TRANSIT VALIDATION FOR CITY CENTRES

By Elbert W. Segelhorst*

The beginning of mass migration of city residents to the suburbs in the late 1940's started a gradual decline of retail trade, service and employment in central business districts. Movement into the city centres nearly equalled movement out, but growth in population and purchasing power was largely confined to the suburbs. New suburban shopping and employment centres sprang up to serve these new markets, in direct competition with the older central business districts. In order to better accommodate suburban shoppers dependent upon private automobiles, and to make suburban shopping easier and more attractive than central business district shopping, large areas of free parking were planned as an integral part of these suburban centres. In an attempt to meet the competitive advantage of this free parking, retail merchants of many central business districts joined together to offer parking validation programmes whereby they refunded the parking costs of their customers.

Although 200 American cities and municipalities have operated parking validation for 20 years or longer, the results have often been disappointing to the retailers, who continue to suffer declining sales and profits. Most programmes, however, continue to operate, although often with an even greater downward trend in the number of validations than in retail sales revenue.

DEFICIENCIES OF PRESENT VALIDATION PROGRAMMES

Present validation programmes are largely unsuccessful because they promote an unbalanced transport system to the central business district. Most validation is for parking only; transit is usually excluded. The rationale is that transit shoppers are captive to the central business district, and that extension of validation to include transit would be an unprofitable subsidy of transit customers by retailers. Thus, downtown merchants anticipated no suburban shopping centre competition for their transit customers.

The economic effects of validation are far-reaching. The subsidisation of automobile use by parking validation reduces its net price relative to that of transit use — which is undesirable in view of their relative marginal social costs — and treats the transit-riding shopper inequitably. This transit bias has an adverse long-run effect upon retail profits. It also reduces potential secondary or indirect spillover benefits

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by limiting the usage of the space-saving transit mode, thereby limiting the development of central business districts and regional land use.

The ineffectiveness of present validation programmes arises from two basic inadequacies: the failure to promote the central business district's transit advantage, and the failure to recognize the importance of benefit and cost spillovers. The result is insufficient participation and improper cost allocation; the two interact to produce a downward trend in validation usage and effectiveness.

The origins of our present central business district decline can be found in the period immediately after the Second World War. Many of those who left military service took advantage of low-interest guaranteed home loans provided by the government and purchased single family dwellings in the suburbs, where more housing space could be obtained at smaller cost than in the city centre. This emigration to the suburbs was closely matched by immigration of rural residents to the city centre as a result of declining agricultural employment. But greater growth in population and purchasing power took place in the suburbs.

Because of inadequate mass transit from the suburbs to the central business district, large-scale shopping centres were built adjacent to the suburban housing developments. In addition, highway construction was both a cause and an effect of growth of the suburbs, but the social cost of providing highways to these new areas was not fully paid by those who benefited from them. This subsidy element was especially great for peak period highway users. Much of the suburban residential sprawl and induced shopping centre development would not have occurred if highways had been priced on a marginal cost basis.

Because of the loss of sales revenue to the suburban centres, the central business district retailers introduced parking validation to combat this new competition and to maximise their profits. Profit maximisation is economically desirable when it results in more efficient allocation of resources. An efficient pattern of retailing and other land use within an urban area requires that retailers and others base their locational decisions upon the marginal resource cost of transport. If commuters, shoppers, and other users of transport base residential, employment, shopping, and other locational choices upon prices which do not reflect marginal resource cost, shopping and other locational patterns will be inefficient.

