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Comparative Commuting Costs: Vanpooling, Carpooling, and Driving Alone

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The costs of alternative commuting modes are compared by developing and using models that recognize both time and travel costs. Vanpool survey data from the Baltimore region are used to calculate costs and find an equal-cost commuting distance beyond which vanpooling is cheaper than carpooling or driving alone. The distance is found to be approximately 18.5 miles for leased vanpools that provide front-door service and 30 miles for leased vanpools that pick up passengers at a few central places. However, front-door vanpools seem less workable for commuting distances beyond 30 miles. Equal-cost distance is shown to decrease, which makes vanpooling cost-effective for smaller commuting distances, as the result of various changes. These include increased fuel cost, an increase in the perceived cost of operating an automobile, employer subsidy, provision of tax rebates or free loans for purchases of vans, and elimination of free commuter parking. High-occupancy-vehicle lanes would encourage vanpooling but no more than other, less costly strategies. Lighter 7-passenger vans do not appear to be as cost-effective as do 13-passenger vans. The decrease in equal-cost commuting distance with perceived value of time suggests that vanpooling should be attractive to lower-income workers if they were given an opportunity to join a vanpool.

As part of a project to estimate the market for vanpooling in the Baltimore region, models have been developed to compare the costs of participating in a vanpool with the costs of other modes that could be used for commuting long distances to work. Five modes are considered: driving alone, carpooling, front-door-service vanpools, central-pickup vanpools, and subscription bus. The commuting distance is assumed to be beyond that of regular bus transit, so mode is not included in the cost comparisons.

The cost models build on an equation developed by Johnson and Sen (1). They include perceived value of time as well as travel costs; thus inconvenience factors are recognized as well as money spent. The models are then applied to the Baltimore region by using data obtained locally, particularly from a vanpool survey conducted by the Mass Transit Administration (MTA) of the Maryland Department of Transportation (MDOT) in 1980 (2).

The relative perceived costs of the modes as given by the models depend on commuting distance. For each pair of commuting modes there is a commuting distance called the equal-cost commuting distance beyond which one of them (vanpooling in particular) is less costly. Insofar as cost is a factor in mode choice, the models can be used to find the commuting distance over which a particular mode would be most attractive. Recent work has emphasized the importance of social factors in the decision to join a vanpool, but cost savings remain important (3-5).

COMMUTING-COST MODELS

Drive Alone

Equation 1 shows the round-trip cost of commuting as perceived by a person driving alone a distance L between home and work. The first part of the expression represents the perceived time costs of making the trip and the second part, the perceived cost of operating the automobile. Clearly, the less aware a driver is of the real costs of operating an automobile, the cheaper the drive-alone trip becomes.

$$\text{Round-trip commuting cost (drive alone)} = 2L[(T/S) + C_{oa}] \quad (1)$$

where

- L = one-way direct commuting distance from home to work,
- T = perceived value of time ($/h),
- S = average speed during drive-alone trip to work or during line-haul portion of carpool or vanpool trip to work, and
- C_{oa} = cost of operating an automobile as perceived by person driving alone ($/mile).

Carpool

Equation 2 estimates the round-trip cost of commuting as perceived by a member of a carpool. The carpool is assumed to meet at a central place that is an average distance (d) from the homes of the poolers and then travel a distance [L - (d/2)] from the pickup place to work. (After joining the pool, members must travel an extra distance d/2 each morning and afternoon.) The first term represents the time and travel costs of the daily trip to the pickup place and back. The second term represents the trip between pickup and work. Note that carpoolers' perceived cost of operating an automobile, C'_{oa}, may be different from that of a person driving

alone. Results of surveys indicate that both S and S_p depend on commuting distance, but that S_p, the average speed between home and pickup place, never exceeded 20 mph.

$$\text{Round-trip commuting cost (carpool)} = 2d[(T/S_p) + (C'_{oa}/O_{hp})] + 2[L - (d/2)][(T/S) + (C'_{oa}/O_{pw})] \quad (2)$$

where

- d = distance driven by carpool or vanpool member to pickup place (miles),
- S_p = average speed during trip to pickup place,
- C'_{oa} = cost of operating an automobile as perceived by person already carpooling ($/mile),
- O_{hp} = vehicle occupancy from home to pickup place, and
- O_{pw} = carpool occupancy from pickup place to work.

