

Transit Price Elasticities and Cross-Elasticities

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Abstract

This article summarizes price elasticities and cross-elasticities for use in public transit planning. It describes elasticities and how they are used, and examines previous research on transit elasticities. Commonly used transit elasticity values are largely based on studies of short- and medium-run impacts performed decades ago when real incomes were lower and a larger portion of the population was transit dependent. As a result, they tend to be lower than appropriate to model long-run impacts. Analysis based on these elasticity values tends to understate the potential of transit fare reductions and service improvements to reduce problems, such as traffic congestion and vehicle pollution, and understates the long-term negative impacts that fare increases and service cuts will have on transit ridership, transit revenue, traffic congestion, and pollution emissions.

Introduction

Prices affect consumers' purchase decisions. A particular product may seem too expensive at its regular price, but a good value when it is discounted. Similarly, a price increase may motivate consumers to use a product less or shift to another brand.

Such decisions are said to be marginal. The decision is at the margin between different alternatives, and can therefore be affected by even a small price change.

Although individually such decisions may be quite variable and difficult to predict (a consumer might succumb to a sale one day but ignore the same offer the next), in aggregate they tend to follow a predictable pattern: When prices decline consumption increases, and when prices increase consumption declines, all else being equal. This is called the law of demand.

This article summarizes research on how price changes affect transit ridership. *Price* refers to users' perceived marginal cost—the factors that directly affect consumers' purchase decision. This can include both monetary costs and nonmarket costs such as travel time and discomfort.

Price sensitivity is measured using *elasticities*, defined as the percentage change in consumption resulting from a 1 percent change in price, all else held constant. A high elasticity value indicates that a good is price-sensitive; that is, a relatively small change in price causes a relatively large change in consumption. A low elasticity value means that prices have relatively little effect on consumption. The degree of price sensitivity refers to the absolute elasticity value—regardless of whether it is positive or negative.

For example, if the elasticity of transit ridership with respect to (abbreviated WRT) transit fares is -0.5 , this means that each 1.0 percent increase in transit fares causes a 0.5 percent reduction in ridership, so a 10 percent fare increase will cause ridership to decline by about 5 percent. Similarly, if the elasticity of transit ridership with respect to transit service hours is 1.5, a 10 percent increase in service hours would cause a 15 percent increase in ridership.

Economists use several terms to classify the relative magnitude of elasticity values. *Unit elasticity* refers to an elasticity with an absolute value of 1.0, meaning that price changes cause a proportional change in consumption. Elasticity values less than 1.0 in absolute value are called *inelastic*, meaning that prices cause less than proportional changes in consumption. Elasticity values greater than 1.0 in absolute value are called *elastic*, meaning that prices cause more than proportional changes in consumption. For example, both 0.5 and -0.5 values are considered *inelastic* because their absolute values are less than 1.0, while both 1.5 and -1.5 values are considered *elastic* because their absolute values are greater than 1.0.

Cross-elasticities refer to the percentage change in the consumption of a good resulting from a price change in another related good. For example, automobile travel is complementary to vehicle parking and a substitute for transit travel, so an

increase in the price of driving tends to reduce demand for parking and increase demand for transit.

To help analyze cross-elasticities it is useful to estimate *mode substitution* factors, such as the change in automobile trips resulting from a change in transit trips. These factors vary depending on circumstances. For example, when bus ridership increases due to reduced fares, typically 10 percent to 50 percent of the added trips will substitute for an automobile trip. Other trips will shift from nonmotorized modes, ridesharing (which consists of vehicle trips that will be made anyway), or be induced travel (including chauffeured automobile travel, in which a driver makes a special trip to carry a passenger). Conversely, when a disincentive, such as parking fees or road tolls, causes automobile trips to decline, there is generally a 20 to 60 percent shift to transit, depending on conditions. Pratt (1999) provides information on mode shifts that result from various incentives, such as transit service improvements and parking pricing.