It is admittedly difficult, politically and administratively, to price transport on a strict marginal cost basis. But, given the present subsidy and average cost pricing of highways and city streets, parking validation is not the appropriate second best response for the achievement of private and social objectives. W. J. Reilly's "Law of Retail Gravitation"\(^1\) says that trade between two communities varies positively according to size and negatively according to distance. Free parking or validation reduces the cost or negative effects of distance and is viewed by retailers as a form of selling cost. Suburban centres provide parking to attract a higher proportion of long-distance shoppers and thereby increase the size of their market areas. But the

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total transport cost of suburban and central business district shopping by automobile is mainly a function of distance. Consequently, a fixed parking subsidy awards the largest cost reduction per mile to those travelling the shortest distance, i.e., those who without a parking subsidy would most likely go to their nearest shops. Suburban retailers thus fail to maximise profits. A transport subsidy based upon distance travelled by shoppers is more difficult to administer than a flat parking subsidy. But increased credit card buying in the future might permit retailers to treat more favourably customers living at greater distances from the central business district. The promotion of parking at suburban centres, on the other hand, is cost effective, because land costs per parking space are low; furthermore, public transit is not a viable alternative, as most transit service is focused upon the central business district. Suburban centres, by encouraging automobile travel, promote the mode giving greater accessibility, but fail to maximise their geographical market areas.

The provision of free parking is much more costly in the central business district than in the suburbs. Parking validation does not give the unlimited and unrestricted free parking provided in the suburban centres. Moreover, both shopper and retailer incur added transaction costs, which contribute to making parking validation a more costly and less effective substitute for free suburban parking. Because of the rapidly rising costs of providing additional parking space in the central business district where land is relatively scarce, the marginal cost to the central business district merchants of attracting additional shoppers would be less for transit than for parking. Thus the lower cost of induced transit shopping is more profitable. While parking validation tends to neutralise the suburban parking advantage, it does this at a higher cost, and promotes the use of automobiles instead of transit.

Because of the stronger competition in regional labour markets and nationwide wholesale markets, retailers have greater discretion in setting the prices of goods sold to consumers who must purchase their requirements in relatively less competitive local markets. Any advantages derived from free parking privileges go to the close-in automobile shopper of both the central business district and the suburban centre. When the costs of providing free parking are passed on to the consumer in higher prices, the transit shopper and the more distant automobile shopper are discriminated against. The net effect of this differential treatment is to reduce the geographical market areas of both centres by the excess entry of competing retailers. Thus both centres forego potential profits. The more distant shopper, whose demand is more price elastic because of his close proximity to competing market centres, is given a relative price increase, rather than the decrease necessary to induce his patronage.

Because the effect of parking validation is equivalent to reducing the delivered price of a product more for the close-in than for the distant shopper, central business district merchants could meet the free parking threat more effectively by direct reduction of prices. This would save the transaction cost of parking validation, and the suburban shopper could be attracted by special discounts on merchandise attractive to suburbanites. While price reduction is not a positive planning instrument for reducing urban transport costs, it would not increase the already existing price bias against public transit.3

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When not cast in its present limited role as a last possible measure to save the central business district from further decline, validation becomes a potentially powerful instrument for coordinated urban transport planning. When emphasis is shifted to transit validation instead of parking validation, the objectives become compatible and attainable. An optimal validation solution could be organised by either of two methods. One method entails voluntary cooperation and is more applicable to small central business districts. The other method requires the formation of a validation district, and applies better to central business districts where retail activity is more depressed. In both instances costs are allocated in proportion to direct plus indirect social benefits, which are calculated partly from increased property and sales tax revenues, central business district site rents, and use by participants.

TRANSIT VALIDATION

The existing transit bias is partly the result of the failure of transit and planning officials to change the obsolete transit fare structure to conform with the present realities of cost and competition. The flat fare is consistent neither with the profit-maximising objective of the transit company nor with efficient transport utilisation. Transit has a high proportion of fixed costs to variable costs. The marginal cost of serving additional passengers is lower than average cost and is often close to zero. However, unlike the automobile user, who incurs only the short-run marginal cost of making an added trip, the transit user is charged average total cost, which further biases the choice against transit use for short trips. Therefore, even if the average cost per trip were identical, transit could not compete with automobile because of the transit price bias.

In view of this biased and unbalanced urban transport system, how can transit validation increase economic efficiency? Who would benefit?

Transit validation is of significance not only to the participants, but also, because of its indirect effects, to all individuals who live, work, or shop in the central business district and in the surrounding area. It could improve the position of the central business district relative to other competing areas, and hence improve central business district profits.