Front-Door-Service Vanpools

The MTA vanpool survey (2) indicated that 80 percent of the vanpools picked up passengers at a few central places. However, a number of vanpool groups were interviewed in which most of the passengers were picked up near their front door. The operating characteristics of these vanpools were sufficiently different to warrant separate classification. Equation 3 divides the daily costs of participating in a front-door vanpool into four parts. The first term, which represents the perceived time costs per passenger of picking up and distributing, assumes that the average passenger is in the van during half of its pickup and delivery time. The second term represents the round-trip perceived time cost of the line-haul portion of the trip. The third term represents the daily operating costs of the van. The round-trip distance (D) traveled by the van exceeds the direct round-trip commuting distance (2L) but must be paid for by the passengers. The last term represents the fixed costs that must be paid to a leasing company or the owner for the use of the van. It is a real cost that must be shared by the passenger regardless of mileage traveled and is one barrier that has tended to limit vanpooling to longer commuting trips thus far.

$$\text{Round-trip commuting cost (front-door service vanpool)} = 2T(t_p/2) + 2T(t_L) + D(C_{ov}/P) + (C_{fv}/21P) \quad (3)$$

where

- t_p = one-way pickup time for vanpool,
- t_L = one-way line-haul time between last pickup place and work,
- D = round-trip distance traveled by van each day (miles),
- C_{ov} = cost of operating van ($/mile),
- C_{fv} = monthly fixed costs for van ($/mile), and
- P = number of passengers in vanpool.

Central-Pickup Vanpools

Equation 4 shows the daily costs per passenger in a vanpool that picks up passengers at a few central pickup places. One term is added to the previous vanpool cost expression. It represents the perceived costs of the trip to pickup place and return. If costs of driving alone and for vanpooling are being compared (C_{oa}), the automobile operating cost as perceived by a person now driving alone is used in this first term. If carpooling and vanpooling are being compared, then C'_{oa}, the automobile operating cost as perceived by an active carpooler, is used.

$$\text{Round-trip commuting cost (central-pickup vanpool)} = 2d[(T/S_p) + (C'_{oa}/O_{hp})] + 2T(t_p/2) + 2T(t_L) + D(C_{ov}/P) + (C_{fv}/21P) \quad (4)$$

Subscription Bus

In localities where the demand is sufficient, a commuter bus provided by the transit authority or a private operator provides an alternative to the modes discussed previously. If the bus picks up passengers at several places, then the cost expression would be similar to that for a central-pickup vanpool, and appropriate values for C_{ov} and C_{fv} would be inserted. An express bus serving one pickup place would have pickup time t_p = 0.

COMPARATIVE COSTS

The models outlined above were applied to the Baltimore region by using assumed or local survey values for the parameters. The numbers obtained are listed below:

- C_{oa} = $0.093/mile for persons driving alone,
- C'_{oa} = $0.165/mile for carpool vehicle,
- C_{ov} = $0.19/mile for vans,
- C_{fv} = $416/month for leased van,
- C_{ov} = $1.25/mile for 45-passenger bus,
- C_{fv} = $1360.80/month for 45-passenger bus,
- d = (0.1)L, approximately, up to a limit of 4 miles,
- D = (2L + 10.6) for front-door-service vanpools,
  = (2L + 5.4) for central-pickup vanpools,
- O_{hp} = 1.3,
- O_{pw} = 2.5,
- P = 13.2 passengers,
- S = 10 + L up to limit of 45 mph,
- S_p = 10 + L up to limit of 20 mph,
- T = $6/h,
- t_p = 0.5 h for front-door-service vanpools,
  = 0.3 h for central-pickup vanpools,
- t_L = 0.78 (L/S) for front-door-service vanpools, and
  = (L - 3.3)/S for central-pickup vanpools.