Special care is required when calculating the impacts of large price changes, or when predicting the effects of multiple changes, such as an increase in fares and a reduction in service, because each subsequent change impacts a different base. For example, if prices increase 10 percent on a good with a -0.5 elasticity, the first 1 percent of price change reduces consumption by 0.5 percent, to 99.5 percent of its original amount. The second 1 percent price change reduces this 99.5 percent by another 99.5 percent, to 99.0 percent. The third 1 percent of price change reduces this 99.0 percent by another 99.5 percent to 98.5 percent, and so on for each 1 percent change. In total, a 10 percent price increase reduces consumption 4.9 percent, not a full 5 percent that would be calculated by simply multiplying -0.5×10 . This becomes significant when evaluating the impacts of price changes greater than 50 percent.

Price elasticities have many applications in transportation planning. They can be used to predict the ridership and revenue effects of changes in transit fares; they are used in modeling to predict how changes in transit service will affect vehicle traffic volumes and pollution emissions; and they can help evaluate the impacts and benefits of mobility management strategies such as new transit services, road tolls, and parking fees.

Factors Affecting Transit Elasticities

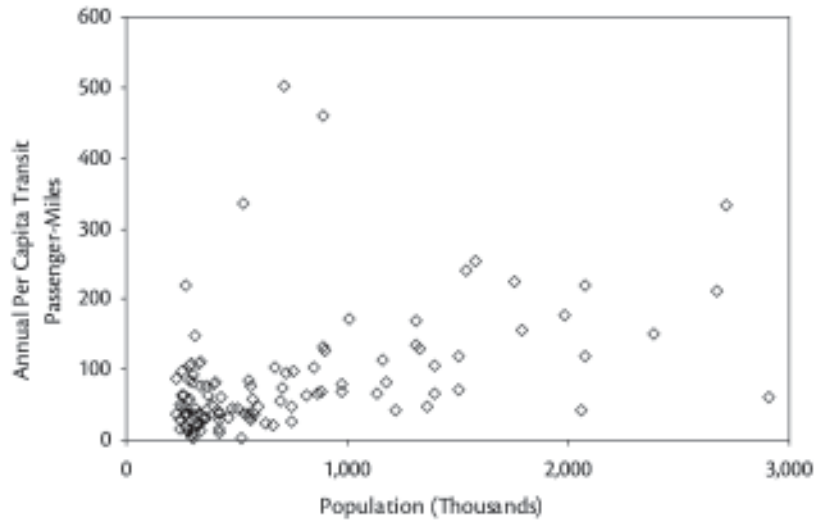
Many factors can affect how prices affect consumption decisions. They can vary depending on how elasticities are defined, type of good or service affected, category of customer, quality of substitutes, and other market factors. It is important to consider these factors in elasticity analysis.

Some factors that affect transit elasticities, as reflected in currently available research, are summarized below.

- *User Type.* Transit dependent riders are generally less price sensitive than *choice or discretionary* riders (people who have the option of using an automobile for that trip). Certain demographic groups, including people with low incomes, nondrivers, people with disabilities, high school and college students, and elderly people tend to be more transit dependent. In most communities transit-dependent people are a relatively small portion of the total population but a large portion of transit users, while discretionary riders are a potentially large but more price elastic transit market segment.
- *Trip Type.* Noncommute trips tend to be more price sensitive than commute trips. Elasticities for off-peak transit travel are typically 1.5 to 2 times higher than peak-period elasticities, because peak-period travel largely consists of commute trips.
- *Geography.* Large cities tend to have lower price elasticities than suburbs and smaller cities, because they have a greater portion of transit-dependent users. Per capita annual transit ridership tends to increase with city size, as illustrated in Figure 1, due to increased traffic congestion and parking costs, and improved transit service due to economies of scale.
- *Type of Price Change.* Transit fares, service quality (service speed, frequency, coverage, and comfort), and parking pricing tend to have the greatest impact on transit ridership. Elasticities appear to increase somewhat as fare levels increase (i.e., when the starting point of a fare increase is relatively high).
- *Direction of Price Change.* Transportation demand models often apply the same elasticity value to both price increases and reductions, but there is evidence that some changes are nonsymmetric. Fare increases tend to cause a greater reduction in ridership than the same size fare reduction will increase ridership. A price increase or transit strike that induces households

