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**CONGESTION MANAGEMENT:
TRAVEL BEHAVIOR AND THE USE
OF IMPACT FEES
VOLUME II:
TRAFFIC IMPACT FEES: ISSUES
REGARDING CALCULATION
AND EFFICIENCY**

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ABSTRACT

Many communities are using or **considering** the use of **traffic** impact fees as a method to help finance construction of roads required because of new development. Such fees are intended to reflect the demand for road capacity which new development generates. However, there is little analysis of the appropriate role of impact fees in the financing of public infrastructure. The literature on impact fees indicates that there are many methods used to implement the fees and much discussion of the methods.

The discussion of methods centers on estimating the impact on demand for road capacity, but the methods which are typically used to estimate traffic impact may not be accurate. Unfortunately, the data required to accurately predict traffic impact are not readily available. Also, the formulas which would be needed to differentiate between different types of development may become quite complex.

Most formulas in use start with estimates of the trip generation rate for different types of development. These estimates of trip generation rate then may be adjusted to more accurately reflect the demand which will be placed on road capacity. Some of the factors which will **affect** the demand for road capacity **are** average trip length, percentage of trips which represent new trips, and peak versus off-peak generation of trips. Data on some of these factors are available, but they are not as uniformly available nor as reliable as the estimates of trip generation rates. There is broad agreement that where traffic impact fees are used they should be **uniform** and predictable, but there is a trade-off between this goal and the goal of accurately charging for the **traffic** impact of specific development projects.

While many jurisdictions use **traffic** impact fees, there is little analysis of the efficiency incentives which would be generated by this use of the price system. In particular, it is expected that lower density of development should lead to longer average trip length and greater demand for road capacity, but no **traffic** impact fees were found to vary with density of development. A variety of other efficiency considerations could be addressed by traffic impact fees, but additional research is needed to determine the appropriate fee structures and likely effectiveness in changing development patterns.

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INTRODUCTION

There is a growing concern that government is not **funding** infrastructure investment in the United States at a sufficient level. Several studies have identified massive **funding** requirements that are not being met (National Council on Public Works Improvement, 1988; **Kaplan**, 1989; U.S. Congress, 1990). Failure to meet these requirements is rational to the extent they are based on standards of service which are set unrealistically high or on other conceptual errors; however, failure to provide the funding to accommodate growth is likely to result in a deterioration in the level of service which is provided. Thus, the choice for growing communities is between infrastructure expenditures and declining service.

In response to the demand for infrastructure and the reduced availability of other funding sources, many local governments have started levying charges on new development for the purpose of **funding** off-site infrastructure requirements. These charges are broadly known as Development Impact Fees or Systems Development Charges. The term "traffic impact fee" (TIF) will be used in this paper to clearly identify the scope of fees under discussion.

Development Impact Fees or Systems Development Charges do not have a universally accepted definition, but they are generally ~~the~~ set of charges or fees levied on new development to generate revenue to cover the costs of required increases in off-site capacity for various types of publicly provided services. Traffic impact fees usually are charges levied on a formula basis to help cover the cost of off-site road development associated with growth; however, some jurisdictions levy fees based on detailed estimates of traffic impact rather than on a formula basis.

There is substantial controversy about the appropriateness of this source of funds and about the likely efficiency and equity effects of changes in the **funding** system for local infrastructure. In general, the courts have held that such charges are acceptable if they are

levied in response to demands which development places on the community and if the funds are used for infrastructure related to that development (Delaney, Gordon, and Hess, 1987, Fulton, 1987, Nicholas and Nelson, 1988, Porter, 1984, Porter, 1985, Snyder and Stegman, 1986) Thus, most traffic impact fees are intended to reflect the demand for off-site road capacity generated by new development However, there are many issues regarding the level of such fees and the methods by which they are calculated

Increased demand for road capacity is associated both with growth and with an increase in usage by existing residents To the extent that the impact fees are intended to raise revenue equal to the cost of providing infrastructure needed for new development, it is essential to separate these different causes of increased demand

Determining impact fees is further complicated by possible alternatives to new construction as methods to meet increased demand. For example, it may be possible to use various methods, such as increasing transit services and requiring traffic management programs or implementing congestion pricing, to reduce traffic volumes. These alternatives may be more cost effective or more **efficient** than increasing capacity. However, we normally expect increases in demand to require increases in road capacity to prevent deterioration of service levels, and discussion of traffic impact fees typically starts with the assumption that additional capacity must be provided.

There are serious questions about the efficiency of the current funding systems and about the efficiency of using impact fees to finance construction of roads, but these issues are seldom addressed in the literature related to traffic impact fees (for an exception, see Lee, 1988). From an economic perspective, the efficiency issues are related to the cost and pricing of services. Since an impact fee is a price for development in a community, the pricing effects should be analyzed for efficiency. Yet most analysis of such fees has focused on the ability to generate revenue and on the equity of the charges.

This report starts with a review of the issues which typically arise in setting a traffic

impact fee. Most of these issues relate to estimating how a particular type of development will impact the demand for road capacity. There are substantial trade-offs between the desired measures of impact and the data available. The next section discusses some of the efficiency issues which may be addressed using traffic impact fees and discusses which type of fee is likely to promote efficiency. In particular, land usage is discussed as an externality which increases average trip length, and the possibility that existing finance methods lead to inefficient under-provision of road capacity in growing areas is developed. Impact fees are evaluated in the context of these **efficiency** considerations. Trade-offs between efficiency and implementation issues are discussed. The concluding section offers some suggestions for research which may lead to improvements in the economic efficiency of traffic impact fees.

LITERATURE REVIEW

Most impact fees have a stated intent to charge new development on the basis of the demand for capacity which is created by that development. Based on this intent and on legal requirements that new development be charged only for the cost of providing **service** required because of the new development, it is necessary to determine the causes of increased demand. First, an increase in demand for service may arise among existing residents of a jurisdiction as people buy additional automobiles, drive more, or do more of their driving at peak times. Second, infrastructure may be needed to replace existing items which are aging or deteriorating. Third, changes in the regulatory environment may require changes in the amount of infrastructure, such as changes in safety requirements. Finally, infrastructure demand can increase in response to growth. It is only the latter increase in demand which can legally be **funded** by **traffic** impact fees. Hence, a community using a traffic impact fee must either have some method of estimating this component of increased demand or must set the fee so low that it is unlikely to be challenged.

When infrastructure requirements are caused by growth, it is also **useful** to distinguish between infrastructure directly related to tying the new development into the community system and new capacity required off-site to provide services associated with the increased demand (sometimes distinguished as project improvements versus system improvements). It is widely accepted that new development should pay for local access streets, but beyond the immediate access, the contributions of new development to traffic problems become harder to quantify

Historically, communities have provided infrastructure **funding** from general tax revenues, and the use of development fees is a change from this method of financing for local infrastructure. Prior to the 1920s, local governments willingly extended infrastructure to undeveloped land to serve existing demand and to induce economic development (**Nelson,**

1988a). During the 1940s, it became normal for developers to connect services to each lot or home **from** the perimeter of the property. Thus, it is now customary that developers install sewers, water lines, and streets within the development. This requirement or exaction of infrastructure is implemented as part of the subdivision process.

Types of Fee Structures and Exactions

The reduction in general fund provision of infrastructure has led to a variety of approaches that involve private funding of roads and other infrastructure. These include special assessments, negotiated fees, exactions, development fees, and impact fees (Cervero, 1988; Meisner et al, 1988, Snyder and Stegman, 1986, Angell and Shorter, 1988). Each of these mechanisms require that developers pay for or provide some of the infrastructure which might **otherwise** be provided by the public sector. However, an overview of the programs in place indicates that there is considerable variation in scope of coverage and methods used for calculating fees. For example, Draper (1987) studied impact programs in localities in five states and found a broad range in levels and types of fees.

Purham and Frank (1987) report the results of a survey conducted in 1985, using a random sample of cities and counties (11,722) stratified to ensure appropriate representation by size. They estimated from the results that "41.2% of communities never require developers to make cash payments for any type of facility whatsoever" (p. 137). For those that required fees, 25.9% used a formula, 17.4% used a case-by-case basis, 7.9% used a standard with some flexibility and 4.7% varied by facility type. The facilities for **which** these fees were charged were most commonly on-site (40.3%). The study did not distinguish among types of cash exactions.

Bauman and Ethier (1987) used a study of 1000 communities nationwide, with a 22% response rate. 30.8% of the respondents required impact fees for roads. The method most often used for calculation was a flat rate. The authors noted that some planners felt that the terms "on-site exaction, off-site exaction, in-lieu-fee, and impact fee" were too imprecise.