Shopping transit validation could reduce the overall cost of transport for central business district shoppers, and consequently improve the relative accessibility of the central business district, for a given transport cost outlay. Substitution of relatively more accessible central business district shopping for former suburban shopping would increase the growth of gross sales in the central business district and retard it in the suburbs. Such reallocation of sales could promote the combined economic efficiency of both central business district and suburban areas.

Some suburban shopping centre customers will prefer central business district shopping when offered a reduced transit fare based upon marginal cost. The redistribution of customers that will result from the lower off-peak fares will result in lower

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total shopping cost. A more efficient pattern of land development will result from a more efficient utilisation of the existing transit system. The amount of increased central business district profits largely depends upon the resulting percentage increase in gross sales, the rate of retail mark up, and the cost of validation to the businessman.

There are two other reasons why transit validation is likely to increase the accessibility and the business profits of the central business district. Some central business district shoppers are likely to substitute the now relatively cheaper transit for their automobiles and, since transit validation is cheaper than parking validation, business validation cost will be directly reduced. More important, parking space will be freed, indirectly making the central business district more accessible to suburban shoppers. Substitution of transit for automobiles by present central business district customers reduces congestion cost in the form of lost time and associated nervous strain imposed upon automobile shoppers, businessmen, and retail suppliers.

The response of central business district shoppers to transit validation should increase over time. Not only will shoppers need time to adjust their shopping behaviour, but the advantages of the central business district should increase with long-run growth and adjustment of the central land use pattern. Retailers are concerned with maximising their net worth, which is a function of the present value of the entire stream of future net income. The long-run adjustments will be brought about by a relative decline in automobile shopping in the central business district, which will release parking space for retail and other expansion. The increased concentration of retailing within the core will increase its relative locational advantage and hence contribute to long-run profitability. The central business district will appear relatively more attractive to one-car families which are partially dependent on transit. Automobile ownership may rise less rapidly.⁵

Retailers have overlooked short-run and long-run effects of transit validation upon marginal revenues and marginal costs, i.e., upon their own profits. If, as a first approximation, retail sales are a linear function of the number of shoppers, then the added revenue contribution of transit validation depends upon the elasticity of demand for transit shopping. Only if the demand for transit shopping were perfectly inelastic to price change would transit validation make no added contribution to gross revenue.

Transit authorities normally base fare structure on a 0.33 price demand elasticity, which has become a “rule of thumb” in pricing policy throughout the industry.⁶ The methods and data used to arrive at this low estimate are questionable in the light of recent research, which classifies transit demand according to time, place and objective.

The earlier estimates mainly reflected the aggregate work trip demand. No distinction was made between those captive to the system and those who had access

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⁵Metropolitan areas which provide greater transit service have a lower per capita rate of automobile ownership. See J. R. Meyer, J. F. Kain, and M. Wohl, *The Urban Transportation Problem* (Cambridge, Mass.: Harvard University Press, 1965), chaps. 1–3.

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to alternative modes, even during the peak period. One study suggests an elasticity near unity for those having a choice between public and private modes for peak period journeys to work.7

For off-peak non-work transit demand for purposes such as shopping, personal business, and social and recreational activities, substantially higher elasticities have been established. Also different social groups, age structures, and family structures exhibit different effects on the elasticity of transit demand. Elasticity estimates reflecting this off-peak demand range from 0.78 to unity9 and as high as 2.0 for smaller cities.10

The failure of transit officials to price transit according to the different demand elasticities of transit users has biased users' choice against transit, with the result that transit riders constitute almost exclusively those captive to the system. A change in relative cost in favour of transit is likely to bring a substantial increase in shopping by transit, since elasticities are greater off-peak when most shoppers travel.

It should be recognised, however, that the greater the price elasticity of transit shopping demand, the greater the cost of the subsidy. It is impossible to identify new users and to offer validation only to those who would not shop in the central business district without validation. While such discrimination might result in increased short-run profitability, it would be inconsistent with desirable long-run policy, since those discriminated against would tend to buy automobiles and to reduce central business district shopping.