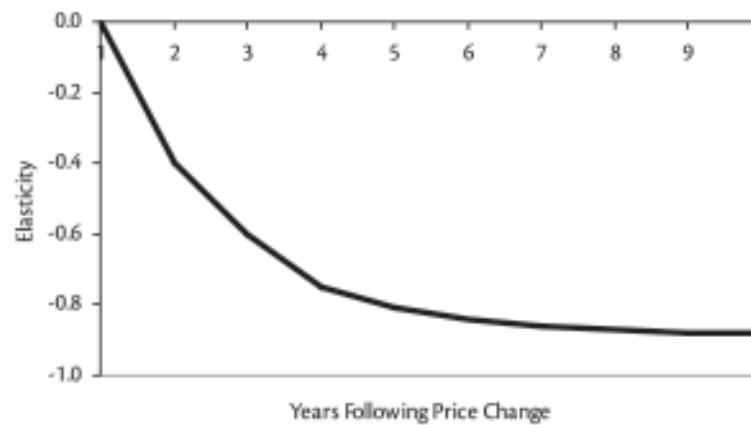
to purchase automobiles may be somewhat irreversible, since once people become accustomed to driving they often continue.

Figure 1. Transit Ridership Versus City Size



Source: Federal Transit Administration, 2001.

Figure 2. Dynamic Elasticity

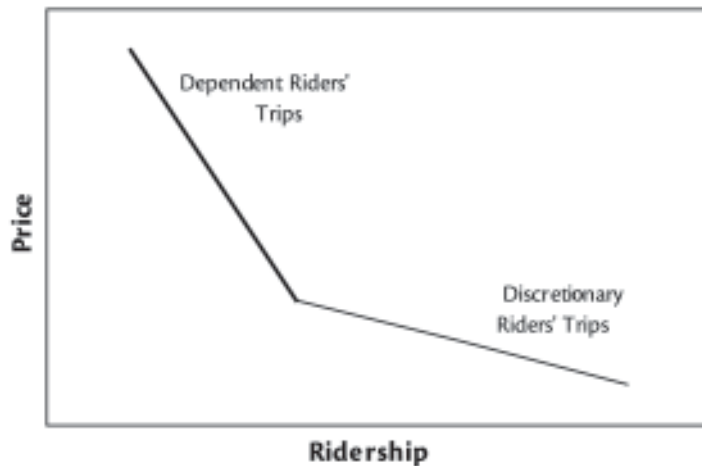


Source: Dargay and Hanly, 1999.

- *Time Period.* Price impacts are often categorized as short-run (less than two years), medium-run (within five years) and long-run (more than five years). Elasticities increase over time, as consumers take price changes into account in longer-term decisions, such as where to live or work, as illustrated in Figure 2. Long-run transit elasticities tend to be two or three times as large as short-run elasticities.
- *Transit Type.* Bus and rail often have different elasticities because they serve different markets, although how they differ depends on specific conditions.

Because there is significant difference in transit demand between dependent and discretionary riders we can say that there is a kink in the demand curve (Clements 1997), as illustrated in Figure 3. As a result, elasticity values depend on what portion of the demand curve is being measured. Price changes may have relatively little impact on ridership for a basic transit system that primarily serves transit-dependent users. If the transit system wants to attract significantly more riders and reduce automobile travel, however, fares will need to decline and service improve to attract more price-sensitive discretionary riders.