Some of the **confusion** can be eliminated by carefully separating on-site and off-site improvements. As noted earlier, there is broad agreement that developers should be responsible for most on-site infrastructure development, including local roads. However, many impact fees are simply designed to reimburse government for the cost of on-site infrastructure. Yet even restricting attention to fees which appear to be intended to fund off-site roads shows a bewildering range of fees and methods to calculate them

It may be helpful to consider the range of impact fees which are in use. In a recent national study, **Leithe** and Montavon (1990) found that, of the 31 communities charging impact fees for roads, the range was from \$298.50 to \$5,000 per dwelling unit, with an average of \$1,329. In addition to fees per single-family dwelling unit for roads, other methods referred to trip ends (e.g., \$30 per trip end or \$1.50 per trip end, which could vary by subarea); average multifamily rates (\$83.1 per unit); average business rates (\$260 to \$8,414 per 1000 sq. ft. of space); and pm peak hour trips through a specific intersection (\$355 per peak hour trip). Other rates included 10% of the value of new business construction, \$300 per house or \$1.00 per sq. ft. of space, \$0.20 per sq. ft. for dwellings, \$300 residential (\$450 non-residential) per vehicle mile for pm peak hour traffic, and \$130 per acre (p. 17). Over two-thirds of the respondents' had separate fee schedules for residential, commercial and industrial developments.

Cervero (1988) studied impact fees, special assessments and negotiated fees used in California. Fifty-eight counties, 103 cities with population greater than 40,000 and fifty-three smaller cities were surveyed, with a response rate of sixty-three percent. Impact fees were rated "good" or "excellent" by two-thirds of the respondents. He found negotiated programs were rated the least desirable.

Obviously, there are substantial differences regarding the method used to implement such fees; but even these relatively arbitrary systems appear to be an improvement over non-fee methods of having developers finance infrastructure. One of the simplest methods

involving private **funding** allows growth to continue until some key infrastructure system reaches capacity, requiring the next development to augment capacity before approval will be granted for that project. These improvements can be far in excess of the impact of a particular development. The developers that follow will use this excess capacity until facilities again become inadequate, requiring the next developer to provide additional capacity. This system is widely agreed to be unfair and inefficient

Requiring that all developers provide some infrastructure before project approval is granted can spread the cost more fairly among developers. This can be accomplished with either exactions or negotiated fees. However, this process can lead to substantial uncertainty as to the ultimate cost. In addition, different developers may have unequal bargaining power, leading to inequitable distribution of costs among developers.

Development Impact Fees, or more specifically, traffic impact fees, are a method to share the cost of infrastructure development in a more predictable and consistent manner, with the developer's share based on that development's trip-producing characteristics. Traffic impact fees are one-time fees based on traffic studies that **determine** future needs and the contribution of development to those needs. They use a fee rate that is calculated on the basis of the number of trips generated by **land** use and the cost of constructing highway capacity to accommodate those trips. Much of the variation in the methods of calculating the fees reflect different methods of calculating traffic impact or trade-offs between accuracy and simplicity

Formula-Type Fee Structures

One of the essential elements in calculating impact fees is establishing the rate mechanism to be used in the formula. The simplest formulas charge a fee based on some easily identifiable **characteristic**, such as the number of residential dwelling units or the acres of land. However, there are likely to be substantial differences in the amount of traffic which is generated by specific developments. It is possible to require that each development be studied in detail to determine its expected impact, but this defeats the desire for simplicity and

certainty in setting fees.

Basic Form

Many formulas for calculating impact fees start from the general form:

$$\text{Charge} = [\text{TGR} * \text{Size} * \text{ATL}/2] * [\text{Cost}/\text{Capacity}]$$

where TGR is measured in vehicle trips per unit of development, Size is the number of **units** of development associated with the project, **ATL**¹ is the average trip length for trips associated with this type of project, Cost is the dollars per lane-mile needed to construct roads in the area; and Capacity is the number of vehicle miles per lane mile. The charge is then a measure of the average cost of constructing enough new road capacity to accommodate the traffic from the new development. The specific numbers will differ depending on the definitions used. For example, capacity will differ if it refers to the entire day rather than peak hour. This base charge can then be adjusted for various reasons.

There are a variety of methods to implement this basic approach, and some specific applications include the following. Barnebey et al (1988) used a basic structure of half the average trip length times the trip generation rate divided by the capacity per lane-mile of road construction. This was then multiplied by the average cost of constructing a new lane-mile. Duncan et al (1989) **determined** roadway costs by the number of peak hour trips generated by current land uses, average trip lengths, peak-hour lane-mile capacity at different levels of service using average capital construction and right-of-way costs per lane-mile for new roads. Delafons (1990) looked at the amount of road space required to service each type of land use.

Capacity of a road is partly determined by the level of service which is to be provided. Congested roads can, up to some point, generate more lane miles of travel than can uncongested roads. Hence, some analysts argue that the level of service for the entire road system must be determined and maintained before the traffic impact fee calculations can be

¹ Using half of the trip length divides the responsibility for the trip between the origin and destination land Uses.

made. In particular, if fees are based on a certain level of service but this level is not maintained, then the new road users are not getting the level of service for which they paid. Hence, charges made under this system are also sensitive to the anticipated level of service on the road system.

An alternative approach tries to address the differences in road impact without explicitly using road construction cost as part of the formula. This fee calculation formula has the following general form:

$$\text{TIF} = \text{Fee} * \text{TGR} * \text{ADJ}$$

where

TIF = Charge per unit of land development

Fee = The amount charged per trip

TGR = Trip generation rate for the particular land use

ADJ = Adjustment factors

Adjustment factors are attempts to take account of the difference between trip generation rates and the demand for road capacity. Among the adjustment factors which could be considered are:

- trip length, percentage of trips occurring at peak hours,
- percentage of trips which are new to the road system, trip generation by trucks, and seasonal demand for road capacity.

The fee which is charged per trip could be related to the cost of road construction directly or it could be specified at some rate which is lower than the expected full cost of providing road capacity. Use of adjustment factors varies among jurisdictions. Some make explicit adjustments for specific factors while others make somewhat arbitrary adjustments that might or might not be justified in relation to some specific characteristic. The calculated

TIF is then multiplied by the number of units of land use development to **determine** the total charge for a particular development. This charge may then be adjusted for credits related to the activities of the developer.

The ITE manual Trip Generation (1991) contains summaries and some statistical analyses of the results of many studies conducted over decades. In particular, the manual provides estimates of "average weekday trip generation" for a large variety of land uses. Average weekday trip generation is the average number of times that a vehicle will arrive at or depart from a site each weekday per unit of development. Since this is a number which is a plausible proxy for impact on demand for road capacity and which has as much reliability as any other standard reported, it is **often** used as the basis for estimating impact fees. Unfortunately, it does not provide as good a proxy for demand for road capacity as might appear. For example, the distribution of road use at peak versus off-peak has an important impact on the demand for **capacity**, but the data for peak use is not as complete nor reliable as the data for average weekday trip generation.

The units of development are measures of activity. For residences, they are usually the number of units, although other bases are available, such as the number of cars. When **specifying** a fee for property which is not yet developed, objectively measured units which are part of the development application are preferred over other measures of activity, since many of the other measures will not be known prior to project use. For example, there are estimates of trip generation per employee for some land uses, but it is often difficult to tell prior to occupancy what the number of employees will be.

While there is some information on peak trips and some other characteristics in the ITE manual, it is not as comprehensive in coverage nor based on as **wide** a sample as the data for average weekday trips. Hence, there is some trade-off between the use of the better data and the simplicity and reliability of the estimates which are generated. There is also some trade-off between the number of land use classifications and the ability to enforce the impact

fee. Specifically, it may be possible to identify a particular use in the development application but to legally use the property for another purpose once development is completed. Hence, it may be preferable to specify fees which vary only by broad land use category.

Another argument for using broad land use categories in specifying **traffic** impact fees are the limited data on some of the characteristics which might affect the relationship between trip generation rates and demand for road capacity. The data is more **likely** to be available for a broad classification than for each detailed classification. However, it should be recognized that few jurisdictions address any of these issues and that none address all of them directly. There is a definite trade-off between simplicity and certainty of the fee schedule and complete equity in assigning cost to different types of development.

Adjustments For Trip Chainine Behavior

Estimates of trip generation rates typically do not differentiate new trips from other stops. Each stop and start is counted as a trip end in generating average trip generation data. Since the ITE data do not include any estimates of trip length, the data on trip length must come from other sources. The difference in sources creates a substantial problem since trip length data must be matched with trip generation data. If the two are not carefully matched, there is a potential for substantial bias in estimating the impact of development on demand for road capacity.

Many trip length estimates are based on the primary purpose of the trip. Making multiple stops on a single trip is known as trip chaining, and counting each stop as a full trip overstates the impact on roads if average trip length estimates are based on the full trip.

- When trip chains are considered, the sequencing and causality may affect the impact which will be felt on the road system. For example, a fast food restaurant may have many trip ends, but if the people stopping were driving by on their way to other destinations, the **traffic** system impact of the trips would be quite different than if each customer had made a special trip. Using the trip length generated from some other source with the trip ends estimated by ITE

could lead to substantial problems if trip chaining is not considered.

Even though these may not be new trips, they do add turning movements to and from arterials that affect capacity and may add to trip length as people drive somewhat out of their original path to make the stop. Hence, they should not be ignored. However, the appropriate method to adjust the trip end data is not readily apparent.