The values of C_{oa} and C'_{oa} are average results obtained by using data from a local commuting survey conducted in the fall of 1980. They are based on responses to a question asking for daily perceived driving costs (including parking). Commuting mileage was measured from maps. For an average 1980 automobile using $1.25/gal fuel and getting 17 miles to the gallon ($1.25/17 = $0.073/mile), $0.093/mile calculated for persons now driving alone corresponds to a perceived cost of fuel plus 2 cents/mile. The carpool operating cost of $0.165/mile was obtained by multiplying the perceived automobile operating cost per carpool member ($0.066/mile) times a regional average carpool occupancy (O_{pw}) of 2.5 (6). Carpool members perceived a higher automobile operating cost. However, both of these perceived costs are less than the actual cost of operating an automobile. It will be shown later that cost of operating an average automobile in 1980 was approximately $0.20/mile.

Values of C_{ov} and C_{fv} for vans are 1980 numbers obtained from VANGO, Inc., the organization that promotes vanpooling in Maryland. With C_{ov} = $0.19/mile and C_{fv} = $416/month, each member of a 13.2-passenger vanpool must pay $0.19/13.2 = $0.014/mile and $416/(21 x 13.2) = $1.50/day. For a 50-mile round-trip van the monthly fare would be $46.62.

The values of C_{ov} and C_{fv} for 45-passenger buses are assumed 1980 values, based on MTA experience.

Vehicle occupancy between home and pickup place

(O_{hp}) was obtained in local park-and-ride surveys (7). The same value, 1.3, was used for vehicles traveling to vanpool pickup places.

The value of time used for the base calculation, $6/h, is assumed. The literature contains a wide range of values of time, depending on the type of travel decision being made (8). The value of $6/h, equal to half the wage rate of a person earning $24 000/year, was chosen because it led to reasonable agreement between the cost models and results obtained in the MTA vanpool survey (2). For simplicity, the same value of time was used for driving alone, carpooling, driving to and from pickup, and line-haul travel.

Values for the other parameters are average results obtained from responses gathered in the vanpool survey. The value given for d does not mean that the distance driven to the pickup place was limited to 4 miles but merely that for direct commuting distances L in excess of 40 miles, d no longer correlated with L and had an average value of 4 miles.

The same may be said of the values for S and S_p. Once vans have picked up all passengers, their average line-haul speed (S) was the same as that for a single-occupant car driven directly between home and work.

It is interesting to note that in the Maryland survey, pickup time (t_p) did not correlate with L. Some of the longest pickup times were for vans traveling short commuting distances.

There was great scatter in the line-haul times (t_L) of the front-door service vans. However, it did correlate with a fraction (0.78) of drive-alone time (L/S). The average line-haul distance for central-pickup vanpools was equal to L - 3.3, so $t_L = (L - 3.3)/S$.

The values for front-door-service vans are based on 26 pools and, for central-pickup vans, on 88 pools.

If the locally obtained values given for all the parameters are inserted in the four cost equations, the value of the direct commuting distance L at which costs of two competing modes become equal (equal-cost commuting distance) can be calculated. The results are calculated below:

Front-door vanpool versus drive alone: L = 18.8.

Front-door vanpool versus carpool: L = 18.3.

Central-pickup vanpool versus drive alone: L = 30.2.

Central-pickup vanpool versus carpool: L = 29.5.

The values of L shown do not indicate the vanpool or carpool distance, but the direct one-way home-to-work commuting distance at which vanpooling becomes the less costly alternative. The cost comparisons assume that the vans are leased.

The equations indicate, first, that the cost of vanpooling drops below that of driving alone and that of participating in a 2.5-person carpool at approximately the same commuting distance (18.3-18.8 miles for front-door-service vanpools and 29.5-30.2 miles for central-pickup vanpools). In the Maryland vanpool survey, nearly half of the vanpoolers had formerly carpooled. The results calculated above indicate that vanpooling should be equally attractive on a cost basis to carpoolers and to solo drivers, were they given the opportunity.