Figure 3. Kink in the Demand Curve



Summary of Transit Elasticity Studies

Many studies have been performed on the price elasticity of public transit, and several previous publications have summarized the results of such studies, including Pham and Linsalata (1991); Oum, Waters, and Yong (1992); Goodwin (1992); Luk and Hepburn (1993); Pratt (1999); Dargay and Hanly (1999), TRACE (1999); and Booz Allen Hamilton (2003). Significant results from this research are summarized below.

General Transit Fare Elasticity Values

A frequently used rule-of-thumb, known as the *Simpson–Curtin* rule, is that each 3 percent fare increase reduces ridership by 1 percent. Like most rules-of-thumb, this can be useful for rough analysis, but it is too simplistic and outdated for detailed planning and modeling.

Table 1 shows transit fare elasticity values published by the American Public Transportation Association, and widely used for transit planning and modeling in North America. The values were based on a study of the short-run (less than two years) effects of fare changes in 52 U.S. transit systems during the late 1980s. Because they reflect short-run impacts and are based on studies performed when a larger portion of the population was transit-dependent, these values probably understate the long-run impacts of current price changes.

Table 1. Bus Fare Elasticities

	Large Cities (More than 1 Million Population)	Smaller Cities (Less than 1 Million Population)
Average for all hours	-0.36	-0.43
Peak hour	-0.18	-0.27
Off-peak	-0.39	-0.46
Off-peak average	-0.42	
Peak hour average	-0.23	

Source: Pham and Linsalata, 1991.

After a detailed review of international studies, Goodwin (1992) produced the average elasticity values summarized in Table 2. He noted that price impacts tend to increase over time as consumers have more options (related to increases in real incomes, automobile ownership, and now telecommunications that can substitute for physical travel). Nijkamp and Pepping (1998) found elasticities in the -0.4 to -0.6 range in a meta-analysis of European transit elasticity studies.

Table 2. Transportation Elasticities

	<i>Short-Run</i>	<i>Long-Run</i>	<i>Not Defined</i>
Bus demand WRT fare cost	-0.28	-0.55	
Railway demand WRT fare cost	-0.65	-1.08	
Public transit WRT petrol price			0.34
Car ownership WRT general public transport costs			0.1 to 0.3
Petrol consumption WRT petrol price	-0.27	-0.71	-0.53
Traffic levels WRT petrol price	-0.16	-0.33	

Source: Goodwin, 1992.

Note: WRT = With Respect To

Dargay and Hanly (1999) studied the effects of UK transit bus fare changes over several years to derive the elasticity values summarized in Table 3. They used a dynamic econometric model (separate short- and long-run effects) of per capita bus patronage, per capita income, bus fares, and service levels. They found that demand is slightly more sensitive to rising fares (-0.4 in the short run and -0.7 in the long run) than to falling fares (-0.3 in the short run and -0.6 in the long run), and that demand tends to be more price sensitive at higher fare levels. Dargay and Hanly found that the cross-elasticity of bus patronage to automobile operating costs is negligible in the short run but increases to 0.3 to 0.4 over the long run, and the long-run elasticity of *car ownership* with respect to transit fares is 0.4, while the elasticity of *car use* with respect to transit fares is 0.3.

Table 3. Bus Fare Elasticities

Elasticity Type	Short-Run	Long-Run
Non-urban	-0.2 to -0.3	-0.8 to -1.0
Urban	-0.2 to -0.3	-0.4 to -0.6

Source: Dargay and Hanly, 1999, p. viii.

Another study compared transit elasticities in the UK and France between 1975 and 1995 (Dargay et al. 2002). It indicates that transit ridership declines with income (although not in Paris, where wealthy people are more likely to ride transit than in most other regions) and with higher fares, and increases with increased transit service kilometers. These researchers found that transit elasticities have increased during this period. Table 4 summarizes their findings.

