Public Transportation and the Nation's Economy

A Quantitative Analysis of Public Transportation's Economic Impact

Prepared by
Cambridge Systematics, Inc.

with

Economic Development Research Group

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Summary of Findings

This report addresses three objectives:

- Update earlier analyses of the job creation and business revenue impacts of investment in public transit at the national level using state-of-the art analytical techniques;
- Examine and expand estimates of transit's economic impacts in other key dimensions; and
- Assess the value to the economy of each dollar invested in transit.

The new analysis reaffirms the significant positive economic impact of transit investment on jobs and business revenues and affirms a variety of broader indirect benefits.

Key Findings

• ***Transit capital investment is a significant source of job creation. This analysis indicates that in the year following the investment 314 jobs are created for each $10 million invested in transit capital funding.***

• ***Transit operations spending provides a direct infusion to the local economy. Over 570 jobs are created for each $10 million invested in the short run.***

• ***Businesses would realize a gain in sales 3 times the public sector investment in transit capital; a $10 million investment results in a $30 million gain in sales.***

• ***Businesses benefit as well from transit operations spending, with a $32 million increase in business sales for each $10 million in transit operations spending.***

• ***The additional economic benefits from the transportation impacts of transit investment in major metropolitan areas are substantial. For every $10 million invested, over $15 million is saved in transportation costs to both highway and transit users. These costs include operating costs, fuel costs, and congestion costs.***

• ***Business output and personal income are positively impacted by transit investment, growing rapidly over time. These transportation user impacts create savings to business operations, and increase the overall efficiency of the economy, positively affecting business sales and household incomes. A sustained program of transit capital***

investment will generate an increase of $2 million in business output and $0.8 million in personal income for each $10 million in the short run (during year one). In the long term (during year 20), these benefits increase to $31 million and $18 million for business output and personal income respectively.

• Transit capital and operating investment generates personal income and business profits that produce positive fiscal impacts. On average, a typical state/local government could realize a 4 to 16 percent gain in revenues due to the increases in income and employment generated by investments in transit.

• Additional economic benefits which would improve the assessment of transit's economic impact are difficult to quantify and require a different analytical methodology from that employed in this report. They include "quality of life" benefits, changes in land use, social welfare benefits and reductions in the cost of other public sector functions.

• The findings of this report compliment studies of local economic impacts, which carry a positive message that builds upon the body of evidence that shows transit is a sound public investment. Summarized in Section 6.0, local studies have shown benefit/cost ratios as high as 9 to 1.

■ Why the Study Results are Important

The relationship between the strength and competitiveness of the nation's economy and the extent, condition and performance of the nation's transportation system is a topic of critical interest. There is mounting evidence that we, as a nation, are severely under-investing in the transportation network that is so vital to our economic interests, and that we are paying inadequate attention to the development of transit and other forms of high-capacity surface transportation.

- ***The economic benefits of transit investment must be clear to compete for limited resources.*** Even during a booming economy and times of declining budget deficits, competition for resources is fierce. The substantial economic benefits of transit investment and use and the urgency of increased investment in transit and transportation must be clear and well-documented.

- ***Transportation is critical to business and personal economic security***. Transportation accounts for approximately 17 percent of our Gross Domestic Product, and for American families transportation represents 18 percent of household spending, the second largest household expenditure after housing.

- ***Travel demand and congestion is increasing dramatically.*** From 1975 to 1995, our nation's population grew 22 percent. In contrast, registered vehicles increased 49 percent and vehicle-miles of travel rose 83 percent. Over this same period, street and roadway mileage increased by 28 percent.

- ***The cost of congestion is enormous.*** Time and money lost to households and businesses from congestion and delay on our highway system is estimated at $40 billion to $100 billion per year and are projected to grow, increasing costs and reducing business profitability and economic competitiveness.

- ***Environmental and quality of life concerns related to transportation are on the rise.*** The environmental consequences of accommodating increases in motor vehicle use are imposing increasingly unacceptable costs and constraints on economic growth and development.

- ***Economic opportunities are being lost for a growing segment of Americans***. The high cost and poor quality of transportation links between willing workers, jobs, training and human services reduces individual economic opportunities and access to labor for business and industry.

- ***Global economic competitors are investing in transit.*** Around the world, countries are investing billions to provide high-capacity passenger transportation systems and services using state-of-the-art technologies as part of aggressive global economic growth strategies.

How Transportation Investment and Expenditure Affects the Economy

Investment in transportation is a fundamental element in the economic strategies being formulated by local, regional and state officials and community leaders nationwide. At the national level, however, there is a continuing, unresolved debate over how much to invest in transportation generally, and what the balance of investment should be among modes.

Direct Dollar Effects and "Multipliers"

In highlighting results from the analysis, it is important to illustrate the fundamental economic relationships that are being measured. Investment in transportation, including public transit, provides economic benefits in several basic ways:

- "Direct" investment supports jobs for the immediate project or activity;

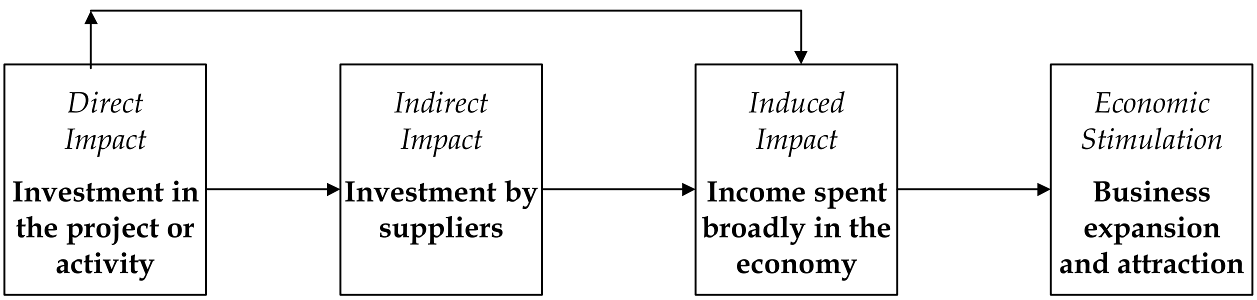
- "Indirect" investment or spending by suppliers whose goods and services are used in the project or activity also supports jobs;

- Both these investment streams provide business revenue and personal income; and

- Income is spent throughout the economy and supports other jobs and related spending, referred to as "induced" impacts.

In combination, direct, indirect and induced spending – the "multiplier effect" – stimulates the economy, resulting in expansion of existing businesses and attraction of new businesses.

Figure E.1 The Multiplier Effect



Earlier Studies

In 1984 APTA carried out analyses of the employment and business revenue impacts of investment in public transit.[1] The results from these landmark studies demonstrated for the first time that investment in public transit supports significant job creation and increases in business revenues at the national, state and local level, creating substantial economic benefits in addition to the more obvious mobility benefits provided to riders and the traveling public.

The analytical techniques used in the current study have been applied by Cambridge Systematics (CSI), Inc., in several major metropolitan areas across the country in recent years to gauge both regional and state-wide economic benefits of investment in public transit. In each of these cases, the economic return to both the regions and to the states was many times greater than the initial investment. The analyses also showed that the long-term negative economic impacts of underinvesting were severe. Several of these studies, including descriptions of their assumptions and analytical techniques as well as their results, are summarized in Part 6.0 of this report.

The economic impacts reported in this analysis are derived from the use of a forecasting economic and simulation model. This model was validated to 1992 economic conditions at the national level, thus all monetary impacts are expressed in 1992 dollars. This type of

[1] *Employment Impacts of Transit Capital Investment and Operating Expenditures*. American Public Transit Association, April 1983. *National Impacts of Transit Capital and Operating Expenditures on Business Revenues*. American Public Transit Association, January 1984.

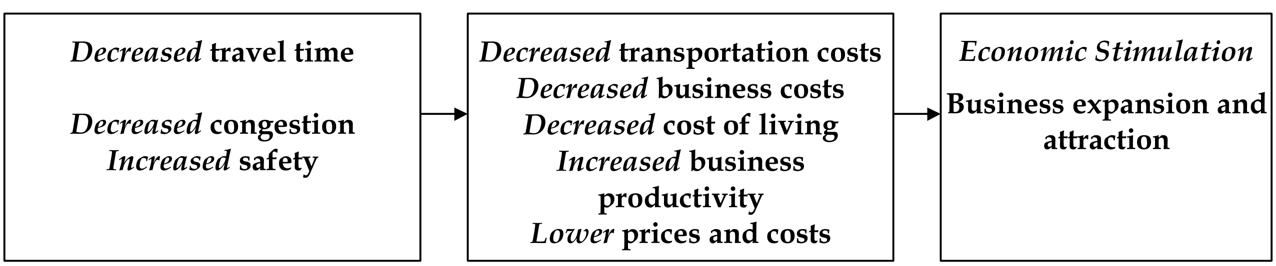
model allows the estimation of income, employment impacts, business revenue impacts, generative impacts, and labor cost and tax impacts of investment. It does not provide a summary measurement of all possible benefits to all possible costs which would be calculated from a separate "benefit-cost analysis" procedure.

Transportation Benefits

Increased transit services affect travel patterns in a variety of ways. Changes in travel patterns, in turn, have consequences for the economy. A vehicle removed from the traffic stream through transit use produces travel time savings for both transit and highway users. Savings in fuel cost may be realized as well. These savings have value in dollar or economic terms. These impacts reflect ***real*** improvements in mobility and access at a personal, neighborhood and community level.

Intuitively, the fact that businesses and workers have a limited budget of time and dollars is the driving fact behind understanding the economic impacts of transit investment. A well-functioning transit system whose operations are well maintained or improved, and in a fully functioning state, saves time and reduces costs related to travel for the millions of transit and highway users daily. Businesses benefit by devoting less of their resources to logistic costs and having access to a relatively larger work force. Lower costs mean these businesses can offer more competitive products and services in the long run and grow to benefit themselves and supporting businesses. Figure E.2 presents the flow of travel benefits to transportation system users resulting from transit capital investment.

Figure E.2 Relationship Between Transportation and Economic Impacts



The economic stimulation brought about by increased personal and business income resulting from transit investment and use increases government revenues from increased sales taxes, income taxes and property taxes.

■ Other Economic Benefits

In addition to the transportation and economic benefits highlighted in Figures E.1 and E.2, there are other benefits that result from increased transit investment and use that are more difficult to quantify or express in dollar terms. In many cases, we do not know enough about detailed cause and effect relationships, or about the monetary value of various impacts, to estimate these benefits in the quantitative analytical models being used. We do know through indirect observation and judgment, however, that there are additional benefits that have significant economic value. These include:

- Environmental benefits that are difficult to estimate or place a dollar value on;
- Energy impacts that are difficult to put a dollar value on; and
- Reduced costs for a variety of public services that are difficult to estimate.