Inability to distinguish new from present shoppers does not mean that all transit shoppers must be given the same subsidy. On the contrary, since more distant shoppers are less likely to shop in the central business district and tend to have more elastic demands, a greater subsidy to them is warranted because of the greater amount of additional net retail revenue they contribute. The distant shopper, upon paying the inbound fare, could obtain a ticket indicating his zone of origin. The ticket could then be validated by the retailer and would allow a free return trip downtown in addition to the immediate trip home. All future transit shopping trips would be free, provided the shopper made subsequent purchases in the central business district.

Employment

Central business district employers also follow policies biased against transit. Employers, including retailers, often provide parking space for employees but make no contribution for employees using transit. Other things being equal, an employee will choose automobile rather than transit because of the subsidy. An equal subsidy


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should be given to each employee to permit him to choose the mode most attractive to him. Since the marginal cost of transit, even for peak period use, is lower than the cost of providing additional all-day parking, employers' costs are reduced and profits increased. As with retailing, non-retail employers located in the central business district suffer when business space is converted into parking. These businessmen and their customers are inconvenienced and incur added costs from deconcentration of the central business district. Thus, non-retail employers have also failed to consider the effect upon marginal business costs and revenues of the present transit bias.

The increase in central business district sales and employment induced by transit validation will result in an increase in city retail sales, gross receipts, license fees, and general property tax collections. This net increase in tax receipts is partly at the expense of surrounding areas, which directly compete for the consumer's dollar. Over time a part may also be at the expense of other areas within the region, state, and nation, as this area experiences faster growth because of its superior accessibility. Although local tax rates may not decrease, the local taxpayer may nevertheless be better off as a result of improvements in the quality of the local environment. For example, less public funds will be required in the central business district to police traffic congestion, and additional tax revenue at constant rates will become available for additional governmental services. The increased accessibility of the central business district will in turn enhance its location advantage, and therefore increase the demand for adjacent property, which will be reflected in higher property values and tax revenue at constant tax rates. The central business district is the focus of service of transit systems. Its decline has meant a decline in transit riding. The fortunes of central business district businessmen and of the transit company rise and fall together. Transit validation is one way in which these two sectors can cooperate to help further their mutual interest. A critical factor in the initiation of such cooperative endeavours is the need for transit officials to adopt a flexible, incremental pricing policy. If businessmen are willing to increase the demand for transit by paying their customers' transit fares, the transit company should reciprocate by allowing the businessman a discount on the basic fare. With no discount on its fare under validation, transit gross revenue must increase because of some additional passenger riding. Consequently, while it is certain that the transit company can profitably make some price concession to the merchants, the size of the discount would depend upon the price elasticity of transit demand. Since off-peak demand for transit has substantial elasticity, profit maximisation by transit requires lower off-peak fares, whether or not retailers provide a subsidy.

**Distribution of Benefits**

Transit company profits, and the profits of all other business establishments located in the central business district, can be increased through a mutually cooperative effort. But a critical factor in the success of any validation programme is that participants, i.e., individuals and organisations contributing to the cost, recoup the benefits resulting from their subsidy. Unless participants can realise the benefits of their actions, benefit spillovers will reduce their willingness and ability to support the cost. Spillover of benefits occurs when some portion of the benefits accrues to non-participants. Ideally an efficient and effective scheme requires that all participants
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share in the same ratio of benefits to costs. Present validation programmes give rise to benefit spillovers and inequitable sharing of benefits, for three reasons.

First, a major portion of parking validation benefits financed by retailers is enjoyed by non-retailers who do not share the costs. Non-retail land uses in the central business district gain from increased accessibility for retail use. For example, a shopper is likely to utilise banking, financial and other professional services in conjunction with his shopping trip. Furthermore, increased accessibility of the central business district for retailing will enhance its desirability for office and other employments.

Secondly, non-participant retailers share in the increased sales and profits. Most shopping trips into the central business district result in customers purchasing at both participant and non-participant stores. Thus benefits are shared by all central business district retailers, while financial costs are borne only by participant merchants. A downward spiral of participation commences as non-participants attempt to ride on the “coat tails” of participants. Higher costs of validation to the remaining participants, plus the decline in the attractiveness to the shopper, cause reduced business participation and encourage a downward trend.