At first glance, it is surprising that front-door-service vanpools, which consume an average of a half-hour each morning and afternoon picking up and distributing passengers, should be cost-competitive at a smaller commuting distance than central-pickup vanpools. However, the front-door service does eliminate the round trip to the pickup place, which is costly in terms of time and money. (For a 2.5-mile trip at 20 mph to and from the pickup place and a one-way direct commuting distance L = 25 miles, the cost of the trip to pickup and back is $2.13 compared with $11.52 for the rest of the trip to and from work.)

The MTA vanpool survey (2) verifies the calculated difference between the two types of vanpools. The average one-way commuting distance (L) was 19.7 miles for front-door vanpools and 30.9 miles for central-pickup vanpools, which indicates that front-door-service vanpools are indeed attractive at intermediate commuting distances.

The lower cost per mile of front-door-service vanpools cannot be extended to very large commuting distances. In most cases, the half-hour pickup time on which the calculations were based would not be maintained for longer commuting trips. Only two front-door-service vanpools responding to the MTA survey had values of L greater than 31 miles.

For a value of time T = $6, carpooling is less costly than driving alone for the commuting distances considered. A comparison of the two was thus not calculated.

In calculating the cost of commuting on a 45-passenger subscription bus, it was assumed that 50 percent deadheading would be required. That is, for each revenue mile, the bus would have to be driven a mile empty. This allows for traveling from a downtown storage facility, for example, to the morning pickup place and then returning to the facility at the end of the day. By using this assumption, an unsubsidized bus carrying 45 passengers costs more than vanpooling for all commuting distances, so a comparison was not calculated. If the bus could be stored near the morning pickup place overnight to reduce deadheading, commuter bus would be competitive for L greater than 18-20 miles.

CHANGES IN REAL AND PERCEIVED COMMUTING COSTS

The calculations to this point match common vanpool experience: The pools tend to be made up of persons traveling a long distance to work. As long as this is true, vanpooling will constitute a minor portion of overall ridesharing activity. In the Baltimore region, only 18 percent of work trips are longer than 20 miles and 3 percent are longer than 30 miles. Nevertheless, the equal-cost distance of vanpools versus driving alone is slightly larger than that versus carpooling because C_{oa} = $0.093/mile is used in the comparison. For comparing vanpooling with carpooling, C_{oa} = $0.165/mile is used.

Thus, the estimated potential for vanpooling in the region is very limited unless some of the cost parameters in the equations change. Now that we have estimated the length of trip over which vanpooling is cheaper than driving alone or carpooling, let us see what the effect on the equal-cost commuting distance would be if the value of some of the perceived or real time-cost or travel-cost parameters were changed. With this, we may see an expansion of the potential market for vanpooling.

Increased Fuel Cost

First, consider an increase in the cost of fuel. Keep the same perception of automobile operating costs as that used previously:

For solo drivers: C_{oa} = ($1.25/17 mpg) + $0.02/mile
= $0.093/mile
or (fuel cost/17) + 0.02.

Table 1. Variation in equal-cost commuting distance with changes in real and perceived commuting costs.

Cost	Front-Door Vanpool Versus Drive Alone[a]	Front-Door Vanpool Versus Carpool[b]	Central-Pickup Vanpool Versus Drive Alone[c]	Central-Pickup Vanpool Versus Carpool[d]
Fuel ($/gal)				
1.50	16.7	17.7	23	26.2
2.00	13.4	16.3	11	21.2
3.00	10.5	14.2	6	15.2
4.00	8.3	13	-	10.1
Increased C_{oa} ($/mile)				
0.13	13.6	-	13	-
0.20	9.2	17	4	20.5
0.163[e]	11	18.5	7	30
T ($/h)				
12	26	20.4	57	48.8
10	23.2	19.6	50	41.5
8	20.9	18.8	43	35.5
6	18.8	18.3	30.2	29.5
4	16.2	17	19.6	24.1
2	13.6	15.5	14.3	22
0	10.5	13.1	11.4	20.5

[a]Base case, L = 18.8. [b]Base case, L = 18.3. [c]Base case, L = 30.2. [d]Base case, L = 29.5. [e]Subcompact car.