Figure E.3 illustrates in concept how increased transit investment and use may impact environmental quality in broad terms, and how resulting changes in environmental quality impact the economy of a region. The figure suggests that:

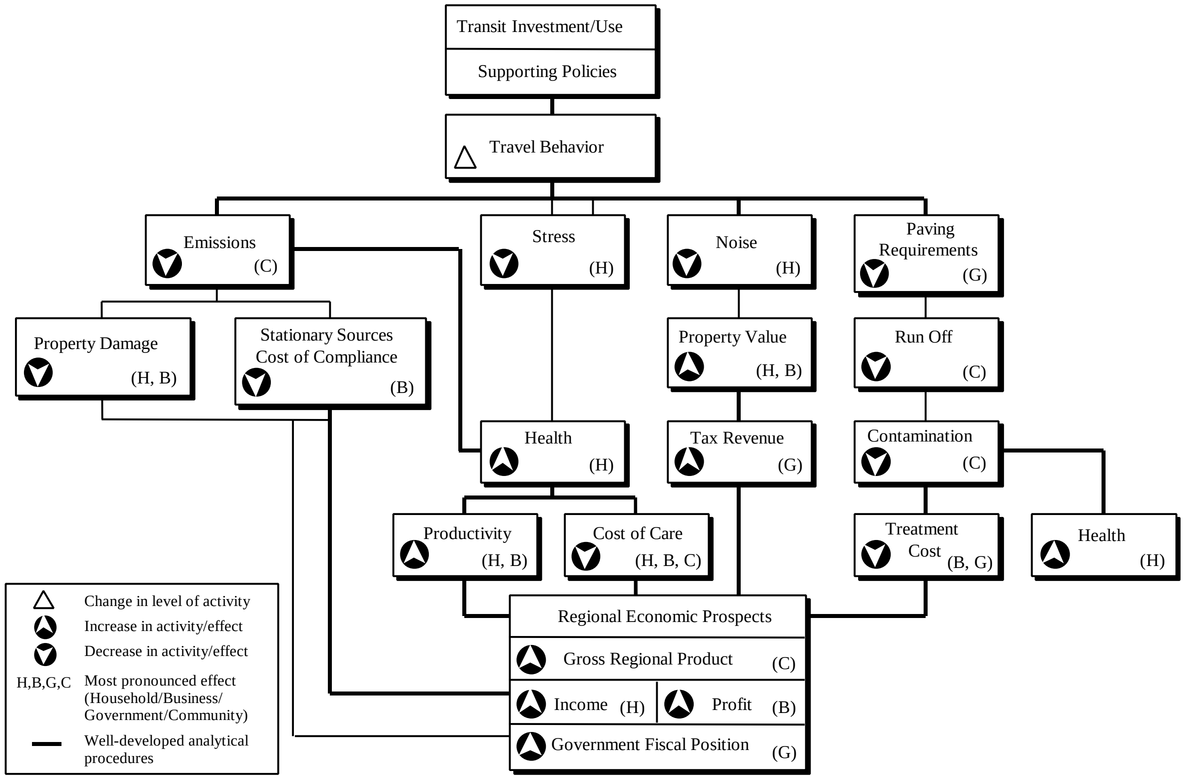
- Increased transit investment and use will impact travel behavior, construction and building activity, and the organization of land uses and development;
- These effects, in turn, will impact various environmental conditions; and
- Changes in environmental conditions will affect the economic prospects of a region.

While the direction of each impact is predictable – positive or negative, as shown by the arrows in Figure E.3 – the actual numerical change may be difficult to estimate, or the dollar value associated with that change may be difficult to establish. Increased transit investment and use has been shown to have positive effects on various aspects of environmental quality, and improved environmental quality has a positive effect on a region's economic prospects.

In some cases, these relationships and values can be estimated, but in many cases they cannot. Similar relationships can be illustrated for a variety of impacts where quantification is difficult.

The estimates of economic benefit emerging from the current study are conservative. The added positive economic impacts of factors that have not been incorporated in the formal analytical procedure represent an additional economic value above and beyond those for which estimates have been made. More importantly, the economic impacts of transit investment and use are truly national in scope. They run through the entire economy and affect the entire transportation network.

Figure E.3 Transportation-Environmental Linkages



The Context for Transit Investment and Impact Analysis

The Multiple Missions of Transit in Metropolitan, Small Urban and Rural Settings

Public transit systems are expected or required to pursue missions and goals that are often contradictory. Financial constraints force managers to live within limited budgets, while strategic goals call for service expansion and initiatives to increase ridership and market share.

Similarly, communities of varying size have different expectations and goals for transit. In larger communities, transit represents one of the few acceptable options available to add capacity to the regional transportation system during rush hours – when the street and highway system is at or over capacity. In serving this function, transit is playing a fundamental role in the provision of transportation capacity essential to sustain economic growth and expansion. The economic benefits of transit in this scenario are substantial and relatively easy to estimate.

In smaller urban and rural communities, the role of transit may be fundamentally different. Transit may play a smaller role in preserving or adding to highway capacity, but a large role in guaranteeing mobility and access for individuals and households that have no transportation options. In providing a transportation option, there are clearly economic benefits accruing to individuals, the community, and local governments as well as business and industry, but these remain difficult to measure in quantitative terms. Measurable economic benefits may also be less important in these settings than the more intangible quality of life benefits afforded by transit. The economic benefit in traditional terms in small urban and rural areas does not suggest however, that the transit services are of less importance than in areas where economic benefits are substantial and can be easily measured.

Measuring Economic Benefits at the Local and Regional Level

The economic impact of transit investment and use will vary from region to region, because the structure of regional economies varies. For example, the region with a bus manufacturing plant will retain more of its transit investment in the local economy than a region whose transit vehicles are supplied from another area of the country.

This variability in regional impacts underscores two important points. First, there is a high degree of economic interdependence between regions and how they serve transit needs and make transit investments. Investments in one region provide direct and indirect economic stimulus to other regions. Second, this interdependence extends far beyond the local and regional transit investment transactions. Substantial transit investment and economic benefit in one region of the country is likely to be matched by other, non-transit, federal investments in other regions. In both senses, this economic interdependence at the local and regional level indicates that there is a shared interest in promoting economic and social well-being in all areas of the country through investment in public transit.

1.0 Analytical Approach

Analysis Framework

In this study, economic analyses were carried out to evaluate the costs and benefits of transit investment to the nation's economy. The study builds upon previous work conducted by the American Public Transit Association (APTA) in the early 1980s and uses analytical approaches that were not available at that time.[1]

Types of Investments

The study considered the economic impacts of both capital and operating investments aggregated to the national level. Capital investments mainly comprise the "hardware" of the nation's transit systems, their vehicles, maintenance facilities, and in the case of rail transit, track, tunnels and other system components. There are several different types of transit capital investments, each with a different mix of capital expenditures and somewhat different economic impacts. These types of investments include:

- New System investments, with expenditures for land acquisition, engineering and all system components;
- Modernization, with expenditures for replacement or rehabilitation of system components at the end of their useful lives; and
- Expansion, with expenditures for additions to existing service. The scope and range of expenditures for expansion projects vary greatly.

Historical information was used to determine the appropriate mix of expenditure types in each of these categories. Allocations of capital expenditures to specific categories were developed for bus, light rail, commuter rail and heavy rail transit. The benefits of a capital investment to any local economy depends in part on the degree to which the materials consumed are produced locally. In a national study such as this one, benefits are realized to the extent that the materials consumed are produced domestically.

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[1] *Employment Impacts of Transit Capital Investment and Operating Expenditures*. American Public Transit Association, April 1983. *National Impacts of Transit Capital and Operating Expenditures on Business Revenues*. American Public Transit Association, January 1984.

Typically, operating expenditures include labor, maintenance and supplies. Operating expenditures provide direct benefits to the local economy since salaries and wages typically comprise two-thirds of total operating expenditures.

Range of Impacts Considered

Consistent with previous studies, *Public Transportation and the Nation's Economy* describes economic impacts in terms of employment generation. In addition, the study examines impacts to income and business sales as additional measures of economic gain. Employment figures indicate the growth of an economy, but increasingly, measures indicating increasing productivity are sought by decision-makers as well. Most directly, business sales place a dollar value on the overall production of the economy, while income indicates whether individuals are "better off" than previously. In addition, they are indirect indicators of productivity change, since an economy that grows in output and wealth is likely to be growing in productivity as well.

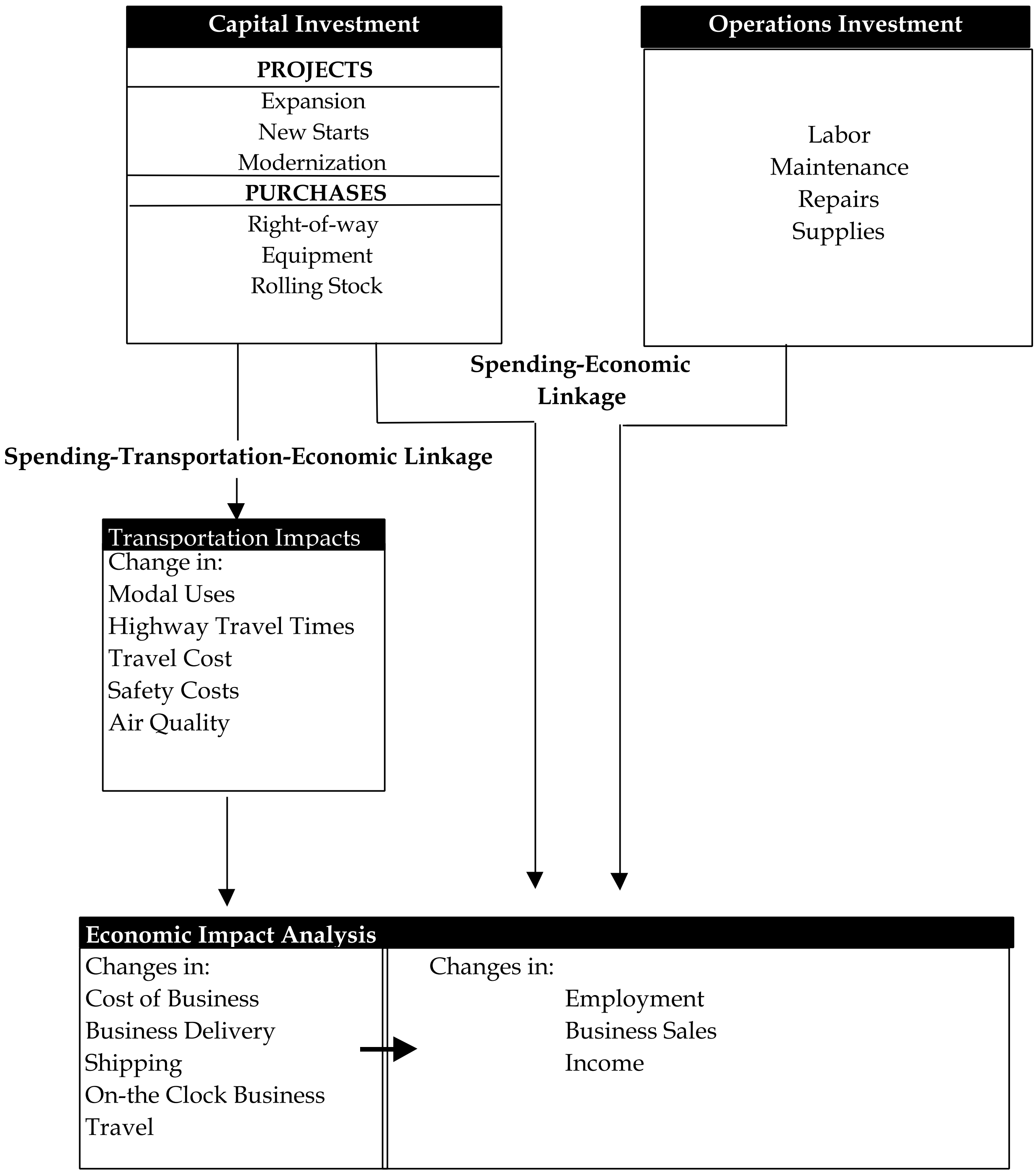
Sources of Impacts Considered

This study approached the analysis of economic impacts from two perspectives. First, the infusion of significant amounts of capital and operating dollars into the economy produces a demand for goods and services that has direct, indirect and induced effects, which can be measured in terms of jobs, business sales and income. Figure 1.1 portrays this investment in the analysis framework as the *Spending-Economic Linkage.* The dollars invested in the construction, operation and maintenance of transit services spur job creation and other effects because dollars are spent time and time again in the local economy. From the perspective of an economist, these impacts are known as transfer impacts – the shifting of dollars from one source to another. Transfer impacts may or may not produce a net economic gain to society, since it is often difficult to establish whether or not dollars spent in another fashion – say for education, would yield superior economic results. However, from the perspective of a policy-maker, it is important to recognize and be able to articulate transit's value as a source of economic stimulation.