Nicholas, Nelson, and Juergensmeyer (1991) approached the problem of determining which trips were 100% attributable to a development and which were not by adding the variable "percentage of new trips". The rationale for the adjustment factors came from national studies. However, according to the authors, "the percentage of new trips is, ultimately, a professional judgment" (p. 130).

Snyder and Stegman (1986) looked at the formula structure used in Orange County, Florida. It used a "percent new trip" factor to adjust for "impact and nonimpact shopping trips". Nonimpact trips were designated as trips to commercial land uses "that occur only after the vehicle is already on the road network and have no independent effects on overall trip generation rates" (p. 116). The Orange County planners claimed that 100% of residential and office trips were impact, while "only about half of those generated by retail land uses in commercial centers are impact trips. The remainder are so-called diversionary trips that take place only after the vehicle is on the roadway for another purpose" (p. 116).

Bamebey et al (1988) observed that the results of the formula used in Manatee County, Florida, were reduced by a "capture and diversion factor." In their case, studies of travel behavior regarding nonresidential destinations showed "that office development actually generates only 50 percent of the trips normally assigned to it...20% for drive-in bank tellers" (p. 26). The fee was then adjusted to that percentage.

Duncan et al (1989) found that many communities in Florida reduce the ITE trip rates for retail uses by a factor for pass-by trips, defined as "trips that would be on the road anyway

and for which the retail stop is not the primary destination" (p. 27). The authors state that, for retail shopping centers, the **passby** rate decreases as the size of the center increases, Since larger centers are more likely to be primary destinations than small ones. They use a formula provided in the ITE manual for determining pass-by trips for shopping centers: Percentage of **Passby** trips = $45.1 \cdot .0225 (A)$, where A is the square feet of gross leasable area measured in thousands. The formula for percentage of new trips is 100% minus the **passby** rate. "These new trip rates range from 50% for the smallest neighborhood shopping centers to 89% for a 1.25 million square foot regional shopping center" (p. 27). The ITE manual is less **useful** for other non-residential trips. As a result, the authors used 50% as the new trips factor for other uses.

Tindale (1991) concluded that trips in a line between origin and destination should be considered "captured"; and he observed in his study of **Pinellas** County, Florida that as trip rates per square foot increased, the percentage of trips captured also increased.

While there is considerable agreement that trip chaining affects the demand for road capacity, there is very little consensus on how to take this into account in calculating a **traffic** impact fee. The attempts to adjust for trip chaining are based on a limited amount of data, and this data addresses sequencing of trips rather than demand for road capacity directly. For example, a trip chain where one segment generates peak hour demand for capacity and another segment generates off-peak demand for capacity should have the two segments treated differently in calculating the demand for new road capacity, but information to allow this type of calculation is not available in practice

Trip Length Adjustment

If all other factors are constant, roadway costs increase proportionately with trip length. Trip lengths vary by the distance between residences and employment, by density, and by mix of land use among other factors. Trip length often varies depending on the purpose of the trip and whether or not trip chaining occurs. Average trip length data is available by

purpose of trip, but data on trip length is not comprehensively available by land use type. Hence, trip length data must **often** be superimposed on trip generation data. If trip chaining behavior is ignored, trip lengths associated with a single trip result in "a vast overstatement of actual travel" (Nicholas, Nelson and Juergensmeyer, 1991, p.130). In addition, trip length is likely to vary depending on land usage. Hence, both the land usage and the amount of trip chaining should be considered in **determining** traffic impact fees, but including these components can substantially increase the cost and complexity of a **traffic** impact fee. Adjustments to trip generation rates to reflect differences in trip lengths for various land uses are necessary to more accurately reflect the impact on roads. For example, **Tindale** (1991) concludes that land development activities that have high trip rates also had a tendency to have shorter trip lengths.

Trip length adjustments might be used in lieu of adjusting the number of trips for pass by or trip chaining. Land uses that attract pass-by trips could have their fees reduced by factors that reflect the marginal distance traveled or deviation from the primary route distances rather than have an adjustment to the number of trips generated. There is no agreed upon best method to adjust for trip length and trip chaining behavior. However, some adjustment is needed to accurately reflect the impact on the demand for road capacity of different types of development.

Peak Hour Adjustment

The basic method of calculating traffic impact often does not differentiate for the amount of travel at peak versus off-peak times. Long peak-hour trips cause the greatest impact on the demand for new road capacity. Since peak hour problems are so important in determining the demand for new capacity, for most uses charging either only for such trips or more heavily for these trips is appropriate. However, some activities create peak demands at times other than standard rush hours, and these patterns may also be important for some road demand impact. For most activities the basic problem is determining which trips are likely to

be peak ones

Some jurisdictions include the impact of peak hour travel behavior in their formulas. Phillips (1990) recommends an adjustment to the basic trip generation model ranging from .75 to 2.00 based on land use categories (p. 23). Cervero (1988) indicates that the data sources used to generate peak-hour travel projections varied widely. The ITE manual was used directly by 37% of the counties and 28% of the cities. Twelve percent of the counties and 36% of the cities used their own staff engineers or hired consultants to project peak hour travel (which may indirectly depend on the ITE manual). Twelve percent of the counties and 7% of the cities used the trip generation assumptions from their general plans, and eight percent of counties and 10% of cities used trip generation projections from environmental impact reports of each project (p. 539).

Duncan et al (1989) used peak hour trips as **determined** by transportation planners. Eighteen percent of all daily trips occur during the two peak hours, 8% in the AM and 10% in the **PM**. They concluded that the most **important** factor in calculating roadway costs is the average peak hour travel distance. However, trip length data is not typically collected by time of trip, so it would be **difficult** in practice to differentiate between average trip length and peak hour trip length.

Adjustments For Road Type

Impact fees are generally used to address greater demand for arterial or collector roads rather than the impact on local roads or highways. Local roads are **often** part of the on-site infrastructure required for new development, and highways are typically **funded** by higher levels of government. Hence, local governments focus their impact fees on the types of road for which they are responsible but for which the relationship to a specific development is limited. However, trip generation formulas do not differentiate between the types of roads on which trips occur nor do they allocate trip length by road type. In addition, the percentage of trips on each road type are likely to differ depending on trip length and destination.

In addition to differences by land use type within a community, there may be some inconsistencies in using formulas based on total road cost to generate fees for some subset of the road system. Communities show substantial differences in the types of roads which are intended to be covered with existing fees. For example, Snyder and Stegman (1988) found that Orange County, Florida, used all roads in their assessment, but Raleigh, North Carolina, only used major arterials. Since local governments use a wide variety of funding sources and exactions for road finance, differences in which roads are to be funded by traffic impact fees may be reasonable. However, there appears to be little data on differences in use of various parts of the road system by trips generated by land use type. Hence, formula allocations appear to be limited to using the relative use of the entire road system as the means of allocating cost.

Adjustments For Geographic Differences

A single rate does not allow for geographic variations which affect traffic demand, trip length, or construction costs. For example, Wilsey and Ham (1985) felt that Washington County, Oregon had large disparities between "subareas with respect to growth rates and the maturity of the transportation system" (p. 11). To address these concerns, they recommended a system which determined rates by subarea activity. Barnebey et al (1988) report on a district divided into two parts to represent different average travel lengths for urban and rural areas. Leithe and Montavon (1990) observed that two-thirds of the respondents in their study assessed fees on a jurisdiction-wide basis while 15% assessed fees on specific areas only.

Cervero (1988) found that one-third of the counties and half the cities in his study with impact fees applied their programs uniformly across the jurisdiction. Impact fees were used in 38% of the cities and in 16% of the counties. Some communities limited the geographic scope of the fees because of development in concentrated areas while others, such as San Diego with 42 planning areas, varied the fees to take account of differences in construction costs and other factors.

Duncan et al (1989) found only two of the six jurisdictions with impact fees used a locationally-sensitive variable fee rate for their impact fee program. They claim that downtown residents either work downtown or commute against peak flows out to the suburbs, and thereby create little or no need for additional capacity. However, new downtown offices and **industrial** uses "compound already existing peak hour traffic problems, thereby creating the need for increased land capacity" (p 34). Downtown retail uses, however, have much less impact on peak hour traffic. In one of the jurisdictions, the residential rates in the **CBD** are less than half the rates in the suburbs, while the **office CBD** rates are 50 to 100% higher.

The study conducted by the Colorado/Wyoming Section of ITE (1987) found that municipalities generally required impact fees within entire jurisdictions, while counties used them for certain corridors or subareas. As will be discussed in the section on efficiency, it is likely that efficient traffic impact fees would differ by geographic area, but there are several factors which should be taken into account in determining the geographic differentiation.