Thirdly, almost all validation programmes allocate cost among participants in proportion to the number of tickets which each merchant validates. Some also include a basic membership fee, which may vary according to business category. Membership fees at most cover only overhead costs of administration and advertisement. These methods of cost allocation fail to apportion cost according to the total benefit/cost ratio rule. The number of shoppers who validate at certain stores, such as large department stores, is likely to be proportionately greater than purchases there. Consequently, small participant specialty shops receive a relatively greater proportion of benefits to costs. Also, a retailer’s profit per customer varies considerably by type of merchandise sold. Stores with low merchandise turnover, but high markup per sale, benefit more per additional customer and share more in benefits than in costs. Thus, even though validation were inaugurated with 100 per cent retail participation, cost spillover would soon induce some participants to drop out.

Therefore, apart from the transit bias effect, spillover is a further important factor in the decline of existing validation. With fewer participants, total costs increase to remaining members, while participant and non-participant retail sales benefits decline because of the decreased overall attractiveness of validation to shoppers. The result is a spiral of increasing cost, decreasing participation, declining benefits, and increasing cost.

But the spiral could be reversed. A well financed and administered transit validation programme could promote self-sustained growth. The solution may be approached through the formation of a transit validation district and, in some less populated areas, through voluntary cooperation.

The Transit District

In order to minimise spillover effects, the cost of the programme must be apportioned in relation to benefits received, which in most cases would require the formation of a transit validation district. The district would embrace a defined geographical area, which could be expanded over time to coincide with central business district lateral growth.
All business firms would be required to support the programme as a condition of obtaining business licenses to trade in the central business district. Individual firms adjacent to transit lines but located beyond the district could voluntarily participate by subscribing to the same cost formula as firms in the district.

As a first approximation, the cost could be spread as follows. The transit companies would grant current fare discounts of 25 per cent on validated tickets used during off-peak hours. Those passengers who used validated tickets during peak hours would be charged the 25 per cent discount allowed during off-peak use. The city and/or other governmental agency which receives revenues from the central business district in the form of sales taxes and property taxes would contribute 25 per cent of the costs. The increased revenue accruing to these governmental agencies from the programme should exceed 25 per cent of the costs; consequently, no increase in tax rates would be necessary. Participating business organisations would contribute the remaining 50 per cent of programme costs. Half this amount should be contributed in proportion to a percentage of the computed site values, i.e., present land values excluding improvements. A land value approach is desirable because it continually and automatically reallocates costs among beneficiaries, as changes in the long-run growth pattern emerge within the central business district and co-operating outlying areas. The remaining 25 per cent of current transit fares should be charged to participants according to the number of validated tickets they issue. This 25 per cent represents the proportion of direct benefits the businessman realises from the customer and approximates the marginal social cost of off-peak transit service.

Cost apportionment based on profits or gross sales revenue would be inefficient and less equitable. A profit approach would discourage more efficient land use by subsidising firms not optimally located in the central business district. A sales revenue approach would differentially favour those using a relatively higher percentage markup on merchandise sold, thus causing participants with relatively lower markups to drop out.

Once the programme costs are distributed in proportion to benefits, the method used by participants in validating tickets is only of secondary importance to the economic success of the overall programme. Each retailer could determine the amount, if any, of the required minimum purchase for a validation ticket. Firms with few customers but high percentage markups might have no purchase requirements. Retailers might offer free one-way tickets to close-in shoppers and free round trip tickets to more distant shoppers, thus equalising the elasticities of these two shopping groups. The projected central business district shopping demand produced by tie-in purchases appears to be of decreasing importance; but a small retail purchase requirement will tend to minimise capricious transit riding. Those employers who provide parking for their employees would offer validation privileges to them as an inducement to transfer to the more economical transit, thereby lowering business costs. As a further inducement the employer might also absorb the added 25 per cent peak period charge. Parking validation programmes should be phased out.