Second, the study also examined the implications to the transportation system and its users of these capital investments and analyzed the economic ramifications of those impacts, in terms of these same indicators – jobs, business sales and income. Figure 1.1 depicts this as the *Spending-Transportation-Economic Linkage*. This linkage is an example of a generative impact, one which produces net economic growth in the economy. The generative and transfer impacts are described and discussed separately in the report.

The linkage between transportation and economic impacts is an explicit recognition of the fact that increased mobility can produce economic benefits. Conversely, a decrease in mobility places barriers to economic growth and productivity. The transportation cost models developed for the study produced estimates of congestion impacts resulting from transit investment in metropolitan areas in the United States. These congestion impacts were translated into changes in business costs, that result from changes in accessibility both for workers and for industries which rely on the transportation system for the

Figure 1.1 General Framework



provision of the goods and services they offer. Through linkages with the economic model used in the study, the changes to business costs create short-term and long-term impacts to income, business sales and jobs separate and distinct from the jobs created from the cash infusion to the economy.

Analysis Timeframe

The analysis considered the economic impacts of transit from both a short-term and long-term perspective, over a twenty year period, starting in 1998 and ending in 2017. Consideration of multiple year impacts allows for consideration of the cumulative impacts of sustained investment and the many interactions and economic adjustments that result.

Use of Baseline and Alternative Scenarios

The transportation and the economic analyses used in this study estimate impacts relative to a *baseline scenario*. This scenario represents the status quo, the forecast levels of future economic activity that would occur in the absence of any change in national policy or investment activity. These results are held constant throughout the analysis and are used as a point of comparison against changes in capital and operating expenditures. Developing these scenarios involved the following steps:

- Formulate the Scenario: Determinations were made of which critical variables would be tested and how those variables would be represented in an analytical framework. The scope of the analysis in terms of time frame and range of impacts to consider was also determined.

- Data Collection: Data for the inputs of the analysis were gathered from several sources, including APTA reports on transit funding needs and the Federal Transit Administration's *National Transit Database*.

- Refine/Develop Analysis Tools: The analysis framework described below required some finetuning to ensure that the baseline inputs and assumptions were consistent with the national-level scale of the analysis.

■ Analysis Tools

A series of interrelated models which are appropriate to this study has been adapted and refined. Cambridge Systematics, Inc., (CSI) has developed an integrated set of procedures to apply to evaluation of regional transit investments which incorporates three related areas: transportation agency and user models, regional economic models, and air quality models. The transportation and air quality models have been merged by CSI into an integrated model which produces air quality pollutant results and costs, along with other impacts such as transit, highway, and multimodal costs and benefits by category (operating, capital, user travel time, parking, auto ownership, accident, service quality, etc.).

The technical approach used in carrying out the transportation/economic analysis can be broadly described as an "integrated transportation/economic model" or approach. The technique was developed by CSI and has been applied at both the regional and state-wide scale in recent years to assess the economic impacts of transit investment scenarios.

The CSI/Regional Economic Models Incorporated (REMI) technique used in the transportation/economic analysis provides both a sound theoretical base for the large scale economic impact analysis of transportation investment, as well as a degree of sophistication that is appropriate to the scale of the analysis.

The technique allows for estimation of: 1) the economic impacts or value of changes in ***travel behavior*** that result from transit investment and use, i.e., value to both transit users and highway users; and 2) estimates of the ***direct, indirect and induced effects of transit investment*** on the economy as a whole, in addition to the transportation effects. The CSI/REMI framework provides for true multimodal and comprehensive economic analysis without double-counting and without speculative assumptions about broader economic impacts. Figure 1.2 depicts the transportation economic modeling framework.

Economic Model

This study employed a *simulation* model which estimated the effects of changes in costs to business competitiveness, profitability and expansion. The model system, REMI, has many features which provide a strong theoretical basis for its use:

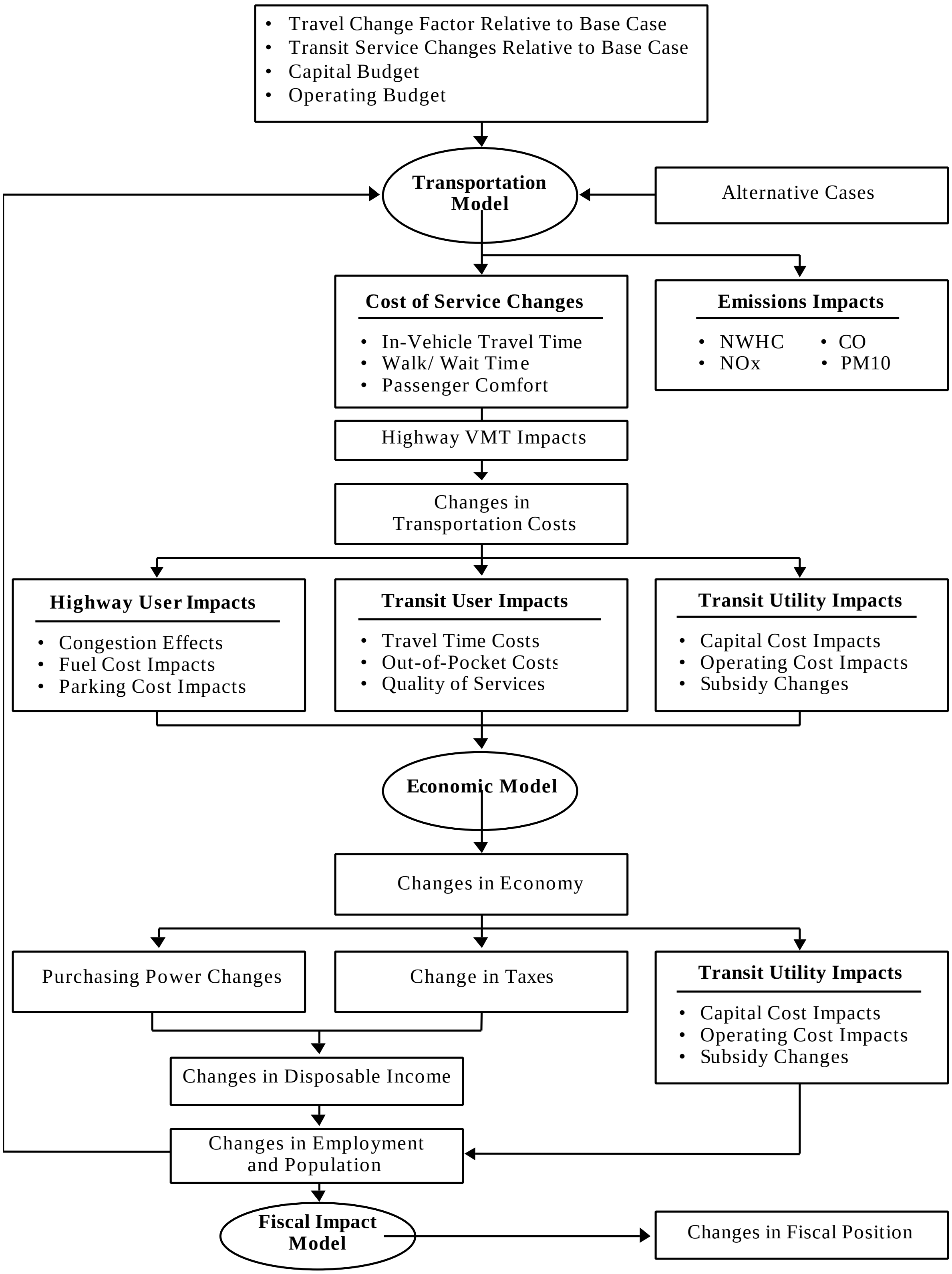
- It is a dynamic model, as it simulates interactions among sectors of the economy on a year by year basis.

- It does not assume a constant relationship between labor and capital inputs, as do input/output models. It estimates substitutions among factors of production in response to changes in relative factor costs.

- It has several feedback mechanisms. Changes in transportation costs among the scenarios being analyzed impact each industry sector and households, causing differences in costs and in competitiveness of industries. In response, business sales increase or decrease, and household income increases or decreases. The REMI model in each year estimates the consumption, investment, and local government demand which are driven by income. The national model predicts exports and imports to other countries depending on the success of its industries, which is dependent on prices. In contrast, I/O models do not simulate the tendency of the economy to adjust to changing demand and supply conditions towards a balance, or equilibrium between the two.

In *Public Transportation and the Nation's Economy*, economic inputs have been defined to model the overall economic consequences of several "direct economic effects":

Figure 1.2 Transportation Economic Modeling Framework



- ***Construction and Operation*** – additional spending associated with project construction and maintenance, generating "demand" (i.e., purchases) of labor, equipment and materials for selected years; and

- ***Direct Travel Costs*** **–** reduction in business costs associated with worker time, safety and expense savings for business-related travel including freight flows via trucks, as well as "on-the-clock" and commuting travel via car and bus; plus any increase in personal disposable income associated with household savings on fuel and vehicle maintenance.

Together, these direct effects lead to "secondary effects" on the economy, in terms of business sales (output), employment and income. They include:

- ***Indirect Economic Effects*** result from additional business sales (and associated jobs and income) generated by orders for products (materials, supplies, equipment and services) needed to serve the directly expanded or attracted business activities; and

- ***Induced Economic Effects*** result from additional business sales (and associated jobs and income) which are generated by consumer spending of workers at directly or indirectly attracted businesses. This spending is dispersed throughout the economy, on food, clothing, shelter, recreation, education and personal services.

The REMI economic simulation model is used to estimate the total (including indirect and induced) economic effects associated with given changes in the flow of dollars – spending (demand), income levels and business sales, as well as the broader impacts on regional costs, competitiveness, productivity, profitability and population changes over time.

Direct effects of policy changes are input into REMI through a large set of policy variables. Industry-specific variables are input for each of 49 specific nonfarm industries, cohort-specific variables for 202 age-sex cohorts, and final demand variables for 25 final demand sectors.