Table 4. Transit Elasticities

	<i>England</i>		<i>France</i>	
	Log-Log	Semi-Log	Log-Log	Semi-Log
Income				
Short run	-0.67	-0.69	-0.05	-0.04
Long run	-0.90	-0.95	-0.09	-0.07
Fare				
Short run	-0.51	-0.54	-0.32	-0.30
Long run	-0.69	-0.75	-0.61	-0.59
Transit VKM				
Short run	0.57	0.54	0.29	0.29
Long run	0.77	0.74	0.57	0.57
Annual fare elasticity growth rate		1.59%		0.66%

Source: Dargay et al., 2002, Table 4.

With a log-log function, elasticity values are the same at all fare levels; whereas with a semi-log function, the elasticity value increases with higher fares. Log-log functions are most common and generally easiest to use. Semi-log elasticity values are based on an exponential function, and can be used for predicting impacts of fares that approach zero, that is, if transit services become free, but are unsuited for very high fare levels, in which case semi-log may result in exaggerated elasticity values.

For typical fare changes between 10 percent and 30 percent, log-log and semi-log functions provide similar results, so either can be used.

Table 5 summarizes estimates of transit fare elasticities for different user groups and trips types, illustrating how various factors affect transit price sensitivities. For example, it indicates that car owners have a greater elasticity (-0.41) than people who are transit dependent (-0.10), and work trips are less elastic than shopping trips.

Table 5. Transit Fare Elasticities

Factor	Elasticity
Overall transit fares	-0.33 to -0.22
Riders under 16 years old	-0.32
Riders aged 17–64	-0.22
Riders over 64 years old	-0.14
People earning <\$5,000	-0.19
People earning >\$15,000	-0.28
Car owners	-0.41
People without a car	-0.10
Work trips	-0.10 to -0.19
Shopping trips	-0.32 to -0.49
Off-peak trips	-0.11 to -0.84
Peak trips	-0.04 to -0.32
Trips < 1 mile	-0.55
Trips > 3 miles	-0.29

Source: Gillen, 1994, pp. 136–137.

Rail and bus elasticities often differ. In major cities, rail transit fare elasticities tend to be relatively low, typically in the -0.18 range, probably because higher-income residents depend on such systems (Pratt, 1999). For example, the Chicago Transportation Authority found that peak bus riders have an elasticity of -0.30, and off-peak riders -0.46, while rail riders have peak and off-peak elasticities of -0.10 and -0.46, respectively. However, fare elasticities may be relatively high on routes where travelers have viable alternatives, such as for suburban rail systems where most riders are discretionary.

Commuter transit pass programs, in which employers subsidize transit passes, are effective at increasing ridership (Commuter Check, Commuter Choice). Deep discount transit passes can encourage occasional riders to use transit more frequently, and if implemented when fares are increasing, can avoid ridership losses (Oram and Stark 1996). Many campus UPass programs, which provide free or discounted transit fares to students and staff, have been quite successful, often doubling or tripling the portion of trips made by transit, because college students tend to be relatively price sensitive (Brown, Hess, and Shoup 2001).

Table 6 summarizes travel demand elasticities developed for use in Australia, based on a review of various national and international studies. These standardized values, adopted by the Australian Road Research Board, are used for various transport planning applications throughout the country, modified as appropriate to reflect specific conditions.

Table 6. Australian Travel Demand Elasticities

Elasticity Type	Short-Run	Long-Run
Bus demand and fare	-0.29	
Rail demand and fare	-0.35	
Mode shift to transit and petrol price	+0.07	
Mode shift to car and rail fare increase	+0.09	
Road freight demand and road/rail cost ratio	-0.39	-0.80
Petrol consumption and petrol price	-0.12	-0.58
Travel level and petrol price	-0.10	

Source: Luk and Hepburn, 1993.

Service Elasticities

Service elasticities indicate how transit ridership is affected by transit service quality factors (e.g., availability, convenience, speed, and comfort), based on transit vehicle mileage, hours, frequency, and priority (Kittleson & Associates 1999; Phillips, Karachepone, and Landis 2001).