**Voluntary Scheme**

The voluntary approach can be initiated in central business districts of smaller cities where retail sales still account for a relatively high percentage of area gross
sales revenue. In such areas, voluntary support must be obtained from central business district retailers and from as many professional, service, and governmental organisations as possible, to ensure a strong and profitable scheme. Voluntary support is more likely when the central business district is relatively homogeneous and possesses a high degree of community awareness.

A moderately lengthy trial period is needed to realise the full potential of the programme and to permit innovation and change as results are experienced. Continuous and vigorous promotion by flyers, billboards, newspapers, radio and television is required to create public awareness and acceptance. The programme is designed to increase demand by changing tastes – to shift the whole demand schedule – rather than simply to increase quantity demanded at a lower price. An initial one-shot promotional campaign may not be sufficient.

A voluntary programme cannot solve the traffic congestion problems in some of our larger cities. The correction of these long-standing economic problems, which have resulted from discriminatory institutional transit policies, generally requires drastic measures. Proposals have ranged from congestion taxes to complete abolition of automobile travel in central business districts. To prohibit the use of a major urban transport mode would adversely affect those who would voluntarily pay the marginal social cost of automobile travel, and would thus further misallocate transport resources.

The transit district solution, although non-voluntary, would be necessary to overcome the obstructionist attitude of some firms, especially those not optimally located and those whose management is tied up in trusts and estates.

CONCLUSIONS

Vast amounts of capital have been invested in the vertical growth and expansion of business service industries located in the regional core. These capital commitments, as well as future investment, will be wasted if current urban transport problems are not quickly solved. The federal government has appropriated funds for urban mass transit research and development. This type of transit subsidy will not appreciably offset the bias in favour of the automobile which has resulted from inefficient institutional transport pricing policies. What is needed is a system of pricing which more closely approximates marginal resource cost. Efficient resource allocation could then be achieved by free market forces. But, in the absence of any movement towards this ideal solution, government subsidies in the form of demonstration grants could be used to underwrite the promotion needed in the early stages of programme development, thereby eliminating any risk that may be involved in initiating validation programmes. Voluntary private support can be more easily achieved if central business district businessmen are assured that any temporary losses resulting from initial validation promotion will not accrue to them.

Transit validation could increase efficiency and equity by reforming and improving the balance of our urban transport system. It can be an effective tool in protecting and improving the rate of return on the large amount of private and social capital we have invested in our cities.
APPENDIX

The following four equations are used to demonstrate the effects of a transit validation programme on central business district retail profits where retailers absorb all the programme costs. The equations do not include contributions from public sources, nor do they include transit company off-peak fare reductions.

The cost of the programme \( C_t \) is expressed in equation 1:

\[
C_t = \frac{BR}{A} [X(1-v) + s(1-v)(xX+yY+z\zeta)+wae]
\]

(1)

where

- \( B \) = Cost of transit validation to retailers per transit shopping trip.
- \( R \) = Total gross retail revenue of area served by existing transit system.
- \( A \) = Average expenditure per retail shopping trip.
- \( v \) = Ratio of \( R \) going to suburban shopping centres.
- \( s \) = Percentage decrease of transit round trip fare to transit shoppers.
- \( X \) = Ratio of gross sales revenue of central business district derived from transit shopping trips.
- \( x \) = Percentage change of \( X \) to transit fare change.
- \( Y \) = Ratio of gross sales revenue of central business district derived from automobile shopping trips of automobile users who seldom use transit to shop.
- \( y \) = Percentage change of \( Y \) to transit fare changes.
- \( \zeta \) = Ratio of gross sales revenue of central business district derived from automobile shopping trips of automobile users who occasionally use transit to shop.
- \( z \) = Percentage change of \( \zeta \) to transit fare change.
- \( w \) = Percentage change in central business district shopping trips, resulting from transit fare changes, of shoppers who previously shopped at suburban centres.