In operation, REMI simulates economic activities in five sectors: 1) output; 2) labor and capital demand; 3) population and labor supply; 4) wage, price and profit; and 5) market shares. Figure 1.3 illustrates the linkages among these models. The transportation projects affect the model in the following ways:

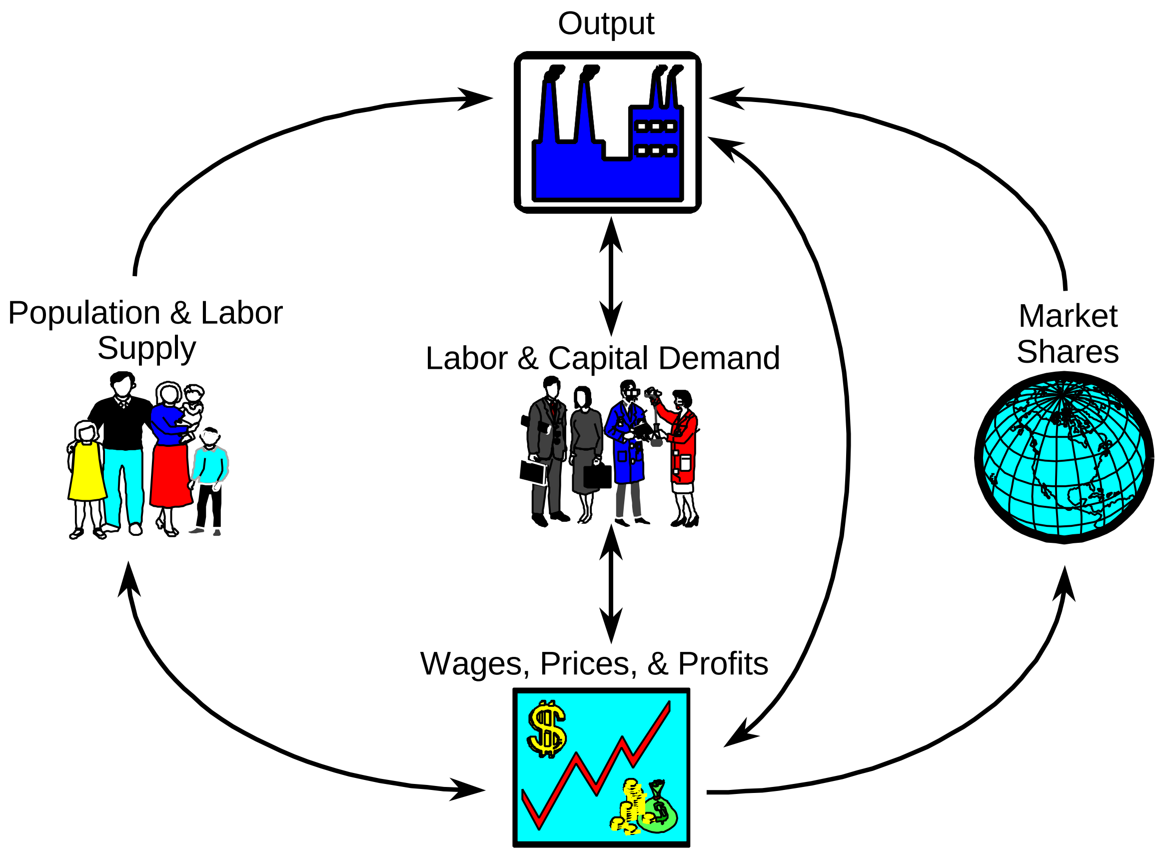
- In the output module, transit spending affects government spending patterns;

- In the output module, transportation cost savings for individuals affects real disposable income levels;

- In the wage/price/profit module, cost savings for business affect overall production costs (i.e., cost of doing business); and

- In the market shares module, the changes in business cost and individual income lead to changes in regional competitiveness and business market shares. Although noted here, this linkage does not occur in a model that simulates economic activity at the national level.

Figure 1.3 Model Linkages



Transportation Model

A demand estimating procedure is used to forecast changes in demand for transit and highway use resulting from changes in levels of service in the public transportation system. The resulting changes to operating costs, travel time, safety, out of pocket costs and emissions, as compared to a baseline scenario, are estimated separately by mode of travel (public transit, car and truck). Using dollar values derived from empirical studies for the values of travel time, the dollar values of changes are estimated and reported separately. Energy and emissions estimates which vary as a function of estimated speed and vehicle miles traveled are included in the analytical procedure as well. These procedures produce estimates for each year corresponding to the analysis period (1998-2017). Impacts to travel times, operating costs and safety are examples of user costs; environmental impacts such as air and noise pollution are examples of external costs, whose effects extend to all members of society.

Impacts Not Included in Analysis

Though the framework for analysis in this study is broader and more inclusive than prior analytical approaches have allowed, the results are still conservative, since many important economic impacts of transit investment and use are not incorporated into the model. In some cases, quantifying these impacts is very difficult and the subject of continued research. In others, the effort involved would be beyond the scope of this analysis. Other research efforts have attempted to enumerate many of these added economic benefits, including:

- Added benefits which accrue only to the transit-dependent population, including low-income, elderly and disabled populations. These are examples of social welfare benefits whose monetization is the subject of continued study.

- Changes in land values due to the increased accessibility afforded by high-quality transit services. Numerous studies in large metropolitan areas have shown a positive correlation between proximity to rail service and property values, although the magnitude of the increase varies from study to study. Land values are generally not considered in studies of this type, as any travel time savings from transit investment presumably capture the accessibility benefits. Adding travel time savings and land value increases together would likely double-count benefits.

- "Quality of life" benefits, including amenities such as recreational and cultural opportunities, absence of crime or quality of education that make an area an attractive one to live in. Attempts to quantify and measure these impacts have occurred at the regional level. The aggregate nature of the analysis did not permit for such a variable to be considered here.

- Benefits from increased reliability in the transit system due to system rehabilitation and modernization. A reliable system experiences fewer breakdowns and malfunctions, and instills confidence that a trip can be made within the time budgeted by travelers. Some studies have indicated that travelers are willing to pay 1.3 times the hourly wage rate for increased reliability in their work commutes, as measured by the variability of travel time for their trip.

- The effect of transit investment and use in reducing the cost of other public sector functions, such as education, healthcare, welfare or public safety.

2.0 Capital Investment Analysis

Transit capital investment is a significant source of job creation. This analysis indicates that in the short run 314 jobs are created for each $10 million invested in transit capital funding. Businesses would realize a gain in sales 3 times the public sector investment in transit capital; a $10 million investment results in a $30 million gain in sales. These findings are based on the application of an economic simulation model to estimate the impacts of needs-level funding over 20 years.

In this study, the employment impacts of two types of capital investments across four vehicle modes were analyzed using the economic model. The capital investment categories are:

- New System investments, with expenditures for land acquisition, engineering and all system components;
- Modernization, with expenditures for replacement or rehabilitation of system components at the end of their useful lives; and
- Expansion, with expenditures for additions to existing service. The scope and range of expenditures for expansion projects vary greatly.

New project and modernization expenditures were allocated among heavy rail, light rail, commuter rail and motor bus. These modes are fundamentally different in the types and magnitudes of expenditures they require, and thus will affect the economy in different ways, depending on the amount of labor required to produce the goods or services needed. For example, commuter rail typically operates on existing rights-of-way and at-grade, while heavy rail operates on its own dedicated right-of-way, sometimes underground. One would expect that the funds needed for construction in heavy rail projects generate somewhat greater employment impacts per dollar expended since construction is labor-intensive. These categories of capital expenditures were formulated to arrive at the most accurate investment totals possible, and not to compare the employment generating capabilities of various modes.

■ Capital Investment Assumptions

The analysis assumed a 20-year program of capital expenditures consistent with the results of APTA's *Transit Funding Needs 1995-2004*, conducted in 1993 and released in 1994. In that survey, transit providers were asked to provide their best estimates of future needs under both a *maintain current service* scenario, and an *expand current service* scenario. The results of the *maintain current service* scenario were used in this study. Table 2.1 shows the results of the study in annual needs over two five-year periods, 1995-

1999 and 2000-2004. Annual needs are considerably higher in the first five-year period ($10.5 billions vs. $7.0 billion) due to a backlog of unfunded and planned projects which the respondents listed as necessary to maintain current levels of service. To extend the analysis over a 20-year period, the annual average for the 10 years' needs as reported by the APTA needs study was used for years 11 to 20.

Table 2.1 Maintain Current Service Transit Capital Funding Needs from APTA Study (Millions of Constant 1993 Dollars)

	1995-1999	2000-2004	Ten Year Total	Assumed Second Ten-Year Period
Annual	$10,480.5	$7,043.4	$8,761.9	$8,761.9
Total	$52,403.4	$35,217.2	$87,619.4	$87,619.4

Source: *Transit Funding Needs, 1995-2004*, American Public Transit Association.

Allocation of Capital Expenditures

The allocation of capital funding dollars to specific categories of funding was based on specific project experience from data collected by the Federal Transit Administration (FTA).

Light rail construction data were derived from the 1991 Urban Mass Transportation Administration report *Light Rail Transit Capital Cost Study*. The study collected "as built" cost data from seven light rail systems in the United States: San Diego, Buffalo, Portland, Sacramento, San Jose, Los Angeles, and Pittsburgh. Average expenditures for all systems cited in the study were aggregated to nine categories of spending for this study.

New heavy rail (rapid rail and commuter rail) and ***bus*** data were derived from the 1994 FTA report, *Fixed Guideway Capital Costs: Heavy Rail and Busway/HOV Lane*. Capital cost data from completed projects in seven cities – Atlanta, Baltimore, Boston, Chicago, Los Angeles, Miami, and Washington, D.C. were collected and summarized. Averages of all systems were used for this study, since it did not appear that any one project was significantly more or less representative of national experience than any other.

Rail modernization project information was derived from the 1992 FTA report *Modernization of the Nation's Rail Transit Systems: A Status Report*. This study is an update of a 1984 study which estimated costs to bring heavy rail systems in thirteen major metropolitan areas to a state of good repair. Cost estimates by major system component were provided.

The cost break outs are shown in Table 2.2. Note that these figures represent national averages collected over several years and are not representative of any one particular transit project.

Table 2.2 Capital Spending Mix by System Component (As a Percentage of Total Expenditures)

Category	New Heavy Rail	New Light Rail	Rail Modernization	Bus Purchases
Vehicles	9.5	12.7	16.7	100
Guideway (Structure and Earthwork)	22.7	18.0	22.7	
Stations (Construction)	23.5	5.7	17.4	
Yards and Shops (Repair Facility Construction)	3.0	5.2	8.3	
Tracks	2.6	2.3	8.5	
Electric and Control Systems	8.3	10.8	26.5	
Utility Relocations	3.0	8.2	N/A	
Land Acquisition (ROW)	5.0	7.3	N/A	
Engineering and Management	22.4	29.8	N/A	
Total	**100**	**100**	**100**	**100**

In the economic analysis, the products and services that are required to develop the transit projects for the study must be identified, and the level of expenditures specified. The REMI economic model provides for entry of these expenditures via a general set of goods and services categories, which are then translated into specific products by the model. This feature was utilized in this analysis. The categories of expenditures used in this analysis and the allocation by categories are shown in Table 2.3 below:

Table 2.3 Capital Spending Mix by REMI Variable Category (As a Percentage of Total Expenditures)

		New			Modernization	
REMI Variable	**Meaning**	**Heavy Rail**	**Light Rail**	**Bus**	**Heavy Rail**	**Light Rail**
PVID38	Guideway construction	22.70%	18.00%		21.60%	7.40%
PVID59	Rolled steel product	2.60%	2.30%		5.20%	23.40%
PVID41	Maint & repair bldg	3.00%	5.20%		27.30%	31.00%
PVID86	Industrial electrical equip	8.30%	10.80%		19.10%	6.30%
PVID29	Station building	23.50%	5.70%			
PVID313	Vehicles	9.50%	12.70%	100.00%	17.10%	25.40%
PVID210	Engineering	22.40%	29.80%			
DEM673	Construction work	3.00%	8.20%			
DEM691	Maint./repair service				9.60%	6.60%
Total*		**95.00%**	**92.70%**	**100.00%**	**90.30%**	**93.50%**

* Totals may not add up to 100% primarily due to exclusion of Right-of-Way spending which is a transfer of dollars, not a source of new economic activity.

