implemented elsewhere and for further evaluation of alternative measures that would overcome the problems it had identified.

FURTHER WORK

Further analysis by GLC officers has concentrated on alternatives that would reduce the reliance on the price mechanism. During the consultation process, one local authority had proposed a system in which virtually all licenses (or permits) were allocated on the basis of need (3). This would clearly have been administratively cumbersome, and the task of assessing needs would have been invidious. Further consultation, however, has suggested a scheme in which licenses could be allocated to firms in the area at a rate based on the floor area of the property. A few daily licenses could be issued each year to all automobile-owning households over a wider area, and the remainder of journeys that were made would continue to require paid licenses. Even such a relatively simple system of allocating permits would present administrative problems, but it could overcome the inequitable effects of price on operational journeys of small businesses and on the more essential journeys made by lower income automobile owners. Work is still continuing on this proposal.

Various ideas have been proposed to reduce the enforcement problem. Ideally it would be preferable to initiate a system in which the police did not have to stop vehicles in order to issue fixed penalty notices. However, it has always been assumed that such a change in legislation would be even more controversial than that required for supplementary licensing itself.

One other alternative that is being considered is a return to cordon enforcement. This had originally been rejected because of the problems of queues at entry points, which could block the boundary route, and the number of entry points to be manned. These problems could, however, be reduced by checking automobiles on exit only and by using some of the capacity released by restraint to introduce environmental management measures that would reduce the number of exit points. Exit-only control would, of course, reduce the impact of restraint; internal journeys would be encouraged, and inbound journeys during the day for which the return journey was to be made after the end of the control period (6:00 p.m.) would not be discouraged.

At the same time, developments elsewhere are being monitored, particularly the Singapore scheme. Another scheme of interest is a proposal by consultants for the center of Bristol, England (4). This would involve a cordon of pricing points around the 10-km² central area, with all inbound and outbound trips by all vehicles except buses during both peak periods being charged at perhaps 60 cents (30p)/one-way journey. The consultants have proposed this method because the high proportions of private parking (60 percent of total stock) and of through traffic (40 percent of total peak-period outbound traffic) make conventional controls on parking ineffective. The proposal is currently subject to public consultation, but it seems unlikely that it will be adopted in the near future.

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Experience With Transit Pricing

Summary of Experience With Transit Pricing

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The quality and price of public transportation have the potential to influence a wide range of facets of urban life. There is an obvious triangular interrelationship for a transit agency among the level of output (which determines the quality of service), the pricing policy, and the level and nature of public subsidy. The key problem for the public agencies that are responsible for funding, regulating, or managing the local transportation system is to fix on the sides and the angles of the triangle. In doing so, however, they are making policy decisions that not only affect the workings of the transit system itself but may also influence the efficiency of the urban transportation system as a whole (including the environmental and energy consequences), the distribution of income and the budgetary decisions of local households, retail spending patterns, employment, urban form, and maybe even the competitive advantage of that particular metropolitan area. So while the major concern in deciding on transit service and fare levels should be with the direct transportation consequences, there are many other less direct considerations that may also legitimately influence pricing decisions.

INFLUENCES ON PRICING DECISIONS

I am aware of several major strands of research, analysis, and operating policy that concern the level and structure of transit fares. For example, the theoretical microeconomists have long been interested in the question of pricing public transportation services. Their interest has centered almost exclusively on considerations of efficiency from a variety of different viewpoints, e.g., the implications for pricing of spatial and temporal variations in the demand for transit service or the use of bus fares to offset a failure to impose efficient prices on private automobiles that share a highway facility. The analysis of transit pricing is a particularly interesting area, not only because of the lumpiness in supply and its cost and peaking characteristics but also because transit service as a consumer product exhibits a number of peculiarities. For example, the level of supply and the level of demand both influence the quality of the product itself in dimensions that are known to be important to the consumer (the frequency of service and the level

of in-vehicle crowding, for instance). Moreover, the unit of supply—vehicle-kilometers or vehicle-trips—is not identical with the unit of demand, the passenger-trip. Such wrinkles present analytical challenges that have led to the publication of several theoretical pieces in the professional literature during the past 20 years.

A second approach to these issues concerns the management and political considerations that have actually determined how transit has been priced. With one or two exceptions, these forces have been completely independent of the analyses of the theoretical economists. In the days when transit was still largely privately owned, one might expect the transit operator to behave like a regulated monopoly supplier, seeking to maximize his return; but of course he had no real monopoly, as a steadily increasing market share for the private automobile bears witness. Under public ownership, the operating agency's motives will be both different and more complex, depending principally on such factors as the degree of involvement of elected politicians in management decisions and the financial arrangements with supporting governments. In both cases, however, the analysis underlying specific pricing decisions has customarily been very limited and simple in conception. Demand response to fare changes has been predicted by industry-wide heuristic rules of thumb about the price elasticity (or the so-called shrinkage ratio), perhaps modified to reflect past local experience. Little has usually been known about the local market and the factors that influence demand among particular market segments.

This last deficiency has been greatly ameliorated by a third strand of analysis, which first gained currency in the late 1960s. Analyses of the travel behavior of individuals—through the development of cross-sectional disaggregate behavioral models of travel demand and modal or route choice and through the application of the techniques of attitudinal survey research—have produced a great deal of information about the factors that influence travel choices. Some of this information has found its way into transit planning and marketing, but it is still true that many transit operators have minimal information about their local markets.

There are also two relatively recent events that affect this debate. The first is an increased willingness of