Pratt (1999) finds that completely new bus service in a community that previously had no public transit service typically achieves 3 to 5 annual rides per capita, with 0.8 to 1.2 passengers per bus-mile (0.5 to 0.7 passengers per bus-kilometer). The elasticity of transit use to service expansion (e.g., routes into new parts of a com-

munity) is typically in the range of 0.6 to 1.0, meaning that each 1 percent of additional transit vehicle-miles or vehicle-hours increases ridership by 0.6 percent to 1.0 percent, although much lower and higher response rates are also found (from less than 0.3 to more than 1.0). The elasticity of transit use with respect to transit service frequency (called a *headway elasticity*) averages 0.5, with greater effects where service is infrequent. There is a wide variation in these factors, depending on type of service, demographic, and geographic factors. Higher service elasticities often occur with new express transit service, in university towns, and in suburbs with rail transit stations to feed. On the other hand, some service increases result in little additional ridership. It usually takes one to three years for new routes to reach their full potential ridership.

Improved marketing, schedule information, easy-to-remember departure times (e.g., every hour or half-hour), and more convenient transfers can also increase transit use, particularly in areas where service is less frequent (Turnbull and Pratt 2003).

Voith (1991) found that, as with monetary price elasticities, service elasticities tend to increase over time. He concludes, "The findings suggest that reductions in public transportation subsidies that result in higher fares and lower service quality may produce higher subsidy costs per rider than would be the case with higher total subsidy. Thus, the results from this analysis support the common public perception that raising public transit fares and reducing service simply reduce ridership, requiring further fare increases and service cuts."

Multimodal Models

Some researchers have assembled elasticity and cross-elasticity data to create models that predict how various combinations of changes in transit fares, transit service, and vehicle operating costs would affect transit ridership and automobile travel. These models can help answer questions concerning the potential role that transit can play in addressing strategic transportation objectives such as congestion and emission reductions. They can help predict the impacts of integrated mobility management programs that include complementary strategies to encourage more efficient transportation patterns, such as combinations of service improvements, fare reductions, and parking or road pricing.

The METS (METropolitan Transport Simulator, Institute for Fiscal Studies 2001) is an urban transport demand simulation model available on the Internet (<http://vla.ifs.org.uk/models/mets22.html>). METS was developed in the early 1980s for use

by the UK Department of Transport, and updated in 2000. It allows users to predict the changes in transit and automobile travel that would result from changes in transit service quality, frequency, fares, and car costs.

Hensher (1997) developed a model of cross-elasticities between various forms of transit and car use, illustrated in Table 7. This type of analysis can be used to predict the effects of transit fare changes on vehicle traffic, and the effect that road tolls or parking fees will have on transit ridership. Such models tend to be sensitive to specific demographic and geographic conditions and so must be calibrated for each area. For example, Table 7, which is based on a survey of residents of Newcastle, a small Australian city, indicates a 10 percent increase in single-fare train tickets will cause a 2.18 reduction in the sale of those fares, and a 0.57 percent increase in single-fare bus tickets.

Table 7. Direct and Cross-Share Elasticities

	<i>Train</i>	<i>Train</i>	<i>Train</i>	<i>Bus</i>	<i>Bus</i>	<i>Bus</i>	<i>Car</i>
	Single Fare	Ten Fare	Pass	Single Fare	Ten Fare	Pass	
Train, single fare	-0.218	0.001	0.001	0.057	0.005	0.005	0.196
Train, ten fare	0.001	-0.093	0.001	0.001	0.001	0.006	0.092
Train, pass	0.001	0.001	-0.196	0.001	0.012	0.001	0.335
Bus, single fare	0.067	0.001	0.001	-0.357	0.001	0.001	0.116
Bus, ten fare	0.020	0.004	0.002	0.001	-0.160	0.001	0.121
Bus, pass	0.007	0.036	0.001	0.001	0.001	-0.098	0.020
Car	0.053	0.042	0.003	0.066	0.016	0.003	-0.197

Source: Hensher, 1997, Table 8.