Those who presently shop in the central business district are divided into three categories according to mode and degree of preference. The first group \( (X) \), those captive to transit shopping, are the major contributors to programme costs. Under the programme, one half of their current transit shopping fare payments, plus one-half of the cost of additionally induced transit shopping trips, would be absorbed by central business district retailers. Only a small portion of the second group \( (Y) \), those with low transit preference, would be induced to shop by transit. Transit validation costs incurred from mode shifts in this group will be offset by parking validation cost savings. The third group \( (\varsigma) \) is comprised of central business district shoppers who are less biased against transit. A greater modal shift will take place in this group, but costs will again be offset by savings in parking validation cost.

The final addition to programme costs results from increased central business district transit shopping trips generated by those who shopped exclusively at suburban centres. A portion of this group will be induced to shift mode and shopping location to take advantage of transit fare reductions. An offset to programme cost is realised when central business district automobile shoppers who previously took advantage of the more costly parking validation programme are diverted to lower cost transit validation. This shift of central business district automobile shoppers to transit shopping will result in cost savings \( (S_t) \) expressed in equation 2:

\[
S_t = \frac{dPR}{A} [v(1-v)(Yx+y\zeta)]
\]

(2)

where

- \( d \) = Percentage of automobile shoppers in central business district who use parking validation.
- \( P \) = Cost of parking validation to retailer per automobile shopping trip.

The amount of net retail sales \( (R_t) \) diverted from the suburban centre to the central business district is expressed in equation 3. \( R_t \) represents only the amount of mark up \( (m) \) realised after deducting the cost of goods sold from area gross sales revenue \( (R) \) shifted as a result of the programme.

\[
R_t = \frac{ueRm}{1+m}
\]

(3)

It should be noted that the transit validation programme cost incurred as a result of the shift in \( R \) is included in equation 1.
Changes in central business district retail profits ($\pi$) can now be determined by summing equations 2 and 3 and deducting the programme costs derived from equation 1:

$$\pi = R_t + S_t - C_t$$  \hspace{1cm} (4)

No provision for increases in sales expense is included in equation 4, because it is assumed that sufficient excess capacity initially exists in central business district retail facilities, owing to a prevailing atmosphere of steady decline in retail sales.

When the variables $w$, $A$, and $v$, which appear to be the most critical, are tested for sensitivity by further lowering their estimated values from conservative initial values, profitability remains probable, at least in the aggregate.

A profit of $5.1$ million is obtained by using in the equations the coefficients\(^1\): $B = 0.25$; $R = 695$ million; $A = 10000$; $v = 0.856$; $s = 0.5$; $X = 0.7$; $x = 0.5$; $Y = 0.5$; $y = 0.1$; $z = 0.2$; $z = 1.0$; $w = 0.1$; $d = 0.5$; $P = 0.50$; and $m = 0.3$. If the value of $A$ is reduced from $10000$ to $5000$, other values remaining the same, profits drop to $3.4$ million. If the estimated value of $w$ is reduced from 0.1 to 0.05, profits decrease to $2.0$ million. The combined effect of reducing the values of $w$ and $A$ by 50 per cent still gives profits of $0.7$ million. When the value of $v$ is increased, reflecting a greater decline in central business district retail sales, lower values of $w$ and $A$ may be used without lowering profits.\(^2\)

Transit validation programmes supported exclusively by central business district retailers appear to be profitable in the aggregate when conservative values are used in the above formula. But the high degree of programme support needed to eliminate cost-benefit spillovers is not likely to be achieved by purely voluntary schemes. The problem of spillover can be greatly reduced by formation of transit validation districts and the additional participation of employers, transit companies and governmental agencies. A higher degree of efficiency in urban transport and land use can thus be achieved.

\(^1\)The coefficients used in the numerical example were obtained from a case study of Long Beach, California (1966 pop. = 500,000). Where statistical data was unreliable or statistically insignificant, conservative coefficient estimates were used.

\(^2\)The estimate for $v$ obtained from the Long Beach data appears to be typical of most retail sales areas containing populations of 500,000. For areas with higher populations $v$ values increase. Areas containing populations of 3 million have $v$ values of 0.92 and greater.

\hspace{1cm}

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