Rate Adjustments and Credits

Traffic impact fees are usually intended to generate **funding** commensurate with the impact on the demand for road capacity created by new development, so alternative contributions to road funding should be considered in setting the level and distribution of the fees. Many jurisdictions provide such adjustments through the use of credits against the impact fees. In the literature, the **term** "credit" is used for two distinct types of adjustments. The first type of credits relate to the contributions which new development will make through property taxes, gasoline taxes, and other general sources of revenue towards the existing backlog of road needs or payment of debt related to existing roads. It is widely accepted that these revenues should be credited to the development in determining the level of impact fees. (Porter, 1986, Nicholas, Nelson, and Juergensmeyer, 1991; Moore and Muller, 1990, Angell and Shorter, 1988). These credits will be referred to as rate adjustments for our **purposes**.

Rate adjustments can be set as broad reductions in impact fee amounts for all land uses or they may be calculated **independently** for each development.

Leithe and Montavon (1990) found that only 20 percent of the respondents in their study gave credit (or rate adjustments) for the amount of other revenues that a new development was anticipated to generate, suggesting that "relatively few impact fee programs have incorporated detailed estimates of other revenues contributed by new residents in determining the amount of the impact fee charges. However, these respondents may, in effect, credit new development for other contributions made by setting the amount of the impact fee at less than the total cost of providing capital facilities" (p. 21). The rate reduction credit most widely given is an allowance for future gasoline tax payments, followed by motor license fees, retail sales, and property taxes (Snyder and Stegman, 1986).

The second type of credits given by communities are reductions in the calculated liability to reflect expenditures made by developers on road improvements not directly related to their development. Thus, the total liability is not affected, but the payment is made in kind rather than in cash. These may be expenditures required by the community or the community may offer the developer an option of making such improvements. In either case the community may allow a credit for these improvements in calculating the impact fees. In these cases the impact fee is calculated and there is a direct reduction in the amount to be paid. Credit for such road improvements may or may not be part of the impact fee itself, but the practice of offering such credits appears to be fairly common.

Most analysts agree that in principle both types of credits are desirable, but they can create substantial administrative costs. In practice, many jurisdictions address the rate reduction credit by using traffic impact fee rates which are far below full cost recovery.

Trip Distribution Methods

Some communities have approached **traffic** impact fees using a variable fee developed

with transportation modeling techniques rather than a trip generation process (Samdahl, 1991). McNeil, Rossi, and Hendrickson (1987) state that "the design of equitable variable impact fees can be achieved through the direct application of highway cost allocation methods such as attribution of costs to vehicles by 'incremental assignment' or 'uniform removal'" (p 74) Essentially, these systems are more sophisticated versions of allowing development until capacity is reached and then requiring the next development to expand capacity before building. The use of models makes it possible to address problems before they appear, but the resulting allocation of fees **often** appears arbitrary and unfair.

Broward County, Florida, uses a computerized trip distribution model to **determine** traffic impact fees (Thompson, 1986; Downing and McCaleb, 1987; Auerhahn, 1988; Frank, 1984; Knack, 1984; Frank, 1988; Stewart, 1984; Snyder and Stegman, 1986), called TRIPS (Traffic Review and Impact Planning Systems). Johnson (1990) describes it as the "pay-as-you-go" or "extra-cost" method. According to Nelson (1988b), it "involves an algorithm in which the assessment depends on the location of the development and the variable cost of adding new (facilities) or expanding existing facilities" (p. 122).

This procedure has the advantage of distributing impact fee burdens more precisely based on cost estimates of different projects. After running through a four step process, TRIPS determines how a development will impact current **traffic** patterns. No impact fee is charged if the level of service is not changed. However, this also means that earlier developments can "soak up" capacity **without** having had to pay an impact fee. Nelson (1988b) suggests that a variable impact fee system can be designed to avoid the problem. If the development will contribute to congestion, the model computes the fee based on "the **proportion** of the improved capacity that can be assigned to the traffic generated by the development" (p. 124).

Lee (1988) finds one obvious error in calculating **traffic** impact fees based on the congestion caused by a new development's traffic. This method violates the basic principle of

efficient pricing, that all users face the marginal cost. Removing some existing users would eliminate the congestion, indicating that any group of users could be called "marginal". If existing residents are not paying peak prices, why should new residents? Lee concludes that as with other forms of infrastructure, it only matters that the agreed-upon miles of road are provided, not which roads are paid for by which development. The efficiency incentive addressed through such fees can only alter the development pattern, not the use of roads after the development occurs. Of course, as will be discussed shortly, the timing of road development and the amount of road capacity provided may be affected by the use of fees, even if congestion can not be efficiently addressed.

Bladikas and Pignataro (1990) point out that if impact fees are computed "only on road segments that are already over capacity, a proposed development may be charged substantially different fees depending on location" (p. 286). According to Frank (1988), using a fee structure of this nature creates "the possibility of creating incentives for infill development" (p. 211) to locations for which road capacity is available. However, he admitted there is no hard data to support this "in-fill" effect. He points out also that customized fees have uncertainty associated with them not found in **formula/schedule** types.

Another variation, proposed for use in **Bellevue, WA**, utilizes the select link analysis of traffic assignment models. The cost of projects needed for new development (a build out plan) is allocated to specific developments in proportion to the **traffic** using the new links. This avoids many of the problems associated with arbitrary and uneven assessments of fees in other trip distribution methods. However, this approach requires great foresight in forecasting the location of new development and developing a plan for road improvements needed to serve that development pattern.

Administrative and Implementation Issues

Ease of administration is an important consideration in the implementation of any impact fee program. The cost of the initial study and later updates, the tracking of **funds**, the

collection and disbursement of revenues, the determination of credits for construction in lieu of cash, and the need to transfer accounts to future buyers can be burdensome for small jurisdictions (Meisner et al, 1988)

Cervero (1988) found that planning offices cited three problems most frequently. The greatest problem was technical difficulties, either because of frequent changes in lot ownership or the use of complicated formulas for allocating costs. The second problem was administrative burden, with major time commitments required of **staff**, often inexperienced with the mechanisms, along with the need for coordination among local, county, and state jurisdictions. The third problem cited was financial, the inability of programs to "raise enough money for meaningful-scale projects, due either to inadequate fee levels or the devaluing effect of inflation" (p. 540)

Leithe and Montavon (1990) found sixty-one percent of the respondents to their survey update their fees for inflation on varying time intervals. Their study revealed the problems faced with impact fees included determining levels of demand and costs of construction; setting rates that were accurate, and "fairly apportioning costs among residential, commercial, and industrial units" (p 30)

Meisner et al (1988) concluded that traffic impact fees are, on the whole, considered equitable for all types and sizes of development. However, Cervero (1988) concludes from his study that a "sizeable gap" remains between theory and practice. He cites most of the problems with implementation stemming from the inability of program designers to "accurately and fairly apportion the cost of infrastructure improvements to developers and gauge the spatial and temporal extent of the traffic impacts of new developments" (p 540). He cites the need for horizontal equity, where developers in similar situations should be treated the same. Since there are many examples of **successful traffic** impact fee programs, the administrative issues are more of a warning about potential problems in designing impact fees than a comprehensive statement of inherent problems.

Political Concerns

Developers are often opposed to **traffic** impact fees while existing residents of a jurisdiction generally favor them. Political decision-makers **often** have to trade off the concerns of each group in determining the actual level and administration of such fees (Link, 1988a; Link, 1988b).

Lillydahl et al (1988) cite five political objectives of local communities using impact fees: to shift the capital financing burden to new development, to synchronize new development with the installation of new facilities; to impose economic discipline on land development decisions by requiring development to absorb the costs of providing new services and facilities, to enhance the quality of life within communities, and to **mollify anti-growth** or slow-growth interest groups (p 4)

Meisner et al (1988) claim that traffic impact fees, if known in advance and included in feasibility studies for projects, often do not significantly affect the cost of a development. They identified a set of politically desirable conditions for a **successful** program: existing traffic congestion which is perceived by the public and the developer as being a problem; recent rapid growth and resulting traffic growth which polarizes a community into promoting a policy of making new development pay; a perceived strong economy where it is assumed that development will occur regardless of fees; strong citizen participation, with political influence; support **from** the business community; previous experience with an impact fee program; larger projects, as they have a greater impact and are more capable of **funding** infrastructure than small projects; and project types that are relatively high **density**, high **cost** or "upscale" and high generators of **traffic** volume. They also observed impact fees being set at a level significantly below anticipated costs, which they attributed to local governments taking into account the "need" by the public at large for the proposed facilities.

Cervero (1988) found none of the jurisdictions in his study charged developers the total cost of necessary off-site improvements as a formal policy. Half of his survey

respondents indicated that they collected less than one-quarter of the cost of highway improvements attributable to new development. "Most indicated that elected officials were politically unable or unwilling to write formal ordinances which pass on the full cost of off-site improvements" (p 538). Uncertainties about trip generation estimates and concerns over litigation were cited as reasons for these policies. He concludes that the flat fee approach is considered the most politically acceptable and easiest to establish. He states that "since all developers pay the same amount per square foot or per peak-hour trip, few charges of inequities have been aired" (p 538).