TRACE (1999) provides detailed elasticity and cross-elasticity estimates for various types of travel (e.g., car-trips, car-kilometers, transit travel, walking/cycling, commuting, business) and conditions, based on numerous European studies. Comprehensive sets of elasticity values such as these can be used to model the travel impacts of various combinations of price changes, such as a reduction in transit fares combined with an increase in fuel taxes or parking fees. It estimates that a 10 percent rise in fuel prices increases transit ridership 1.6 percent in the short run and 1.2 percent over the long run, depending on regional vehicle ownership. This declining elasticity value is unique to fuel, because fuel price increases cause motor-

Table 8. Elasticities with Respect to Fuel Price

<i>Term/Purpose</i>	<i>Car Driver</i>	<i>Car Passenger</i>	<i>Public Transport</i>	<i>Slow Modes</i>
Trips				
Commuting	-0.11	+0.19	+0.20	+0.18
Business	-0.04	+0.21	+0.24	+0.19
Education	-0.18	+0.00	+0.01	+0.01
Other	-0.25	+0.15	+0.15	+0.14
Total	-0.19	+0.16	+0.13	+0.13
Kilometers				
Commuting	-0.20	+0.20	+0.22	+0.19
Business	-0.22	+0.05	+0.05	+0.04
Education	-0.32	+0.00	+0.00	+0.01
Other	-0.44	+0.15	+0.18	+0.16
Total	-0.29	+0.15	+0.14	+0.13

Source: TRACE, 1999, Tables 8 and 9.

Note: Slow Modes = Walking and Cycling

ists to purchase more fuel-efficient vehicles. Table 8 summarizes elasticities of trips and kilometers with respect to fuel prices in areas with high vehicle ownership (more than 450 vehicles per 1,000 population).

Parking prices (and probably road tolls) tend to have a greater impact on transit ridership than other vehicle costs, such as fuel, typically by a factor of 1.5 to 2.0, because they are paid directly on a per-trip basis. Table 9 shows how parking prices affect travel in a relatively automobile-oriented urban region.

Hensher and King (1998) calculate elasticities and cross-elasticities for various forms of transit fares and automobile travel in the Sydney, Australia, city center. Table 10 summarizes their findings. The table shows, for example, a 10 percent increase in prices at preferred CBD parking locations will cause a 5.41 percent reduction in demand there, a 3.63 percent increase in park-and-ride trips, a 2.91 increase in public transit trips, and a 4.69 reduction in total CBD trips.

Table 9. Parking Price Elasticities

<i>Term/Purpose</i>	<i>Car Driver</i>	<i>Car Passenger</i>	<i>Public Transport</i>	<i>Slow Modes</i>
Trips				
Commuting	-0.08	+0.02	+0.02	+0.02
Business	-0.02	+0.01	+0.01	+0.01
Education	-0.10	+0.00	+0.00	+0.00
Other	-0.30	+0.04	+0.04	+0.05
Total	-0.16	+0.03	+0.02	+0.03
Kilometers				
Commuting	-0.04	+0.01	+0.01	+0.02
Business	-0.03	+0.01	+0.00	+0.01
Education	-0.02	+0.00	+0.00	+0.00
Other	-0.15	+0.03	+0.02	+0.05
Total	-0.07	+0.02	+0.01	+0.03

Source: TRACE, 1999, Tables 32 and 33.
 Note: Slow Modes = Walking and Cycling

Table 10. Parking Elasticities

	<i>Preferred CBD</i>	<i>Less Preferred CBD</i>	<i>CBD Fringe</i>
Car trip, preferred CBD	-0.541	0.205	0.035
Car trip, less preferred CBD	0.837	-0.015	0.043
Car trip, CBD fringe	0.965	0.286	-0.476
Park-and-ride	0.363	0.136	0.029
Ride public transit	0.291	0.104	0.023
Forego CBD trip	0.469	0.150	0.029

Source: Hensher and King, 2001, Table 6.