For carpools: C'_{oa} = ($1.25/17 mpg) + $0.092/mile
= $0.165/mile
or (fuel cost/17) + 0.092.

For vanpools: C_{ov} = ($1.25/10 mpg) + 0.065
= $0.19/mile
or (fuel cost/10) + 0.065.

If the cost of fuel were to increase at a rate greater than inflation, as has happened in the past, the calculated equal-cost commuting distance would decrease, as shown in Table 1. Fuel cost is shown in 1980 dollars. The base calculations shown above are repeated for comparison. Not surprisingly, driving alone is more sensitive to fuel cost than is carpooling. Central-pickup vanpools improve from being less costly beyond 30 miles at a fuel cost of $1.25/gal to being less costly beyond 15 miles at a fuel cost of $3/gal. Front-door-service vanpools show less gain because their half-hour morning pickup time looms relatively larger for the shorter commuting distances at which costs of the competing modes become equal.

Change in Perceived Cost of Operating Automobile

Now suppose that the cost of fuel remains at $1.25/gal, but an educational campaign succeeds in raising the perceived cost of driving to more realistic levels. First, assume that the average solo driver is made to recognize that the real cost of operating an average car is as follows:

Cost	Amount/Mile ($1980)
Fuel	0.073
Tires and oil	0.007
Maintenance	0.045
Insurance	0.005
Total	0.13

The insurance cost shown is the portion of automobile insurance--approximately 15 percent--that depends on mileage driven. The results of a change in attitude are shown in Table 1. The equal-cost commuting distance for front-door-service vanpools versus driving alone drops from 18.8 miles to 13.6 miles. For central-pickup vanpools, the equal-cost commuting distance drops from 30 miles to 13 miles. Carpools are not included in the comparison because the average perceived operating cost for them is already assumed to be $0.165/mile.

Automobile operating costs should also include mileage depreciation. Other ownership costs such as insurance, loan interest, and age depreciation will not be assigned to the work trip because, in most cases, the commuting vehicle is used for other trips as well. However, driving to work does cause wear. If a conservative estimate of 7 cents/mile (initial cost minus salvage value equal to $7000 and 100 000 miles of use) is added to operating costs of $0.13/mile, the total automobile operating cost is $0.20/mile.

Table 1 lists the equal-cost commuting distance calculated on the assumption of C_{oa} = $0.20/mile. In this case, vanpooling is less costly than driving alone for commuting distances exceeding 9.2 and 4 miles. According to the models, vanpooling is now less costly than carpooling at commuting distances exceeding 17 and 20.5 miles. In these cost comparisons, the operating cost of vans is held at $0.19/mile because the mileage depreciation is being paid for as part of the monthly leasing cost.

Suppose now that a commuter is aware of the full cost of operating an automobile but considers the expense of driving alone--or carpooling--in a subcompact car having a fuel efficiency of 35 miles/gal. Then, with all other costs at the 1980 level, fuel cost decreases from $0.073/mile to $1.25/35 = $0.036/mile. C_{oa} drops from $0.20/mile to $0.163/mile. Doubling of fuel efficiency decreases automobile operating costs 19 percent. The new equal-cost commuting distances were calculated above. Vanpooling is still less costly than driving alone for commuting distances longer than 7-11 miles. Competition of vanpools with subcompact carpools is not significantly different from the base case.

Change in Perceived Value of Time

The last perceived parameter to be considered and listed in Table 1 is the value of time, T. Values of T from zero to $12/h, in addition to the base value of $6/h, were used in the cost models. According to the models, the cost-competitiveness of central-pickup vanpools is more sensitive to perceived value of time (L decreases more with decreasing T) than is the cost-competitiveness of front-door-service vanpools because the driving time to and from pickup increases proportionally to L. Driving-alone cost is also more sensitive to T than is carpooling cost. Insofar as value of time is linked to salary, the calculations indicate that vanpooling, if made available, should be attractive to low-income workers over smaller commuting distances than to high-income workers. The present predominance of high-income vanpoolers [the average 1980 household income in the MTA vanpool (2) survey was $30 061] may be the result of the type of employer that has cooperated in promoting vanpooling thus far as well as longer work trips made by high-income workers (6).