The Technical Committee of the *Colorado/Wyoming* Section of ITE (1989) found that fees are currently collected at 20% of the calculated impact fee, a policy which is resulting in inadequate funding for necessary projects to be constructed. Duncan et al (1989) found that the greatest percentage of actual roadway costs captured was 34%, and the least was 10%

Draper (1987) cites a FHWA study on developer-funded improvements which found developers want to minimize up-front capital costs by phasing in improvements (or fees) to coincide with build out, to share with other developers the burden of expense of off-site improvements that benefit more than the new development, and to have control over improvements constructed with his/her money. "Thus, a developer often prefers to assume responsibility for constructing the off-site improvements so he has more control over the cost and the timing and has assurance that the improvements will be constructed" (p 69)

Shorter (1989) examined the effect of impact fees on feasibility, claiming every cost is important to a developer's project feasibility and competitive market position. He maintains that a dollar-based fee program may cause a decrease in the reasonable rate of return, which will delay or stop a development. The developer's options are limited to: passing the fee forward or backward; financing the fee as part of the project; absorbing the fee and reduce the rate of return; or a combination passing and financing.

Both proponents and opponents of traffic impact fees make rather extravagant claims

regarding their impact, and these claims form the basis of most discussion of the feasibility of fee financing. Opponents argue that the fees will stop development or cause it to shift to other communities while proponents argue that it will have no impact on development. Neither position seems **fully** tenable. Some parts of the fees will be shifted to land prices; but even with a **full** shift to land prices, the amount of development in a community may be **affected** because the value of land in different uses is affected by this backward shifting. Hence, there is a potential impact on the mix of development and on the amount of land used for development.

Housing Prices

The concern which most seems to affect people other than developers is that the fee will end up causing housing prices to rise. While the fee could only affect new housing directly, higher prices for new housing might cause the price of all housing to rise since older housing is an alternative for those priced out of the new housing market. For this to happen, there must be an impact on the total amount of housing built in the region. Even if the total amount of new housing is reduced there may be an offset due to older housing being kept in use longer; and even if housing prices rise, the cost increase may be offset by reductions in the taxes needed to fund road construction.

The ultimate impact of the fee is known as its incidence. Aside from simply being passed on to the buyer in the form of a higher price, the fee could be absorbed by the builder or it could be passed back to the owner of land in the form of a lower land price. Incidence of the fee is a major concern for many communities (Nicholas, Nelson, and Juergensmeyer, 1991, Morgan, 1988; **Singell** and Lillydahl, 1990, Delaney and Smith, **1989a**; Delaney and Smith, **1989b**; White, 1991, Stegman, 1987, Delafons, 1990)

In competitive real estate markets, the price for housing and other real estate is set by supply and demand conditions. Housing prices would only rise if either the supply curve for housing **shifted** up, indicating higher costs of production, or if the demand for housing shifted

up, indicating a higher willingness to pay for a given amount of housing on the part of consumers. Developers often take the simplistic view that the supply curve will shift up by the **full** amount of the tax and that therefore, the price will rise by the full amount of the tax. Opponents of this view believe that the amount of land available for development is essentially fixed in supply. They believe that faced with lower demand for land for construction, land owners will face lower land prices, and that these lower land prices will at least partly offset any higher housing cost associated with impact fees.

It is worth noting also that without facilities the supply of developable land could diminish, causing housing prices to rise. Impact fees may actually work to forestall or prevent adverse price effects in a competitive housing market.

The reduction in other taxes or increase in service levels associated with impact fee financing is often ignored in these discussions. To the extent that service levels rise, the demand for housing in a location rises as well. If the demand for housing rises, the resulting higher housing prices would reflect the buyers being better *off* because of the better service. If this happens it does not negatively affect either the buyers or the community. Finally, if the amount of road construction is not affected by the method of financing, then other taxes are reduced. This reduction offsets at least some of the impact of the higher fees. To the extent that the reduction is a reduction in property taxes, the change in **funding** methods is likely to reduce the net cost of all housing other than new housing. Since new housing tends to be higher cost, this change in cost structure for housing may be judged highly desirable.

Community Competition

Communities are **often** concerned with the prospect of driving away development or losing new development to neighboring communities. If the development is a net drain on the community, this position may not make much sense, but if the new development is expected to generate a net surplus of revenue over cost for the community in relation to all services provided, the community may be better off with the development even if it requires

subsidization for some infrastructure.

Snyder and Stegman (1986) found that calculated fees are often explicitly "discounted" for seemingly political reasons. In Orange County, Florida, the Commissioner adjusted the fee formula **after** deciding that **traffic** development fees should be reduced to 52% of the calculated fee. In Raleigh, North Carolina, the fee structure had not yet been adopted at the time of their research; however, the authors anticipated that since none of **Raleigh's** neighboring communities imposed fees, and the maximum allowable road fee on commercial development is "politically unacceptable, fees will have to be uniformly adjusted **downward**..or selectively reduced to eliminate the extremely high burden on certain types of development" (p. 119).

Barnebey et al (1988) observed Manatee County, Florida, also used a "competitive factor adjustment " In a compromise between a **full** fee and fees of surrounding communities, the county commission kept the residential road impact fees at 100 percent, but reduced those for commercial, industrial, and institutional developments. For example, of the 16 commercial land use categories, the county reduced 12 by at least 40% and the remaining uses by about 75% (p 26) Nicholas, Nelson, and Juergensmeyer (1991) observed a "discount" of between 5% and 15%, being applied to the final **traffic** impact formula

According to **Angell** and Shorter (1988), an underlying concern in selecting a type of impact fee was "how to achieve private-developer participation without discouraging all development" (p 20) They concluded that there was little evidence that exactions alone dampen development in the communities that used them, nor have they driven development elsewhere **Exaction** programs used in a strong real estate market "do not appear to have placed either developers or communities in a less competitive position " (p 21)

Duncan et al (1989) found most of the jurisdictions with impact fees consider themselves as "pro-growth." "Where the impact fees have been in place for some time, all of the jurisdictions indicated that the fees have not had a noticeable impact on growth" (p. 41).

Moore and Muller (1990) point out that communities can exempt certain users from the fee, such as **affordable** housing, retention of certain employment or generators of jobs. Explicitly exempting commercial uses may be hard to do, as politically it must be found that there is sufficient public benefit to warrant exempting them. They concluded that communities appear to prefer taking the risk of not collecting sufficient revenues to meet infrastructure expansion requirements by applying impact fees that recover only a portion of the calculated costs in order to avoid lengthy equity disputes.

Conclusions Relating to Current Practice

Traffic Impact Fees are a viable and growing method for financing at least part of the cost of off-site road construction associated with new development. A substantial number of impact fee systems are in use and some of the more important legal issues have been settled. The fees are treated as a method of charging new development for the cost which it imposes on the community. If we divide the discussion into questions of the theoretical justification of **impact** fees versus the method of implementing such fees, most discussion in the literature revolves around how best to implement such systems. However, there are many issues which have not been adequately addressed in **designing** such systems. Communities which are implementing the fees are making a variety of ad hoc adjustments to account for some of the problems which arise, but the ad hoc approach leaves many of the issues unresolved.

Among the most important implementation issues are the level of the fee, the method of determining differences in **traffic** impact for various types of land use, and the administrative and political problems created by using impact fees. The level of the fee needed for development to pay the **full** cost of required off-site capacity expansion can be determined in principle, but this calculation faces various practical problems. Estimates of both road construction **cost** and **traffic** impact have substantial uncertainty. Perhaps more important, there is not a consensus that new development should pay the **full** cost of the required road construction. **The reluctance** to charge fees representing the **full** cost may simply reflect

uncertainty about a relatively new financing mechanism or it may reflect more **fundamental** disagreements about the appropriate level of fees and the methods of determining them.

The issues relating to the level of the fee are also closely tied to the political acceptability of the fees. While there is little evidence that they have any detrimental effect on community growth or on the cost of housing or other development, the issues continue to be debated. It is unlikely that the impact on cost or development will be resolved without additional empirical evidence. Consequently, it is difficult to assess the incidence of traffic impact fees, particularly in light of the uncertain effects which this source of finance has on the level of road infrastructure.

When a **traffic** impact fee has been determined to be the appropriate method for financing road construction, there are two distinctly different approaches. One uses detailed studies of the impact of each new development on the existing road system and tries to estimate the specific impact which the development will have. The other relies on estimates of the average impact which development will have and sets fees based on this average cost. The former approach is better for optimizing the use of an existing road system in the short run, but it can treat otherwise identical developments very differently depending on the timing of development. The latter approach is more common, both because it is easier to implement and more uniform. However, there are problems with estimating the average impact on road use and relating this to the cost of road construction.

From a technical perspective, the issues in determining the appropriate basis for a **cost-**recovering traffic impact fee are conceptually easy to address, but they create requirements for data that are not readily available. Such an impact fee should reflect the demand for road capacity which new development will generate, but there are substantial gaps between the estimates of trip generation which are readily available and the actual impact on road use which a development will have. In particular, issues like trip chaining, peaking characteristics of trips, average trip length, and a variety of other characteristics argue for more complex fee

systems, but these issues must be balanced against the limited data available and the administrative and other costs associated with complex systems.