Conclusions and Recommendations

An important conclusion of this research is that no single transit elasticity value applies in all situations: Various factors affect price sensitivities including type of user and trip, geographic conditions, and time period.

Available evidence suggests that the elasticity of transit ridership with respect to fares is usually in the -0.2 to -0.5 range in the short run (first year), and increases to -0.6 to -0.9 over the long run (five to ten years). These are affected by the following factors:

- Transit price elasticities are lower for transit-dependent riders than for discretionary (choice) riders.
- Elasticities are about twice as high for off-peak and leisure travel as for peak and commute travel.
- Cross-elasticities between transit and automobile travel are relatively low in the short run (0.05), but increase over the long run (probably to 0.3 and perhaps as high as 0.4).
- A relatively large fare reduction is generally needed to attract motorists to transit, since they are discretionary riders. Such travelers may be more responsive to service quality (speed, frequency, and comfort), and higher automobile operating costs through road or parking pricing.
- Due to variability and uncertainty, it is preferable to use ranges rather than point values for elasticity analysis.

Commonly used transit elasticity values primarily reflect short- and medium-run impacts and are based on studies performed 10 to 40 years ago, when real incomes were lower and a greater portion of the population was transit dependent. The resulting elasticity values may be appropriate for predicting how a change in transit fares or service will affect next year's ridership and revenue, but long-run elasticity values are more appropriate for strategic planning. Conventional traffic models that use standard elasticity values based on short-run price effects tend to understate the potential of transit fare reductions and service improvements to reduce problems such as traffic congestion and vehicle pollution. Conversely, these models will understate the long-term negative impacts that fare increases and service cuts can have on transit ridership, transit revenue, traffic congestion, and pollution emissions.

In most communities (particularly outside of large cities) transit-dependent people are a relatively small portion of the total population, while discretionary riders

(people who have the option of driving) are a potentially large but more price-sensitive market segment. As a result, increasing transit ridership requires pricing and incentives that attract travelers out of their cars. Combinations of fare reductions and discounted passes, higher vehicle user fees (e.g., priced parking or road tolls), improved transit service, and better transit marketing can be particularly effective at increasing transit ridership and reducing automobile use (Victoria Transport Policy Institute 2002).

Transit planners generally assume that transit is price inelastic (elasticity values are less than 1.0), so fare increases and service reductions increase net revenue. This tends to be true in the short run (less than two years), but long-run elasticities approach 1.0, so financial gains decline over time.

Not all increased transit ridership that results from fare reductions and service improvements represents a reduction in automobile travel. Much of this additional ridership may substitute for walking, cycling, or rideshare trips, or consist of absolute increases in total personal mobility. In typical situations, a quarter to half of increased transit ridership represents a reduction in automobile travel, but this varies considerably depending on specific conditions.

Table 11 summarizes recommended generic values based on this research. These values reflect the results of numerous studies, presented in a format to facilitate their application in typical transport planning situations. High and low values are presented to allow sensitivity analysis, or a midpoint value can be used. Actual elasticities vary depending on circumstances, so additional review and research is recommended to improve and validate these values, and modify them to specific situations.

Table 11. Recommended Transit Elasticity Values

	<i>Market Segment</i>	<i>Short Term</i>	<i>Long Term</i>
Transit ridership WRT transit fares	Overall	-0.2 to -0.5	-0.6 to -0.9
Transit ridership WRT transit fares	Peak	-0.15 to -0.3	-0.4 to -0.6
Transit ridership WRT transit fares	Off-peak	-0.3 to -0.6	-0.8 to -1.0
Transit ridership WRT transit fares	Suburban commuters	-0.3 to -0.6	-0.8 to -1.0
Transit ridership WRT transit service	Overall	0.50 to 0.7	0.7 to 1.1
Transit ridership WRT auto operating costs	Overall	0.05 to 0.15	0.2 to 0.4
Automobile travel WRT transit costs	Overall	0.03 to 0.1	0.15 to 0.3

Note: WRT = With Respect To

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