VANPOOL INCENTIVES

The previous section showed the effect of the cost of fuel and changes in perceived costs on the cost-competitiveness of vanpooling. There are also a variety of control measures that could be carried out to encourage vanpooling by reducing its cost relative to other commuting modes or by facilitating the initial purchase of a vehicle.

Financial Measures

All the vanpool calculations thus far have been for

Table 2. Variation in equal-cost commuting distance as result of vanpooling incentives.

Incentive	Front-Door Vanpools Versus Drive Alone[a]	Front-Door Vanpools Versus Carpool[b]	Central-Pickup Vanpools Versus Drive Alone[c]	Central-Pickup Vanpools Versus Carpool[d]
Company subsidy of 22 percent	15.9	16.1	20	20.9
Tax rebate to purchasers of pool vans of 15 percent	16.3	16.2	19.3	21.4
Interest-free van loans to purchasers of pool vans	15.1	15.3	17.5	17.3
Seven-passenger vans	21.6	21.4	33.9	38
Priority parking	16.4		25	
Parking fee of $2	9.7	15.3	0	15.9
HOV lane	14.1		10	-

[a]Base case, L = 18.8. [b]Base case, L = 18.3. [c]Base case, L = 30.2. [d]Base case, L = 29.5.

a leased van. Maryland vanpool data show that fares in company-owned and owner-operated vanpools are 22 percent lower than those in leased vanpools. This implies that corporations are subsidizing their vanpools in various ways, so that, for company-operated pools, altered cost figures should be used in the cost equation. If the van operating cost (C_{ov}) and the monthly fixed cost (C_{fv}) are reduced approximately 22 percent, from $0.19/mile to $0.15/mile and from $416/month to $324/month, respectively, the equal-cost commuting distance will decrease as shown in Table 2.

If an individual purchased a $12 000 van with a four-year 14 percent loan in 1980, the monthly payment would be $343.20. Assuming a salvage value of $3800 after four years, a 13-member pool should pay a total of $278.86/month toward the loan. Monthly fixed costs (C_{fv}) would then amount to the following:

Cost	Amount/Month ($)
Loan payment	278.86
Insurance	46.18
License, fees	2.50
Total	327.54

If the owner were to receive a 15 percent federal tax rebate on the $12 000 purchase of the van for pooling, and the $1800 rebate were spread over four years, the monthly rebate would be $37.50. Net fixed costs for the van would be decreased to $290.04. If that value of C_{fv} along with the base value C_{ov} = $0.19/mile are used in the models, the equal-cost commuting radius would be reduced to the values shown in Table 2. Legislation providing such tax relief is being discussed by the United States Senate and House of Representatives (Bill S239, Senator David Durenberger, Congressional Record, Jan. 22, 1981).

An alternative financial proposal is to provide low-interest loans for purchase of vanpools. If a totally interest-free four-year loan of $12 000 could be obtained, the monthly fixed cost (C_{fv}) would be as follows:

Cost	Amount/Month ($)
Loan payment	185.66
Insurance	46.18
License, fees	2.50
Total	234.34

The results of calculations shown in Table 2 indicate that low-interest or interest-free loans could be the most powerful of the three financial incentives discussed. The equal-cost distance would be reduced to 15.1-15.3 miles for front-door vanpools and 17.3-17.5 miles for central-pickup vanpools.