If we accept that the goal of allocating road construction cost to development based on cost imposed is a reasonable one, several conclusions seem sensible. Given the relatively low rates for most **traffic** impact fee systems and the complications in generating detailed estimates of the impact of development on road demand, relatively simple formulas for estimating traffic impact fees appear to be best. However, the data exist for making some broad adjustments to simple trip generation rates and these should be used by larger jurisdictions or jurisdictions setting relatively high **traffic** impact fees. The formula method appears to be far superior to the trip distribution method of determining fees except where the trip distribution method is based on allocating road costs for full build out.

EFFICIENCY ISSUES

The discussion to this point, and most discussion of traffic impact fees, has been oriented toward the methods of **determining** the level of fees and distribution of fees consistent with the trip generation rates of each type of development. However, from an economic perspective, the TIF is a **price**, and there are some goods for which pricing will improve the efficiency of allocation of resources and others for which it might not. There has been little discussion in the literature of the role of the TIF as a price and its possible use to address efficiency distortions, except for Lee (**1988**) who claims that "only some small portion of the street system can be financed efficiently through impact fees and the bulk of this is on-site to most development" (p. **303**). His position is that the major efficiency problem is unpriced use of congested roadways and that only congestion pricing can efficiently address this problem. While he is correct that there appear to always be theoretically superior alternatives to traffic impact fees as prices, the argument will be developed that impact fees can lead to **substantial** efficiency improvements **relative to existing** finance mechanisms.

Planners have long criticized development patterns in the United States as being too dispersed and having low density. While economists have generally not agreed with the arguments raised by planners, they have noted that financing methods for infrastructure tend to subsidize new development. Further, the lack of congestion fees for roads at peak hours make dispersed development cost less to the user than the **full** social cost. Hence, the use of fees to internalize some of these costs could in principle lead to more efficient land use.

Sprawl: **Efficient** Land Use or Subsidized Externality?

From the economic perspective, land should be developed according to its highest valued use unless there are specific externalities associated with that type of development. Hence, low-density suburban development is not in itself an issue from the perspective of the urban economist. Generally, the low density reflects peoples' preferences and their willingness

to pay for a particular life style. So long as the consumer is paying the cost of consumption, the land use pattern chosen would be the most economically efficient, but a number of externalities have been identified with low-density development which might result in the consumer paying less than the full cost. We will focus on the externalities associated with traffic. After identifying some of the possible causes of inefficiently low density, we will consider whether traffic impact fees might be designed to address the efficiency issue.

The most commonly cited externality with respect to suburban development is the time cost which drivers impose on others when using congested roads. Efficient pricing of roads would lead to higher costs for peak hour usage. These higher costs would in turn lead to more compact development and shorter commuting trips. Hence, failure to use congestion pricing is expected to lead to a suboptimal use of land because people will tend to locate further from the CBD than they would if roads were priced efficiently.

A less frequently discussed external effect is created by the need for people to travel further on average because of low-density development. All else equal, an activity which takes up no land allows for more compact overall development and allows for shorter trips for people who must pass the property. The land which an activity uses in effect forces other activities further apart. Hence, greater density should reduce average trip length, all other things constant.

In this context, land use creates a spatial externality by making it more costly to provide service to others. Wilbur Thompson (1968) argued that land in an urban area should be taxed at least partly on the basis of area because even an undeveloped area raised the cost of providing some services. For example, water lines would have to be extended further to provide services. The nature of this externality is somewhat more evident with network utilities, such as water and sewer, where cost is dependent on front footage; but it arises with roads as well.

Another way to think about the land use externality is to imagine an urban area where

all activities were concentrated in a single place. If it were possible to do this, many of the costs of infrastructure would be reduced. It would still be necessary to bring water to the city, but the costly distribution network over the urban area would not be necessary. Similarly, a road system within the urban area would not be necessary.

Obviously, activity does have to be spread over space, but the amount of land used will slightly affect other people's average trip length. Further, it is important to recognize that this externality is separate from the congestion externality.

The question raised from an economic perspective is whether existing finance mechanisms lead to excessive development at the fringe of an urban area or lead to development which is too low in density relative to an efficient allocation of resources. It is important to note that the issue is both a theoretical and an empirical one. The use of fees or charges might lead to changes in the use of land, but such changes in the existing system may not be worthwhile if they would not substantially alter existing patterns.

Efficient Price Incentives

Lee (1988) argues that congestion pricing is the only way to efficiently price roads and that congestion pricing would lead to the fully efficient construction and use of roads. This argument is incomplete. Congestion pricing leads to a first best use of roads but it does not account for the fact that the use of land **increases** average trip length in an area. Hence, even with congestion pricing, each decision-maker may choose to use too much land relative to the optimum and cause other people to average longer trips than is **efficient**. Just as one person's use of a road creates an externality by slowing other people down, a person's use of land creates a different externality by making other people take longer trips to get past the land. Consequently, congestion pricing alone would not lead to optimal road construction and usage.

It appears that this type of externality would be best addressed by means of a land tax,

and the land tax would presumably **vary** inversely with distance from the region's center. Those who use much land on the edge of the urban area increase trip length for few people while those who use much land at locations closer to the center increase trip length for a larger number of people.

Efficient incentives for land use and road construction appear to require both congestion pricing of roads and a land tax based on area and distance from the CBD. If the congestion charges were to raise all of the revenue needed for roads, the land tax could be used for general revenue purposes since the key to promoting efficiency is to internalize the externality rather than to **fund** specific projects.

Second-Best Considerations

Neither congestion pricing nor land area taxes are used to internalize externalities in the U.S. Hence, the resulting road usage and land usage patterns are likely to be inefficient. In addition, the actual methods of road finance are likely to create other efficiency concerns. Hence, it is reasonable to ask if traffic impact fees improve the allocation of resources relative to other actual sources of road funding. It appears that traffic impact fees may be able to offset a tendency to under-fund new road capacity in growing communities.

Consider the decision-making process which would be used in a community faced with congestion. Assuming that the community has land available for development, the level of **services** offered in the community is likely to influence the rate of development. For simplicity assume that without additional infrastructure construction, no development will take place. Further, assume that the amount of development will be a function of the amount of infrastructure constructed. In effect, benefits to existing residents will depend on whether or not development will be allowed after infrastructure is developed. If no development will be allowed (**fixed** population), residents are likely to choose a higher level of infrastructure construction than if the construction will cause a population increase (variable population).

Figure 1 shows the demand for road usage with a fixed population versus a variable population. Certainly, the demand with a variable population would be more elastic than the demand associated with a fixed population. As congestion is reduced on the roads, more development would occur and the quantity of road usage would increase relative to the quantity with a fixed population. Hence, an increase in capacity would result in less reduction of congestion with the variable than with the fixed population. This means that the cost of achieving any given level of congestion reduction would be higher for the variable population than it would be for the fixed population. This is illustrated in Figure 2 where the cost of congestion reduction is shown as varying for the fixed versus the variable population.