Results

Table 2.4 below presents the employment and business output impacts of a sustained national program of transit capital funding to maintain current condition needs.

In the short term, an investment of $10 billion produces over 314,000 jobs, or over 3,100 jobs for every $100 million invested. As Table 2.5 shows, the majority of these jobs are created in the services and construction sectors, with the former accounting for 32 percent and the latter accounting for 18 percent of all new jobs. Business output, or total profits, generated from all activity generated by the investment reaches $30.3 billion in the first year, for a return three times greater than the investment.

Indirect and induced employment generation account for the majority of short-term employment impacts. Indirect employment accounts for 132,000 jobs or 42 percent of the total, as local suppliers benefit from the increase in demand for their goods and services. Induced demand accounts for 77,000 jobs or 24 percent of the total. Direct employment generation accounts for another 24 percent of the total. The remainder – attributable to investment activity (10 percent) accrues to employment generating activities which are not produced by static input/output models.

In the long term, the return on investment remains positive, diminishing significantly however. A $7.3 billion investment in the year 2017 produces over 86,000 jobs, or 1,177 jobs for every $100 million invested. As was the case in the short term, the sectors showing the greatest gains are the services and construction sectors. Business output, or total profits, generated by the investment reaches $12.5 billion in year twenty, for a return 1.7 times the investment.

In contrast to the short-term impacts, direct effects account for the majority of long-term employment impacts. Direct employment accounts for 45,000 jobs or 52 percent of year 20 impacts. Indirect job creation accounts for 46 percent of the total, while induced impacts produce only 2,400 jobs, 2.7 percent of the total.

Table 2.4 Impacts of Capital Expenditures by Year[1]

	1998	2005	2012	2017
Employment (Thousands)	316.2	115.1	93.9	86.3
Business Output ($1992 Billions)	30.3	13.7	13.0	12.5
Investment Level ($1992 Billions)	10.09	6.99	7.33	7.33
Jobs per $100 Million	3,135	1,648	1,281	1,177

[1] Amounts shown in Table 2.1.

Table 2.5 Industry-Specific Employment Impacts of Transit Capital Investment (Jobs in Thousands)

Sector	1998	2005	2012	2017
Manufacturing	**61.1**	**21.1**	**14.6**	**12.0**
Durables	47.4	17.4	12.3	10.1
Non-Durables	13.7	3.7	2.3	1.9
Non-Manufacturing	**255.1**	**94.0**	**79.2**	**74.3**
Mining	1.9	0.5	0.3	0.2
Construction	57.4	27.4	25.6	24.9
Transport and Public Utility	14.7	4.8	3.3	2.7
FIRE	13.9	2.8	1.5	1.2
Retail Trade	48.7	10.9	7.0	6.0
Wholesale Trade	15.5	4.9	3.4	2.8
Services	100.4	42.1	37.6	36.1
Agriculture/Forestry/Fishing	2.7	0.7	0.5	0.5
Total	**316.2**	**115.1**	**93.9**	**86.3**

The declining rates of return over time reflect the economy's need to balance employment with the available supply. The initial market response to an increase in demand for labor is to increase wages. Businesses respond to this upward pressure on wages in a number of ways, including investing in equipment and machinery as a substitute for labor. Capital is substituted for labor such that costs are minimized and profits maximized. This ability to substitute capital for labor varies by industry. Attaining a balance between the supply and demand for labor is a fundamental concept in macroeconomic theory, and is embedded in REMI's algorithmic structure.

Is it realistic to expect that the impacts per unit investment will decrease due to an imbalance between the supply of and demand for labor? Some people point to the lack of inflation over the past 15 years as a reason to believe that numerous adjustment mechanisms exist to keep wages from rising to the point where capital is substituted for labor. Such mechanisms might include:

- Changes in the labor force participation rate. More individuals, mostly women, have sought employment, thus increasing the supply of labor;
- Shifts in workers' part-time to full-time status; and
- Immigration policy, which can affect the supply of low or highly-skilled labor.

These trends are not reflected in the REMI model. Thus, the equilibrium-seeking behavior of the REMI model may overstate the drop in employment to some extent.

The REMI model also adjusts employment forecasts based on projections of technological advances. The transit capital investment industry has traditionally produced many jobs due to the labor-intensive nature of the work involved. Advances in manufacturing and construction techniques may indeed change the number of jobs per dollar invested over time, as the model indicates.

3.0 Operating Expenditure Analysis

Transit operations spending provides a direct infusion to the local economy. Over 570 jobs are created for each $10 million invested in the short run. Operating expenditures generate a significant number of local jobs directly, as all maintenance and operating functions are performed by the local labor force. The estimation of the employment effects of transit operating expenditures was based on the results of economic simulations.

The analysis of operating expenditure impacts focused on employment generation and business sales potential on a national basis. Businesses realize a $32 million increase in business sales for each $10 million in operations spending.

■ Operating Expenditure Assumptions

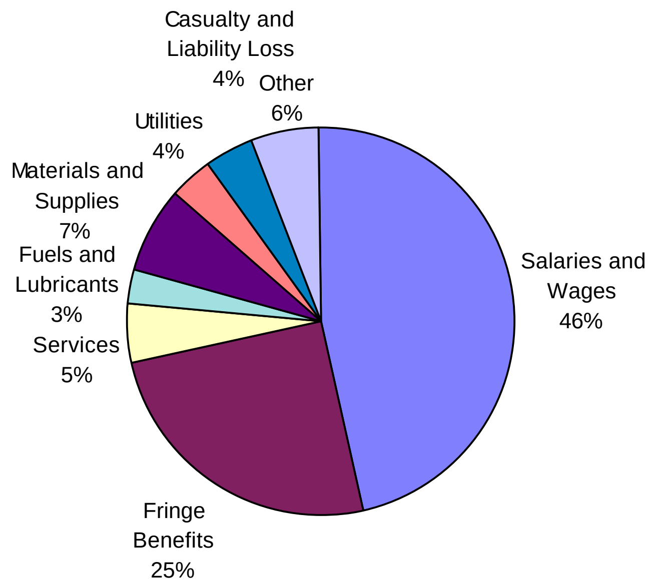
As was the case with Capital Investment assumptions, APTA's *Transit Funding Needs 1995-2004* provided input data on aggregate levels of operating expenditures for this study. The survey found annual transit operating needs at $20.9 billion over 10 years. In this analysis, operating expenditures were assumed to hold steady at that rate over years 11 to 20. Historical levels of operating expenditures varied between $22 billion and $25 billion between 1985 and 1995, when adjusted for inflation.

Allocation of Operating Expenditures

In this analysis, it was assumed that a dollar spent for operations and maintenance would produce the same employment and business sales impacts for any transit mode. It was felt that this simplifying assumption would not seriously distort the results in a national study examining all transit expenditures.

Figure 3.1 presents the distribution of operating expenditures by "object class" between 1985 and 1995. Labor costs account for over 71 percent of all operating expenditures, by far the greatest category of expense among operating expenditures. Labor's share of total operating expenses changed little between 1985 and 1995, showing no discernable trend either upward or downward.

Figure 3.1 Allocation of Operating Expenditures by Object Class (1985-1995)



Source: American Public Transit Association.

The funding allocations derived from APTA's analysis of historical expenditure patterns translates almost directly into variable definitions used by the economic model. Table 3.1 below shows the variables used and the allocations of total expenditures. All variables are expressed in millions of dollars, with the exception of the transit employment variable, EMP 26. That variable is expressed in terms of full-time equivalent employment. An equivalent annual salary of $33,900 dollars ($1992) was assumed as the average salary among all transit workers nationally, and was used to arrive at the total number of employees used. The distribution of the operating budget among the object classes was assumed to remain constant over the 20-year timeframe of the study.

Table 3.1 Operating Expenditure Mix by Object Class (As a Percentage of Total Expenditures)

REMI Variable	Meaning	Percentage
EMP26	Transit On-Site Labor	71.40
DEM669	Fuel	3.00
DEM656	Materials and Parts	7.10
DEM680	Utilities	3.80
DEM696	Professional Services	4.80
DEM682	Insurance	4.10
DEM676	Miscellaneous Transportation	7.10

Results

In the short-term, an investment of $20.9 billion produces over 1,192 million jobs, or over 5,700 jobs for every $100 million invested. Business sales generated by operating expenditures total over $66 billion in the first year, three times greater than the investment. These results are shown in Table 3.2. As Table 3.3 shows, direct labor in the transit industry comprises almost 50 percent of the jobs created. Jobs in the retail trade and services sectors, stimulated by the demand created by the transportation jobs, account for 30 percent of the total.

In the operating expenditure analysis, direct employment generation accounts for 50 percent of short-term employment impacts as most jobs created are directly related to transit operations. Indirect employment accounts for 257,625 jobs or 22 percent of the total, as local suppliers benefit from the increase in demand for their goods and services. Induced demand accounts for 246,375 jobs or 21 percent of the total. Eight percent of total job creation is attributable to increases in investment activities.

Table 3.2 Impacts of Operating Expenditures by Year

	1998	2005	2012	2017
Employment (Thousands)	1,192.3	775.6	671.6	645.6
Business Output (1992 Billions)	66.0	37.2	32.7	32.3
Investment Level (1992 Billions)	20.9	20.9	20.9	20.9
Jobs per $100 Million	5,703.0	3,711.0	3,213.4	3,089.0

Table 3.3 Industry-Specific Employment Impacts of Operating Expenditures (Jobs in Thousands)

Sector	1998	2005	2012	2017
Manufacturing	**94.3**	**24.5**	**7.8**	**3.4**
Durables	61.4	15.6	5.2	2.6
Non-Durables	32.9	8.9	2.5	0.8
Non-Manufacturing	**1,098.0**	**751.1**	**663.9**	**642.4**
Mining	6.3	2.8	1.7	1.2
Construction	62.1	14.0	5.6	4.5
Transport and Public Utility	594.1	582.8	576.0	573.8
FIRE	56.5	26.1	16.2	12.7
Retail Trade	137.8	40.6	18.3	13.3
Wholesale Trade	31.3	9.5	2.6	0.7
Services	203.0	73.4	42.6	35.6
Agriculture/Forestry/Fishing	7.0	1.9	1.0	0.8
Total	**1,192.3**	**775.6**	**671.6**	**645.8**

In the long term, the return on investment remains positive, but is reduced to almost half the level in the first year. As discussed in the section on capital investments above, the reasons for the diminishing returns relates to long term economic adjustments that reduce the need for indirect and induced jobs in the retail and service sectors. A $7.3 billion investment in the year 2017 produces over 574 million jobs, over 2,400 jobs for every $100 million expended. Job creation in the transit industry assumes an even greater proportion of total job creation, 89 percent of the total. Induced and indirect employment impacts are almost negligible, accounting for only nine percent of the total. Business sales or total profits generated by the investment, reach $31.8 billion in year 20, for a return 1.5 times the investment.