Smaller Vans

The calculations carried out earlier for a 45-passenger subscription bus suggest considering a smaller, lighter van for pooling. If a four-year $8000 loan at 14 percent was obtained for a seven-passenger van in 1980, the monthly loan payments minus salvage-value rebate would be $175.11. The monthly fixed costs would then be as follows:

Cost	Amount/Month ($)
Loan payment	175.11
Insurance	36.94
License, fees	2.50
Total	214.55

If the smaller van gets 13 miles to the gallon of fuel, the operating costs could be as follows:

Cost	Amount/Month ($)
Fuel	0.096
Tires and oil	0.007
Maintenance	0.051
Mileage depreciation	0.006
Total	0.16

When these values of C_{fv} and C_{ov} are used in the models, the per-passenger costs are higher than those for 13-passenger vans and the equal-cost commuting distances shown in Table 2 are longer than those for the base case. Lighter 7-passenger vans are not so cost-effective as are 13-passenger vans.

Parking Management

One parking measure that is already in common use is the provision of convenient priority parking spaces for pool vehicles. If solo drivers are forced to park in a less convenient place (for example, one that is a 2.5-min walk further from the entrance to work), a 5-min ($0.50) time penalty is being imposed each day. The penalty is small, yet it causes a 2- to 5-mile reduction in the equal-cost distance. The penalty would not be applied to carpools, so their competitive status relative to vanpools would remain unchanged.

A much more drastic impact, comparable to the one produced by $3 fuel (Table 1), would result from the imposition of a $2 parking fee on all commuting vehicles. The cost for a drive-alone commuter would be $2/day; for a carpooler, $0.80/day; and for a vanpooler, $0.15/day. As shown in Table 2, vanpooling becomes less costly than 2.5-person carpooling for all distances beyond 15-16 miles and less costly than driving alone for even shorter distances.

High-Occupancy-Vehicle (HOV) Lanes

To conclude, consider a more costly measure--the

implementation of a reserved highway lane for carpools and vanpools. Assume that the facility carries pool vehicles from their last pickup place to the edge of the central city or work area at 50 mph. Following that, they must travel central-city streets for 2 miles at 11 mph. If that change in speed (S) is applied to the cost models, the equal-cost distance for vanpools versus driving alone is reduced from 18.8 and 30.2 miles to 14.1 and 10 miles. The impact is significant, but no more than that of $2 fuel and less than that of a $2 daily parking fee. To implement HOV lanes in all commuting corridors would be prohibitively expensive.

CONCLUSION

Although employer promotion, computer-matching facilities, and social factors are significant in the growth of vanpooling, an important question remains: Will it result in a net time and money savings for the commuter? The cost relations developed in this paper are an attempt to express both time and money costs associated with commuting quantitatively, so some cost comparison can be applied to alternative commuting modes for trips of different lengths. By using values obtained from surveys in the Baltimore region, the models indicate that carpooling is cheaper than driving alone at all distances considered. A front-door-service vanpool becomes less costly than carpooling or driving alone for commuting trips longer than 18 miles one way, approximately, but becomes less workable for trips longer than 30 miles. Vans that pick up passengers at a few central places become more competitive at 30 miles and beyond. These results are based on costs existing in 1980 for leased vans.

If the cost of fuel increases or drivers' perception of automobile operating costs becomes more realistic or ways to make van purchasing easier are initiated or free commuter parking is eliminated, vanpooling becomes cost-competitive for a much larger portion of work trips. If the commuting distance at which central-pickup vans are cost-competitive is decreased from 30 miles to 20 miles--achievable in several ways, according to the calculations--vanpooling's share of the commuting market in Baltimore could increase by a factor of more than 6.

The connection between value of time and salary is not certain. However, the decrease in equal-cost commuting distance with decreasing value of time suggests that vanpooling, now a commuting mode used primarily by high-salaried workers, should be equally or more attractive to low-salaried employees. Promotional efforts should recognize this.

A final point can be made concerning the encouragement of ridesharing by preferential treatment of high-occupancy vehicles, for example, the implementation of traffic lanes reserved for carpools or vanpools. They should certainly be considered as part of new or widened freeway projects. However, to implement them in all corridors, thus to produce a significant impact on ridesharing, would be very costly and difficult to enforce. Furthermore, the models indicate that the impact of HOV lanes would be no greater than that of $2 gasoline, of motorists becoming aware of the real cost of operating an automobile, or of the elimination of free parking.

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