FIGURE 1
IMPACT OF CAPACITY INCREASE
WITH FIXED AND VARIABLE POPULATIONS

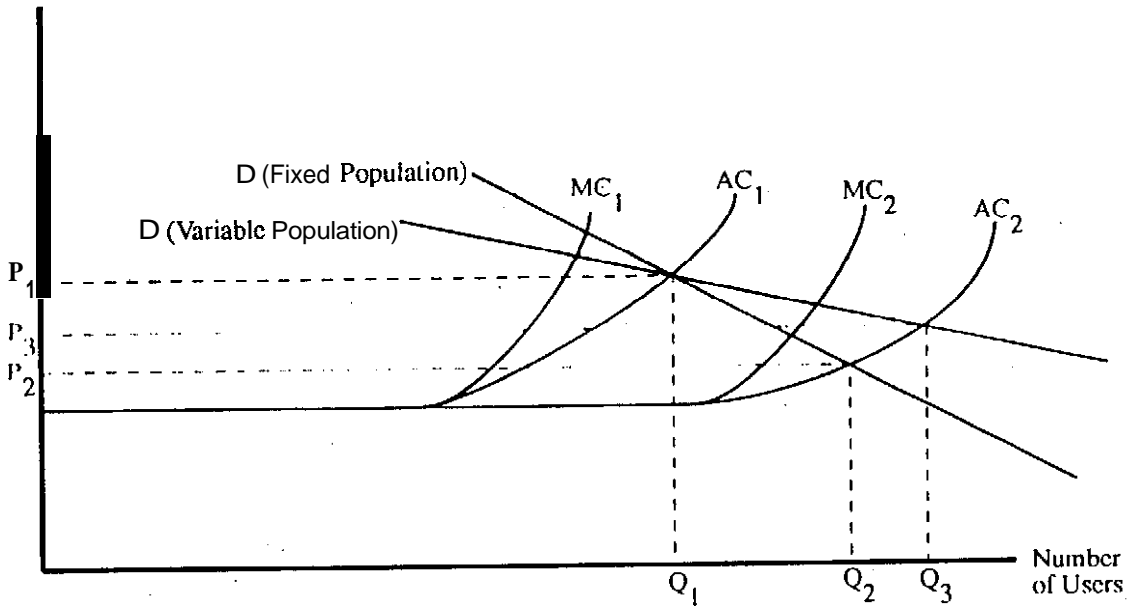
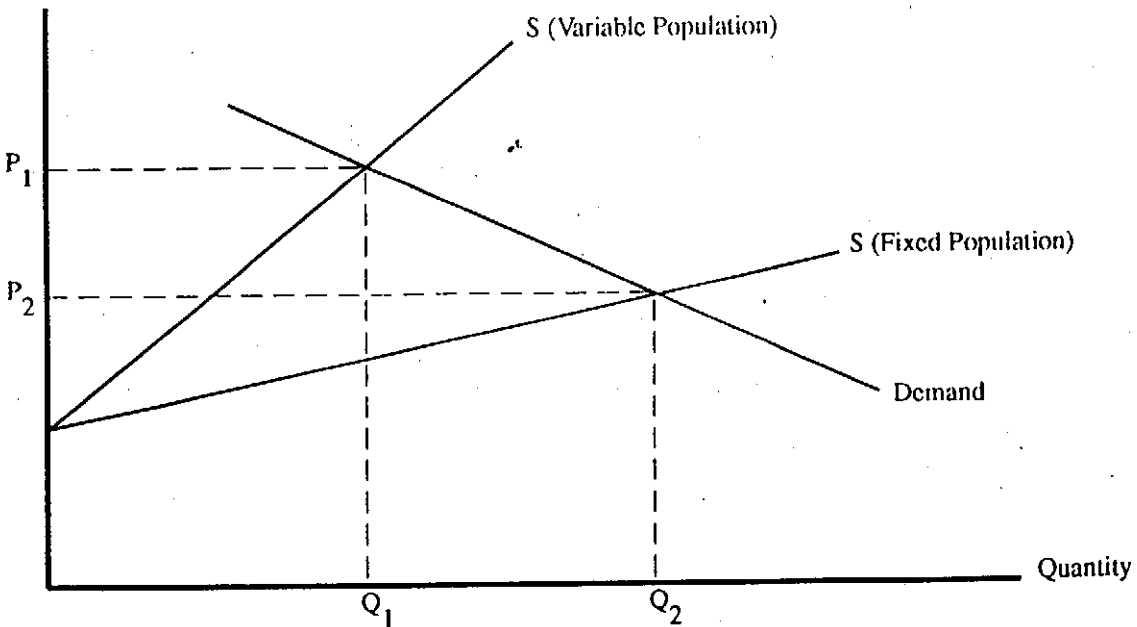


FIGURE 2
DEMAND FOR CONGESTION REDUCTION



In the figure, Q is a measure of the quantity of congestion reduction purchased by means of road expansion and P is the per person cost of one unit of congestion reduction.

The concern with respect to second best pricing is that too little road capacity would be provided in a growing community if the amount of growth is sensitive to the amount of road capacity in place. Existing residents faced with an undesirable level of congestion would choose to fund an increase in road capacity of Q_2 for the price P_2 per person in the graph. However, the cost of providing a particular level of service improvement in the context of the problem is greater than the cost per person of increasing capacity. As capacity is increased, more development takes place, hence, the increase in service level is less than would occur with a fixed population. Under these circumstances, the existing residents choose the lower quantity Q_1 at a cost per person of P_1 .

If the fixed population represents the decision-makers in the community, voters for example, it is clear from the diagram that a lower quantity of congestion reduction would be purchased than if the population were fixed. Since some of the benefits of the congestion reduction would accrue to future residents, the cost effect leads to under-provision of roads. Also, the cost of reducing congestion will be greater with a variable population since the increment to road capacity needed to make a new trip is greater than the increment needed to reduce congestion. Hence, a small increase in the number of road users would have a disproportionate cost impact.

Traffic impact fees have the potential to internalize the cost of new capacity to development, and this would allow the cost curve for the existing users to shift back to that associated with the fixed population. Hence, the traffic impact fees could be used to improve efficiency associated with under-provision of roads in growing communities.

This particular part of the analysis is worth emphasizing since it appears to be consistent with the actual use of traffic impact fees in growing jurisdictions although it does not appear to have been stated in this manner previously. Essentially, the impact fees are used

to pay for part of the cost of road capacity and this would be equivalent to lowering the cost curve in Figure 2 for the existing residents. This raises the possibility of getting to the more efficient quantity, recognizing that this is efficient only in a second best sense.

If we accept the under-provision of road improvements as the major reason for traffic impact fees in practice, it may explain why there is such a wide variety of impact fees. From the perspective of the existing residents, it is more important to have new development pay its share of the cost than it would be to accurately allocate the costs.

Other Efficiency Considerations

While under-provision of roads is an important issue, there are a variety of other road characteristics which could in principle be addressed through traffic impact fees. This section will briefly discuss some of the other possibilities.

Travel outside of the jurisdiction is another possible cause of under-provision of arterial and collector roads. Transfers from higher levels of government can be used to offset some of the externalities associated with travel across jurisdiction boundaries; however, this type of transfer is usually not precise enough to allow the appropriate development incentives. In particular, the nature of the demand for roads outside of the jurisdiction is likely to have a directional bias, with communities further out placing a greater externality on communities closer to the CBD.

The effect on other jurisdictions could in principle be addressed by having traffic impact fees levied at a regional level and used to fund roads based on the traffic demand generated. This would be opposite of the actual practice in many areas where the fees are set locally based on local road requirements. In the local requirements case, the fee would be higher for communities closer in even though part of the cost is associated with development further out. Development fees of this design create perverse incentives for more development further out.

The land use externality would require that land itself be taxed and that the tax be a **function** of location of the land. That land which is closer to the urban center would be taxed at a higher rate than land **further** away. This tax would be levied on the land alone and would reflect the additional distance which the existence of the land imposes on others. In the absence of a land tax system it may be possible to approximate some of the incentive effects of the land tax with the use of development fees

No development fee could generate all of the efficiency incentives which the land tax could generate and it would not be able to accommodate changing incentives over time. In particular, existing development would be subject to a land tax but not to a development fee. Hence, an impact fee creates no incentive to redevelop existing uses at higher densities. However, a development fee could be designed to represent the discounted present value of the land tax for the **future**. Such a system would generate an impact fee which varied inversely with the density of development. Thus, ten **housing** units on two acres of land would pay a lower impact fee than ten housing units on ten acres of land, since the additional land would generate a larger travel externality. For simplicity this could be developed as an impact fee which simply had lower rates for higher density and which had rates which declined with distance from the CBD. It would also be necessary to have the fee increase at an appropriate rate over time to avoid distorting the *timing* of land development.

The decline in the land usage portion of the traffic impact fee with distance from the CBD would be contrary to most practice and would appear to encourage development at the fringes. However, the decline would be associated with the density component of the fee not the trip generation or distance aspects of the fee. In principle these issues would also be addressed in designing an efficient traffic impact fee.

Density and Trip Generation

Trip generation rates appear to vary with density and this creates another rationale for having traffic impact fees which vary inversely with density. It is widely accepted that more

densely developed areas have on average a lower rate of automobile trip generation than areas of similar levels of population and activity but lower levels of density. For example, see Pushkarev and Zupan (1977, pp. 29-35). The lower levels of automobile trip generation arise for two reasons. The first is that at higher density all types of trips on either transit or automobiles are lower per unit of development. The second is that transit gets a larger percentage of the trips which are made when density is higher. In either case, the demand for road capacity associated with new development in the densely developed area appears to be less than the demand in the less densely developed area on a per dwelling-unit basis. However, the total quantity of trips would likely be higher as the decrease in trip generation per unit is offset by a higher number of units.

That the reduced trip generation is caused by higher density can not be taken completely at face value since there are other factors which may account for the lower trip generation rates. In particular, more densely populated areas tend to have higher levels of congestion and this would also tend to reduce trip generation rates. To the extent that the lower levels of trip generation are associated with such factors, there is no real benefit of higher density relative to trip generation. However, if higher density reduces the number or length of trips because things are closer together, there is an external benefit to high density development.

In addition to a reduction in trip generation caused directly by higher density, there are effects associated with greater use of mass transit. The existence of density makes transit more feasible and so it is more readily available in more dense areas. This effect will exist even if the reduction in total travel is simply a response to congestion.

Another issue is whether isolated pockets of density have the same impact on trip generation as higher aggregate levels of density do. Unfortunately, the evidence is at best mixed. Higher density development when viewed in isolation does not necessarily reduce the number of trips generated per unit of development. The most widely cited source of

information on trip generation rates, the ITE Trip Generation Manual, cites an increase in the rate of trip generation for the highest densities of apartment construction and only minor reductions in trip generation rates for higher density single family residences.

Cervero (1991) provides some evidence that high density office buildings in suburban locations generate fewer trips per worker by automobile than do lower density buildings. However, even this evidence is somewhat inconclusive because the higher observed density is likely to be the result of factors which may also promote transit use or other reductions in automobile usage.