4.0 Transportation Analysis

The additional economic benefits from the transportation impacts of transit investment in major metropolitan areas are substantial. For every $10 million invested, over $15 million is saved in transportation costs to both highway and transit users. These costs include operating costs, fuel costs and congestion costs.

Business output and personal income are positively impacted by transit investments, growing rapidly over time. These transportation user impacts create savings to business operations, and increase the overall efficiency of the economy, positively affecting business sales and household incomes. A sustained program of capital investment will generate an increase of $2 million in business output and $0.8 million in personal income for each $10 million in the short run (during year one). In the long term (during year 20), these benefits increase to $31 million and $18 million for business output and personal income respectively.

The analysis of the benefits of transit investment to the nation's economy focused on the benefits of a shift in mode from automobile travel to transit caused by changes in service levels from increased capital spending. In order to develop these estimates, the following steps were followed:

- Determine current and future year highway conditions under a "base" case;
- Estimate the impact of capital spending on transit service levels;
- Estimate the multimodal impacts of changes in transit service levels;
- Estimate transportation costs; and
- Estimate the impacts to business sales, employment and income of changes in travel costs to businesses and individuals.

Each of these steps is described in turn below.

■ Determine Current and Future Year Highway Conditions Under a "Base" Case

The scope of the transportation analysis was limited to urban areas with significant congestion levels. Current and future year data needed for the analysis included two tasks:

- Estimate the number of auto and transit travelers in the urban area; and
- Estimate the level of congestion in the urban area.

Current year congestion levels were derived from the Texas Transportation Institute's (TTI) annual estimates of urban roadway congestion in 50 or more urban areas nationwide. The TTI congestion estimates are based on data available from the Highway Performance Monitoring System (HPMS). The HPMS database includes statistics on highway condition, extent and usage. Each state submits HPMS data to the Federal Highway Administration (FHWA) annually according to prescribed reporting guidelines. The data are used to develop numerous reports, including submissions to Congress on highway funding needs. The congestion estimates developed by TTI are based on average volume to capacity ratios weighted by vehicle miles traveled for interstate facilities and arterial roadways. Congestion levels greater than 1.0 are an indicator of significant congestion, especially during peak hours.

Several sources of data were used to estimate the total number of auto and transit trips in the 50 urbanized areas analyzed in the study. From the FHWA 1990 *Nationwide Personal Travel Survey* (NPTS), an average trip length for all trips was applied to vehicle mile of travel estimates (VMT) provided by TTI for each area, in the case of highway trips. Estimates of passenger transit trips were derived from the Federal Transit Administration's *National Transit Database* for these urbanized areas. That database reports unlinked trips, that is, each transfer is counted as a separate trip. An assumption of 1.5 transfers per trip was applied to the FTA data, to arrive at a definition of a trip as comprising travel from door to door with no intermediate stops.

Estimates for future levels of congestion in the base scenario were produced by the Highway Economic Requirements System (HERS). HERS is a decision support system designed to analyze the effects of alternative funding levels on highway performance. HERS uses data describing an extensive sample of the nation's highway system as the basis for analyses of the benefits and costs of alternative improvements. HERS is used by the U.S. Department of Transportation (U.S. DOT) to perform financial programming analyses used in U.S. DOT's biennial report to Congress: *Status of the Nation's Highway and Transit System: Condition and Performance*. Cambridge Systematics, Inc., is one of the creators of the HERS, and is currently under contract with U.S. DOT to design and implement enhancements to the model. HERS is capable of estimating the cost of highway improvements based on the user's specification of the desired levels of performance. In order to use HERS to arrive at future baseline levels of congestion, a desired highway "level of service" must be specified.

The levels of service specified in this analysis were based upon data contained in the U.S. DOT's 1995 *Condition and Performance* report. That report compared the model's estimates of projected funding needs to achieve a status quo level of service as against current funding levels. Current funding levels amount to 60 percent of the needs projected by the model. Therefore, the HERS model was set to produce the highway conditions that would result if current funding levels were maintained into the future, that is, at the 60 percent of-projected-needs level.

Highway trips were calculated exactly as they were for the base year estimates, based on VMT and an assumed trip length of nine miles. Transit trips were held constant to base year levels, a conservative estimate.

■ Estimate the Impact of Capital Spending on Transit Service Levels

In order to arrive at a relationship between capital spending and benefits to the transit user, a simple estimate of *dollars per unit travel time* was developed. This estimate was produced to develop a rough estimate of the relationship between spending levels and levels of transit service provided. Averages of capital expenditures for two periods in time (adjusted to reflect 1992 dollars), 1985 and 1995, were calculated for each of 33 urbanized areas (where data were available for the two time periods) used in the TTI study, based on *National Transit Database* data. System-wide speeds for these urban areas were compared between these two time periods as well. Next, average capital expenditures and travel time differences weighted by passenger miles of travel were calculated. The result – $82 thousand per minute of travel time improvement per urban area – was used in the next stage of the capital investment impact analysis to predict impacts after 20 years of capital investment.

Behind the estimate of dollars per minute of time savings lies an important assumption. The analysis assumes that all time savings came as a result of sustained investment in system modernization, replacement and other forms of investment. While the investment in better and more reliable equipment and implementation of higher-speed technologies undoubtedly had a large part in producing these historical overall improvements, other causes may have contributed as well. For example, better personnel management and system management, route-restructuring and other operations-oriented actions may have played a role in overall speed gains. However, in the sketch-level nature of the exercise, obtaining reasonable correlations between variables as proxies for unambiguous cause and effect relationships was the focus of the analysis.

■ Estimate the Multimodal Impacts of Changes in Transit Service Levels

To convert dollars per minute saved into actual transit time savings, a capital funding level was assumed. A 25 percent increase over the investment levels cited in the needs analysis was chosen as the basis for estimating the multimodal transportation impacts of transit investment. Average transit times for each of the 50 urban areas were adjusted to reflect the assumed change in capital investment. Travel time savings were scaled up or down based on historical levels of funding.

The model used for the analysis is an adaptation of the Sketch Planning Analysis Model (SPASM) developed for the Federal Highway Administration by CSI. This model was derived from work originally conducted for a project to assess the economic benefits of public transportation renewal in the Philadelphia and New York regions. The transportation model is a simplified version of a regional transportation model, and produces impact estimates on the basis of intra-regional travel patterns. The estimates of public transportation system travel times resulting from changes in investment levels alter the relative attractiveness of the transit mode relative to the highway mode in the model, and changes in demand for each mode are estimated based on these changes. Changes in mode are estimated via an adaptation of the multinomial pivot-point logit model developed by the Federal Highway Administration for use in sketch-level planning applications. Once new demand for highway and transit travel is estimated, highway travel times are estimated using equations relating volumes on highway networks to delay on the highway system. These equations, which account for the buildup and dissipation of traffic queues under congested conditions, were developed for the Federal Highway Administrations' HERS model by CSI. These highway times are used as the basis for a new set of demand estimates. This procedure is repeated until the difference between one iteration and the next is negligible. Once this process is completed, final user and external costs are estimated for the two modes.

The transportation model used in *Public Transportation and the Nation's Economy* estimates changes in transportation costs including:

- Direct user costs, incurred as a result in travel time changes, or as a result of changes in out-of-pocket expenses for travel, including fuel use. These costs are estimated in terms of on-the-clock costs (work-related travel), off-the-clock costs and other travel costs for work and non-work purposes; and

- External costs, including changes in accident costs and emissions.

Input Assumptions

The magnitude of economic impacts of capital investment is greatly affected by the unit cost assumptions used in the transportation analysis. This section presents the values assumed for the most critical variables used in the transportation cost analysis:

User costs for travel time include both in-vehicle and out of vehicle time. A value of $10.00 per hour is assigned to transit and highway users, which is the figure used in this analysis. This figure is based on average local wages and the proportion of travel that is work-related (on-the-clock and commuting) and non-work related. The value of medium and heavy truck travel is a proportional factoring of the figure used by the HERS. The $39.42 figure for the heaviest trucks is consistent with the $10 per hour figure used for auto and light truck users.

Excess, or out-of-vehicle, time includes time spent walking and waiting. Such times are typically valued at 1.5 to 2.0 times the value of in-vehicle time. In this study, highway and transit excess times are valued at $15 per hour. This is a very conservative estimate, at the low range of the values of excess travel times compared to the values of in-vehicle travel times.

Table 4.1 Selected Transportation Model Inputs

Value of Travel Time ($ per person-hour)	**Auto**	**Truck**	**Carpool**	**Bus**	**Rail**
In-Vehicle Time	$10.00	$39.00	$10.00	$10.00	$10.00
Excess Time	15.00	39.00	15.00	15.00	15.00
Fuel Cost per Gallon ($)	1.25	1.25	1.25	0	0
Non-Fuel User Cost Per Vehicle Mile ($)	0.034	0.1	0.034	0	0
Out-of-Pocket Costs per Trip	0	0	0	1.00	1.75
External Costs (excluding emissions) ($)					
Per Vehicle Mile	$0.07	$0.1	$0.07	$0	$0
Emissions Costs (all vehicles) per ton					
HC	$1,615				
CO	$3,540				
NOX	$3,397				

Out-of-pocket costs per trip include expenditures for tolls, transit fares and parking. In this analysis no costs for parking or tolls was assumed, since the vast majority of highway users nationally pay nothing for parking or tolls. For transit fares, an average transit fare per rail trip of $1.75 and per bus trip of $1.00 were derived from statistics contained in the Federal Transit Administration's *National Transit Database*.

Non-fuel user costs comprise the costs of depreciation, insurance and maintenance. These figures were derived from the FHWA report *Estimating the Impacts of Transportation Alternatives*.

External costs include safety and the costs of vehicle emissions, and are presented separately in Table 4.1 above. Safety costs vary with vehicle miles traveled, while emissions costs per ton are applied to vehicle miles traveled and emissions rates that vary with speed. Cost assumptions for the analysis were derived from the FHWA report *Estimating the Impacts of Transportation Alternatives*.

Estimate Transportation Costs

Transit and Highway Trips

Changes in mode of travel were based on these changes in travel times and the original number of highway and transit trips. Although the percentage of trips which change modes in the analysis is modest – less than two percent when all urban areas are considered – urban areas with relatively high congestion levels tend to be affected most by the shifts. Table 4.2 below presents shifts in transit modes for a selected number of urban areas. Transit riders in New York City show the largest single shift in ridership among the urban areas studied.

Table 4.2 Shifts in Transit Mode for Selected Cities

	Percent Change in Modal Trips	Number of Peak Hour Trips Affected per Day
New York	7.7	195,217
Baltimore	1.7	1,626
Houston	4.1	23,269
Dallas	3.9	15,196
Minneapolis/St. Paul	2.6	16,137

Transportation Cost Estimates

The average annual increase over "maintain current service" funding needs, assuming a 25 percent increase in funding over 20 years is $2.04 billion. The actual totals for each year are based on the APTA *Transit Funding Needs 1995-2004* report. Additional investment in years 1-5 are based on the $10.5 billion figure, and years 6-10 based on the $7.1 billion estimate. An annual investment of $7.6 billion was used for years 11-20, based on the assumption that some system replacement and rehabilitation would necessitate expenditures above the year 6-10 level. Annual funding assumptions were factored by 25 percent to arrive at the funding increment for each year.

User costs savings for transit users amount to $29.6 billion over 20 years, as shown in Table 4.3. Highway users gain as well, as the decreased travel times cause a shift in trips from the highway to the transit mode. This shift causes a decrease in congestion below what would have occurred in the base case condition. Highway user benefits total $33.9 billion over the 20-year period. In total, transportation user benefits equal $15.5 million for every $10 million in additional capital expenditures.

External costs, including emissions and safety costs, amount to $11.2 billion over the 20-year period. Emissions costs are presented as a transportation cost but are not used by the economic model because their impacts are dispersed across both transportation users and non-users. The economic analysis in this study is focused on impacts to the users of the nation's transportation system.

Over the 20-year analysis period, transportation savings are projected to total over $74.6 billion, as against an investment of $40.9 billion. Thus the analysis shows a positive benefit cost ratio of 1.8 when transportation effects only are considered. In addition to results for the 20-year period, impacts for selected years are shown in Table 4.3 as well.

Table 4.3 Transportation Cost Estimates

Name	Units	20-Year Total	1998	2005	2017
Capital Investment	$ millions	40,946	2,411	1,620	1,751
Chg. User Costs - Hwys	$ millions	-33,883	-149	-1,333	-5,754
Chg. User Costs - Transit	$ millions	-29,599	-160	-1,194	-4,451
Chg. Pollution/External Costs	$ millions	-11,159	-58	-448	-1,723
Chg. Total User Benefits	$ millions	74,641	367	2,975	11,927
Chg. Pnger. Trips - Hwys	Millions	-3,662	-21	-149	-537
Chg. Pnger. Trips - Transit	Millions	3,930	22	159	581
Chg. Pnger. Minutes - Hwys	Millions	-155,964	-685	-6,134	-26,486
Chg. Pnger. Minutes - Transit	Millions	-153,689	-831	-6,200	-23,142

■ Estimate the Impacts to Business Sales, Employment and Income to Businesses and Individuals

The economic impact analysis, based on transportation costs, proceeded along the same lines as the capital investment and operating cost analysis. Transportation costs, with the exception of air quality impacts, were translated into REMI variables for use by the model. For business costs, this translation is based upon the degree to which transportation services are used in the production or distribution of goods for the industry in question. The percentages which were used to allocate transportation costs for industry sectors represented in the REMI model used for this study were derived from the U.S. Census transportation satellite accounts and other data from the Bureau of Economic Analysis.

Shipping costs, on-the-clock costs and commuting savings (or costs) are all represented in the REMI model as business costs. The corresponding REMI variable, COSPOL, accounts for increasing costs to business of producing goods or providing services for each industry sector. The analysis assumes that increased on-the-clock costs and shipping costs are passed directly to businesses. Commuter travel costs are not fully passed on to businesses, however. This analysis assumes that 50 percent of the change in commuter travel costs are passed on to the employer who must offer higher wages to compensate. Recent research on wage gradients (the change in wages with respect to distance from the city center) suggests that employers do compensate for longer commuter travel times by offering higher wages. The remainder of the commuting costs are represented as reductions in household purchasing power.

Results of Transportation-Economic Analysis

In the short term, the impacts to the economy of an increase in transit investment based on reduced transportation costs only, are modest. This is because the transportation impacts grow steadily over time. That is to say, the cumulative effects of increased capital spending cause transit travel times to improve steadily over time. Highway times decrease as well, leading to increasing business cost benefits. In year one, only 5,800 jobs are created, and business sales register a modest $0.5 billion as shown in Table 4.4. Incomes rise as well, but only by $0.2 billion.

Table 4.4 Impacts of a 25 Percent Increase in Capital Expenditures by Year

	1998	2005	2012	2017
Employment (Thousands)	5.8	31.7	48.4	57.9
Business Output ($1992 Billions)	0.5	2.8	4.5	5.6
Investment Level ($1992 Billions)	2.5	1.6	1.6	1.8
Income ($1992 Billions)	0.2	1.4	2.5	3.3
Impacts per $10 million of Investment				
Business Output	$2.0	$17.5	$28.2	$31.1
Personal Income	$0.8	$8.8	$15.6	$18.3

In the long-term, the return on investment based on transportation impacts alone is positive and significant, substantially greater than in the short-term. By year 20, employment gains reach 58,000. Forty-five percent of this gain is realized by the service sector, which includes delivery services; another two percent is gained in the retail sector. Industry specific employment impacts are shown on Table 4.5. Business sales top $5.6 billion, more than three times greater than the additional $1.8 billion invested that year. Personal income registers a modest gain as well, over $3.3 billion in year 20.

Table 4.5 Industry-Specific Employment Impacts of a 25 Percent Increase in Capital Expenditures by Year (Jobs in Thousands)

Sector	1998	2005	2012	2017
Manufacturing	**0.8**	**3.2**	**4.0**	**4.3**
Durables	0.5	1.6	1.9	1.9
Non-Durables	0.3	1.5	2.1	2.4
Non-Manufacturing	**5.0**	**28.5**	**44.3**	**53.6**
Mining	0.0	0.1	0.2	0.2
Construction	0.6	2.5	3.2	3.5
Transport and Public Utility	0.3	1.5	2.0	2.2
FIRE	0.4	2.3	3.5	4.1
Retail Trade	1.4	8.1	12.3	14.6
Wholesale Trade	0.3	1.3	1.7	2.0
Services	1.9	12.1	20.6	26.3
Agriculture/Forestry/Fishing	0.1	0.4	0.6	0.8
Total	**5.8**	**31.7**	**48.4**	**57.9**

5.0 Fiscal Analysis

Transit capital and operating investments generate personal income and business profits that produce positive fiscal impacts. On average, a typical state/local government could realize a four to 16 percent gain in revenues due to the increases in income and employment generated by investments in transit. For this study, a simple fiscal model to illustrate the linkage between transit investment and fiscal outcomes was developed and applied.

The fiscal analysis described in this section demonstrates that local/state government can realize tangible fiscal benefits from transit capital investment. The approach taken for this analysis was to adapt national data on spending patterns and revenue generation to the results of the transportation analysis, described in the previous chapter. As such, the fiscal impacts estimated are illustrative of the revenue-generating potential of transit in support of a growing community.

The fiscal impact analysis comprised several steps:

- Collect national data on spending and revenue-generating patterns;
- Develop relationships between national revenue spending patterns and the inputs of the transportation/economic analysis; and
- Apply the relationships developed to the results of the transportation scenario.

Collect National Data on Spending and Revenue-Generating Patterns

Data pertaining to aggregate local and state expenditures and revenues were gathered from readily available sources, including the U.S. Statistical Abstract. When state and local revenue sources are considered together, four sources account for over two-thirds of the total dollars collected: property taxes, general sales taxes and specific taxes imposed on goods such as tobacco products and motor fuel, various charges and fees and intergovernmental transfers. Consistent with this sketch-level analysis, the various revenue sources were combined into seven general categories: Personal income tax, corporate income tax, sales tax, gross receipts (from taxes charged for certain goods), property tax, intergovernmental revenue and fees, charges and miscellaneous. In this latter category, consisting of many 'small' fees and charges from various sources, the largest single item is the insurance trust revenue, which alone accounts for over 12 percent of all revenues generated. Likewise, available expenditure categories from the national data were collapsed to six: General government, public safety, welfare, public health, education and transportation. Among these categories, general government is the single largest, accounting for over 40 percent of all expenditures. General government includes parks and recreation, bond payments and water treatment facilities and services and many other small categories. The next largest expenditure is education. Together, expenditures for education and general government services account for over 70 percent of the total.

Table 5.1 Categories of Local and State Government Revenues Used in Analysis

Revenue Category (in $ millions)	Total	State	Local	Percent
Income Tax	$128,810	$117,128	$ 11,682	9.7%
Corporate Tax	28,319	25,692	2,627	2.1
Sales Tax	149,040	123,006	26,034	11.2
Gross Receipts	74,588	62,865	11,723	5.6
Property Tax	197,140	8,386	188,754	14.8
Inter-government Revenue (a)	215,445	240,518	242,027	16.2
Fees, Charges and Miscellaneous	$538,100	$300,107	$237,993	40.4
Total	$1,331,442	$841,702	$720,840	100%

(a) Total Equals net of transfers between state and local governments.
Source: Statistical Abstract of the United States, 1997.

Table 5.2 Direct Local and State Government Expenditures Used in the Analysis

Expenditure Category (in $ millions)	Total	State	Local	Percent
General Government	$ 467,991	$189,737	$278,254	37.1%
Public Safety	87,038	26,591	60,447	6.9
Welfare	179,829	148,244	31,585	14.3
Public Health	100,430	46,996	53,434	8.0
Education	353,287	94,896	258,391	28.0
Transportation	72,067	43,812	28,255	5.7
Total	$1,260,642	$550,276	$710,366	100.0%

Source: Statistical Abstract of the United States, 1997.

Develop Relationships Between Revenue and Spending Patterns

The economic model produces estimates of changes to business sales, income and employment. In order to use the results of the economic model in the fiscal analysis, relationships between changes in the economic variables and those used in the fiscal analysis must be developed.

Tables 5.3 through 5.5 present these relationships. Where there is not a direct correspondence between a result from the economic model and the variables used in the fiscal analysis, intermediate rates or factors were developed. For example, to generate estimates of sales tax revenues, a factor converting income to retail purchases, *retail sales portion of personal income,* was developed. The sources for these factors are the Statistical Abstract of the United States (1997) and the County and City Data Book (1994).

The rates and factors developed were validated against the national-level data. Where necessary, the rates were adjusted slightly to obtain a reasonable match against the national data.

The relationships between economic and fiscal outcomes developed reflect national trends, consistent with the national scope of the overall analysis. Since government expenditures and revenue generation vary greatly from one community to another, the rates and factors presented here can be considered illustrative, rather than representative of any one particular community.