In a high density area, we would expect to find that average trip length is shorter than in a low density area; however, there appears to be very little **empirical** data to **confirm** this expectation. A shorter average trip length would mean that any given trip had less of an impact on demand for road capacity than would a trip of longer average length. Again, this reduction in length is likely to be an area-wide **effect** rather than an effect on the particular development under consideration. Since the reduction in trip length is external to the specific development, it is **unlikely** that a high density development in a low-density environment would have a measurable traffic impact.

Fees and Density

The imposition of impact fees that are sensitive to density would still have little efficiency effect if they did not induce changes in the actual density of development. It would seem that the potential for inducing changes in density is fairly small given the current level of most such fees, but it might be important at the margin. Further, other systems development charges might also be lower for higher density development, and the **efficient** level of such fees may be considerably higher than current averages. If the overall fees were higher, reductions in the fees would create much more incentive for density. One survey found the combination of development fees for off-site infrastructure as high as \$20,000 per dwelling unit in **some areas** (Professional Builder & Remodeler, 1990). Thus, the potential for fees to

be used to encourage or discourage activities is much higher than current average levels of fees would indicate.

Note that if charges are lower per unit of development for high density land use, the total charge is likely to be higher per acre of land because of the higher density of development. In general, one effect of higher-density development would be a requirement of larger amounts of infrastructure in the areas where development occurs because of the greater amount of activity to be served. However, it is possible that there would be less infrastructure for the entire urbanized area because it would not be required in areas without development.

Another possible relationship between impact fees and density is developed by **Gyourko (1991)**, who argues that use of property taxes to fund infrastructure creates incentives for large-lot "fiscal zoning" so that the revenue generated by new development will offset the cost of the services provided. If the property tax is the major source of local revenue for infrastructure, then large lot development would appear to generate greater revenue per family. However, the large lot development in turn creates lower density of development. Use of impact fees rather than property taxes would reduce the incentive for large lot "fiscal zoning." To the extent that low-density is encouraged by reliance on property taxes for infrastructure funding, the use of alternative methods of finance would reduce this incentive. Again, the empirical magnitude of any such effects would be difficult to estimate.

Density and Infrastructure Cost

It is important to recognize that the cost of road construction tends to increase with density. Proponents of higher density development focus on the likely decrease in the number and length of trips demanded, but the cost of providing capacity for those trips might increase even more rapidly than quantity of travel decreases, leaving the total cost higher with dense development. To the extent that the cost of capacity per trip increases with density, the higher density development might actually have higher impact fees per unit of development than the lower density development would. This presumes that the fee is varied to reflect the actual

cost of infrastructure development in each area where it is levied

If there is a certain level of population in a region, which must be housed somewhere, then the question of road impact relates to whether the amount of demand for road capacity is sensitive to the location decisions made by the people. If the same number of trips on the same mode and of the same average length were going to be made no matter what the location of the population, then fees would not have much impact on the total amount of **service** demanded, and if higher density increases the cost of providing service, then encouraging density may increase the total cost of providing infrastructure rather than reducing it. However, if the choices which are made do impact on the amount and cost of providing road service, then the use or lack of use of fees may be an important issue.

One example of the difference between local effects and system effects is found in attempts to move activity away from congested areas. For example, Los Angeles has moved to limit the density of development so as to limit increases in congestion on existing roads. This type of policy can only work if it also restricts the total amount of activity. If it simply spreads the activity **further** apart, it may lead to longer average trips and higher levels of congestion (Wachs, 1990). Consequently, it is important to distinguish the impact on the whole road system from the impact in one part of the system.

Policy Responses

The standard approach to setting traffic impact fees is to look at the traffic generation associated with each type of land use. However, some characteristics of land use on the aggregate affect the amount of road demand as much as the specific development. For example, the standard approach assumes that the same number of trips of the same length will occur no matter where or how a specific type of development takes place. Yet if the development takes place near existing transit systems there are likely to be more people using transit and fewer using automobiles for their trips (for example, see Moon, 1990). Hence, the development near transit would generate fewer auto trips and should pay less for automobile

trip generation than the same development in a more isolated **area**.

Density of land use is likely to be important at the aggregate level rather than at the individual community level. Both because of shorter trip length and greater use of transit, the traffic impact fee of dense development should probably be less than the traffic impact fee of less dense development per unit of development. Few if any current fee structures take this issue into account. There is good reason for such caution. First, there are substantial data problems, both at the general level and when looking at specific locations. Second, the magnitude of the benefit from higher density development is not always obvious to the community in which the development takes place. Higher density means more trips in that community even though it may mean fewer trips for the region as a whole. Thus, a local government might not find that its gains in the form of reduced average trip length or reduced demand for road usage were sufficient to warrant it offering a reduced fee for higher density development. Indeed, if there are diseconomies of scale in production or if the cost of producing roads is higher in high density areas, there might be incentives for the local government to generate a surcharge for high density.

If there is a negative externality associated with low density development, it can only be effectively internalized through some form of density related pricing, and the incentive to generate such pricing must come from other government units since there is not likely to be a substantial external effect within a single community. The higher cost of building infrastructure past the property should be considered as well as the cost of building **infrastructure** to serve the demand generated by the property. Empirically, this is a difficult cost to estimate. The question is whether these adjustments are sufficiently large to be worth the additional administrative and other costs and whether such adjustments create any substantial incentive to develop land in a manner which generates lower amounts of traffic.

The key steps in such an analysis **relate to** the estimation of traffic generation by land use and the sensitivity of land use development to the cost differences associated with **traffic**

impact fee differences. For example, the fee differences could be so small that they would have no noticeable effect on land use decisions.

A related issue is the use of fees to discourage development in areas which are not designated for urban development. In these cases, the cost of roads per unit of development is likely to be considerably higher than in areas with consistent development. This would occur for example if a road had to be built to serve a small number of land users. The typical methodology would attribute only a small number of trips to any specific development and so would generate a charge small relative to the actual cost of providing service to the activity.

Perhaps a more realistic method to approach the use of reductions in traffic impact fees as a means of controlling land use would be to focus on granting credits or reductions for designs which specifically are intended to reduce the amount of traffic generation which occurs. These type of incentives can be targeted much more effectively than general types of reductions associated with a particular density of development. Further, types of development which do not reduce density but do reduce the amount of automobile traffic generated would also be eligible for lower fees under such a system. Directly attempting to alter the amount of trip generation which development generates is likely to be much more effective at controlling the trip generation amounts than would any indirect attempt to reduce trip generation through higher density of development.

The one characteristic of land use which might be significantly affected by fees rather than other approaches would be development outside of urban areas. Fees for this type of development would presumably be higher both because of the higher cost of service with fewer people and longer distances and because of the lack of alternatives to automobile travel.

Traffic impact fees generally improve efficiency in traffic by making it possible to increase the supply of roads in a more timely manner than is possible with many other funding sources. They do not internalize the congestion externality which is generated at any specific time, but they do reduce the dynamic inefficiency of requiring severe congestion before supply

adjustments are made. They also reduce some of the inefficiency of other revenue sources when used to **fund** road construction. The major benefit of **traffic** impact fees as currently used is to provide better coordination of demand for road capacity and increased supply of road capacity. However, they could be used to at least indirectly address some of the other efficiency concerns generated with respect to traffic and land use. There is room for considerable research on the effect of density on average trip length and the ability of impact fees to affect the density of development.

CONCLUSIONS AND RECOMMENDATIONS

Analysis of the theoretical foundations for traffic impact fees leads to the conclusion that they can promote efficiency in a second-best context. In particular, they can offset a tendency to **underfund** road construction in growing communities. This appears to be consistent with the actual uses of impact fees, although this analysis would seem to imply impact fees which covered the full cost of meeting new road demand associated with development. When used for this purpose, the allocation of charges by **formula** based on demand for road use appear to be preferable to systems designed to allocate charges based on the specific impact of a new development on road conditions. The major concern with this type of fee is the trade-off between accurate estimation of traffic impact and simplicity of the fee structure.

Traffic impact fees could in principle be used to promote other efficiency improvements, but there has been little theoretical or empirical work to design such a system. In particular, it appears that a density-sensitive traffic impact fee would be appropriate for internalizing some land use externalities. However, a density-sensitive impact fee may be too **crude** to have much impact on actual development patterns. Consequently, negotiated adjustments to impact fees based on travel demand management **strategies** may be more effective.

These conclusions suggest that additional research is needed in the following areas:

- * The impact of traffic impact fees on the **willingness** of residents to approve other road construction. Will a traffic impact fee actually encourage greater willingness to invest in roads by existing residents?
- * The effect of density on trip generation, trip length, and the cost of infrastructure.
- * The possibility of using a land tax together with a traffic impact fee to generate better

efficiency incentives.

- * The effect of differential impact fees on the density of development**
- * The relationship between different levels of government in setting efficient traffic impact fees and allocating the resources.**
- * Effectiveness of negotiated adjustments in traffic impact fees on altering development characteristics and actual trip generation from new developments**

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