Table 5.3 Rates Used In Revenue Estimation

	Rate	REMI Variable Used
State Revenue (Basis)		
Income Tax (Percent of Personal Income)	4.51%	Income
Corporate Taxes (Percent of Net Corporate Income)	4.63%	Business Sales
Sales Tax (Percent of retail sales receipts)	4.87%	Business Sales and Income
Gross Receipts (Percent of Personal Income)	1.09%	Income
Residential Property Tax Rate (Percent of Assessed Value)	2.18%	Employment
Commercial Property Taxes (per employee)	$101	Employment
Fees, Charges and Miscellaneous (per capita)	$1,145	Employment
Other Taxes & Fees (per capita)	$568	Employment
Local/County Revenue (Basis)		
Income or Wage Tax (Percent of Personal Income)	0.20%	Income
Corporate Taxes (Percent of Net Corporate Income)	0.47%	Business Sales
Residential Property Tax Rate (Percent of Assessed Value)	2.53%	Employment
Commercial Property Tax (per employee)	$101	Employment
Sales Tax (Percent of retail sales receipts)	1.03%	Personal Income & Business Sales
Gross Receipts	0.20%	Employment
Fees, Charges and Miscellaneous (per capita)	$908	Employment
Intergovernmental Revenue (per capita)	$822	Employment

Table 5.4 Factors Determining Taxable Base

Description	Factor	Conversion
Taxable Personal Income/Total Personal Income	45.09%	Income to Income Tax
Taxable Corp. Income/Total Business Sales	5.55%	Business Sales to Income Tax
Retail Sales Portion of Personal Income	38.65%	Income to Sales Tax
Retail Sales Portion of Business Sales	3.00%	Business Sales to Sales Tax
Percentage of Property Value Assessed (local)	57%	Employees to Residential Property Tax
Percentage of Property Value Assessed (state)	3%	Employees to Residential Property Tax
Avg. Assessed Taxable Value (per household)	$118,000	Employees to Residential Property Tax
Avg. Change in Population Change in Employment	2.07	Per Capita Calculations
Percentage of Employees Owning Home	0.57	Employment to Residential Property Tax

Table 5.5 Rates Used in Expenditure Estimates

	Rate	REMI Variable
State Expenditures ($1,000's)		
General Government (per capita)	$1,152	Employment
Public Safety (per capita)	$102	Employment
Welfare (per capita)	$569	Employment
Public Health (per capita)	$180	Employment
Education (per capita)	$364	Employment
Transportation (per capita)	$170	Employment
Local/County Expenditures ($1,000's)		
General Government (per capita)	$663	Employment
Public Safety (per capita)	$231	Employment
Welfare (per capita)	$121	Employment
Public Health (per capita)	$205	Employment
Education (per capita)	$991	Employment
Transportation (per capita)	$109	Employment

There are two principal assumptions which underlie the analysis. The first is that government expenditures are proportional to the variables used in the analysis. This means that the fixed costs of providing public services are built into the expenditure rates used, rather than considered separately. To consider the fixed costs of public services separately would have required substantial additional analysis beyond the scope of this sketch-level analysis. To illustrate, consider the problem of determining at what point adding a student to a community creates a demand for new school construction. To avoid this problem, we simply assume that each student adds to school expenditures in proportion to current per capita spending for education. Secondly, all government expenditures are assumed to increase as employment (resulting from transit investment) increases, *with the exception of welfare expenditures.* Specifically, each additional employee is assumed to generate no additional public spending for welfare services. This is reasonable, since most employed persons and their dependents do not receive welfare benefits.

■ Apply the Relationships Developed to the Results of the Transportation Scenario

The fiscal analysis provides an estimate of how the predicted gains in jobs, business activity and income resulting from the transportation scenario would affect local/state government finances. In the first year, there is a modest surplus of $2.4 million in 1992 dollars. The surplus grows roughly in proportion with the steady increases in income, employment and business sales. Net revenues are predicted to grow to $27.0 million by 2005, reaching $88.3 million in the final year, 2017.

These findings indicate that local/state governments can realize a fiscal benefit from investment in transit, although the magnitude of that benefit is likely to vary widely from one community to another. So too would the likely uses of any surplus vary among communities, reflecting as it should, local priorities and the desires of local constituencies.

Table 5.6 Expenditure Estimates from Transportation Scenario

Combined State and Local/County Expenditures (in thousands of 1992 dollars)	**1998**	**2005**	**2017**
General Government	21,580	119,040	217,203
Public Safety	3,959	21,840	39,850
Public Health	4,577	25,251	46,073
Education	16,110	88,870	162,154
Transportation	3,317	18,299	33,388
Miscellaneous	3,971	21,906	39,970
Total	**53,515**	**295,206**	**538,638**

Table 5.7 Revenue Estimates from Transportation Scenario

Combined State and Local Revenues (in thousands of 1992 dollars)			
	1998	**2005**	**2017**
Income Tax	4,694	30,754	69,579
Corporate Tax	1,344	7,815	16,100
Sales Tax	5,877	37,888	84,731
Gross Receipts	2,861	18,744	42,407
Property Tax	6,948	38,325	69,929
Intergovernmental Revenue	9,777	53,933	98,406
Fees, Charges and Miscellaneous	24,419	134,703	245,782
Total	**55,920**	**322,162**	**626,934**
Net Revenue	**2,405**	**26,956**	**88,296**
Net Revenue as Percentage of Expenditures on Table 5.6.	**4.5%**	**9.1%**	**16.4%**

6.0 Techniques for Analyzing Economic Impacts of Transit at the Regional Level

Introduction

The purpose of Section 6.0 is to assist individuals and organizations that are interested in more fully analyzing – or simply better understanding – the economic benefits of investment in public transit. While the need for and the benefits of public transit are widely recognized and well-established in terms of improved accessibility and mobility, estimating the economic benefits of infrastructure investment, including transportation generally and transit specifically, has received major attention only in the past decade.

The Importance of Assessing the Economic Benefits of Transit

A number of significant trends and changes have taken place over the past two decades or more that point to the increasing importance of public transit as an element of our urban and rural transportation networks. Among these trends is a well-documented continuing backlog of critical investment in a wide range of public services and facilities. There is mounting evidence that we, as a nation, are severely under-investing in the transportation network that is so vital to our economic interests, and that we are paying inadequate attention to the development of transit and other forms of high-occupancy surface transportation.[1]

Despite the continuing strength of the American economy and the projected surpluses in Federal as well as state budgets, funding for all types of public services and facilities remains tight and competition among worthy goals, programs and projects remains strong. This fiscal environment, coupled with the pursuit of economic growth and competitiveness on a global scale, requires that the benefits of competing investments – including transit – be expressed in economic terms. To be effective, the effort to do so must be rigorous and credible from an analytical standpoint and readily understandable by both technical and non-technical actors and audiences. The reasons for doing so are compelling:

[1] *The Status of the Nations Highways, Bridges and Transit: Condition and Performance*, U.S. Department of Transportation, Washington, D.C., 1995.

- ***Transportation is critical to business and personal economic security***. Transportation accounts for approximately 17 percent of our Gross Domestic Product, and for American families transportation represents 18 percent of household spending, the second largest household expenditure after housing.

- ***Travel demand and congestion is increasing dramatically.*** From 1973 to 1993 our nation's population grew 22 percent. In contrast, registered vehicles increased 49 percent and vehicle-miles of travel rose 83 percent. Over this same period, street and roadway mileage increased less than 28 percent.

- ***The cost of congestion is enormous.*** Time and money lost to households and businesses from congestion and delay on our highway system are estimated at $40 billion to $100 billion per year and are projected to grow, increasing costs and reducing business profitability and economic competitiveness.

- ***Environmental and quality of life concerns related to transportation are on the rise.*** The environmental consequences of accommodating increased motor vehicle use are imposing increasingly unacceptable costs and constraints on economic growth and development.

- ***Economic opportunities are being lost for a growing segment of Americans***. The high cost and poor quality of transportation links between willing workers, jobs, training and human services reduces individual economic opportunities and access to labor for business and industry.

- ***Global economic competitors are investing in transit.*** European and Asian countries are investing billions to provide high-capacity passenger transportation systems and services using state-of-the-art technologies as part of aggressive global economic growth strategies.

Chapter Overview

This section is intended to: 1) point the way toward credible, comprehensive application of analytical techniques and/or findings at the local and regional level; and 2) enhance general understanding of the linkages that exist between transit investment and use, and benefits to the economy.

This section is organized into the following sub-sections:

- "Framing the Issues and Analysis" provides an overview on how the issues associated with estimating transit's economic benefits might be framed.

- "Analytical Methods and Applications" highlights various analytical approaches that can be applied to capture a full range of benefits.

- "Applying the Results of Recent Analyses" highlights how these results might be applied, as well as other factors and data developed from other sources that may be of value in local efforts to carry out similar analyses.
- "Choosing the Correct Analytical Techniques" outlines analytical methods to consider when estimating transit impacts.
- "Factors and Findings from Other Sources" summarizes the results of recent analyses of the economic benefits of transit.

At various points throughout this section, explicit recommendations are highlighted to assist in conducting local analyses.

Framing the Issues and Analysis

Tracing and estimating the economic consequences of public infrastructure investment, including transit investment, is a complicated task. While complex modeling and estimating techniques lie at the heart of the analysis, it is critically important that both analysts and non-technical decision makers "see" the broad dimensions involved in assessing transit's economic benefits. Framing the issues and identifying cause and effect linkages are an important first step in making sure that analytical results are fully appreciated and understood**.** In general, it is useful to define three types of impact measures:

Travel impacts refer to the travel time, cost and safety improvements that are realized by travelers. These benefits may be expressed in terms of their dollar value to travelers. Effects on non-travelers are not counted in the analysis of user benefits. This is the measure of benefit traditionally used by transportation agencies for project evaluation.

Economic impacts are defined as impacts on the flow of dollars in the economy. They are most commonly described in terms of dollars of income for people, including both travelers and non-travelers. It is important to recognize that economic impacts encompass only money flows and do not necessarily capture all aspects of benefits that can affect the quality of life for people.

Total societal impacts are measured, in theory, as the value of all impacts regardless of whether or not they affect flows of dollars. They can encompass both flows of dollars (income impacts) and the equivalent value of additional quality-of-life impacts that do not affect flows of dollars. Care must be taken to avoid double-counting of total societal benefits.

This guide focuses specifically on the assessment of economic impacts, although the need for recognizing other societal impacts is also discussed.

Illustrating the Linkages Between Transit and Economic Benefits

Until recently, analysis of the economic benefits of transit has been limited in scope and geographic scale. Most analyses have been conducted for individual corridor improvements, notably proposed rail transit investments. Little has been done historically to assess the system-wide, long-range regional economic benefits of transit investment and use. This "gap" in our documentation of transit's impacts was identified in a recent Transit Cooperative Research Program (TCRP) study and led to an examination of alternative analytical approaches that allow better, more comprehensive estimates to be made of transit's economic benefits at the regional scale.[2]

As part of that effort, a new, broad framework was developed that identifies in simple and direct terms both the recognized and assumed links between transit investment and use, and key regional economic variables or indicators. The framework is based on the notion that if we can chart linkages, or the chain of cause and effect relationships between key variables, we can then determine whether:

1. Data exists about those variables;

2. A technical or mathematical expression of the relationships has been developed for use in an analysis; and

3. Analytical results can be credibly translated into dollar or monetary terms.

As one would expect, in the case of some cause and effect relationships between transit investment and economic consequences, reliable data does exist, models of the relationships between variables have been established, and we know how non-monetary impacts (e.g., minutes of delay) can affect the flow of dollars in the economy. In many cases, however, one or more of these critical components are missing. As a result, it remains necessary to make educated or informed guesses based on logic and professional judgment. The result is that not all presumed economic benefits can be calculated precisely or expressed in monetary terms.

Despite the frailties of current analytical approaches, techniques are being improved. Because our knowledge of analytical technique is incomplete, however, it is important to illustrate in other ways that the framework for analysis – the scope of transit's economic benefits – is far broader than has been noted or measured in the past. A first step in the analysis, therefore, should be development of a simple, graphic depiction of the framework that can both guide subsequent analysis and inform non-technical audiences about the scope of transit's economic benefits. One such framework is illustrated in Figure 6.1.

[2] Cambridge Systematics, Inc. *Measuring and Valuing Transit Benefits and Disbenefits*, TCRP Report 20, Transit Cooperative Research Program, Transportation Research Board, Washington, DC, 1996.

Figure 6.1 illustrates the basic linkages between transit investment and use and the performance of a region's economy. Transit investment and use (together with supportive public policies) result in a combination of three basic effects:

1. Changes in travel behavior and cost, as travelers switch from personal motor vehicles to transit;

2. Changes in spending, including construction and building activity influenced by transit (particularly rail transit); and

3. Changes in other social and environmental factors including the organization of land uses.

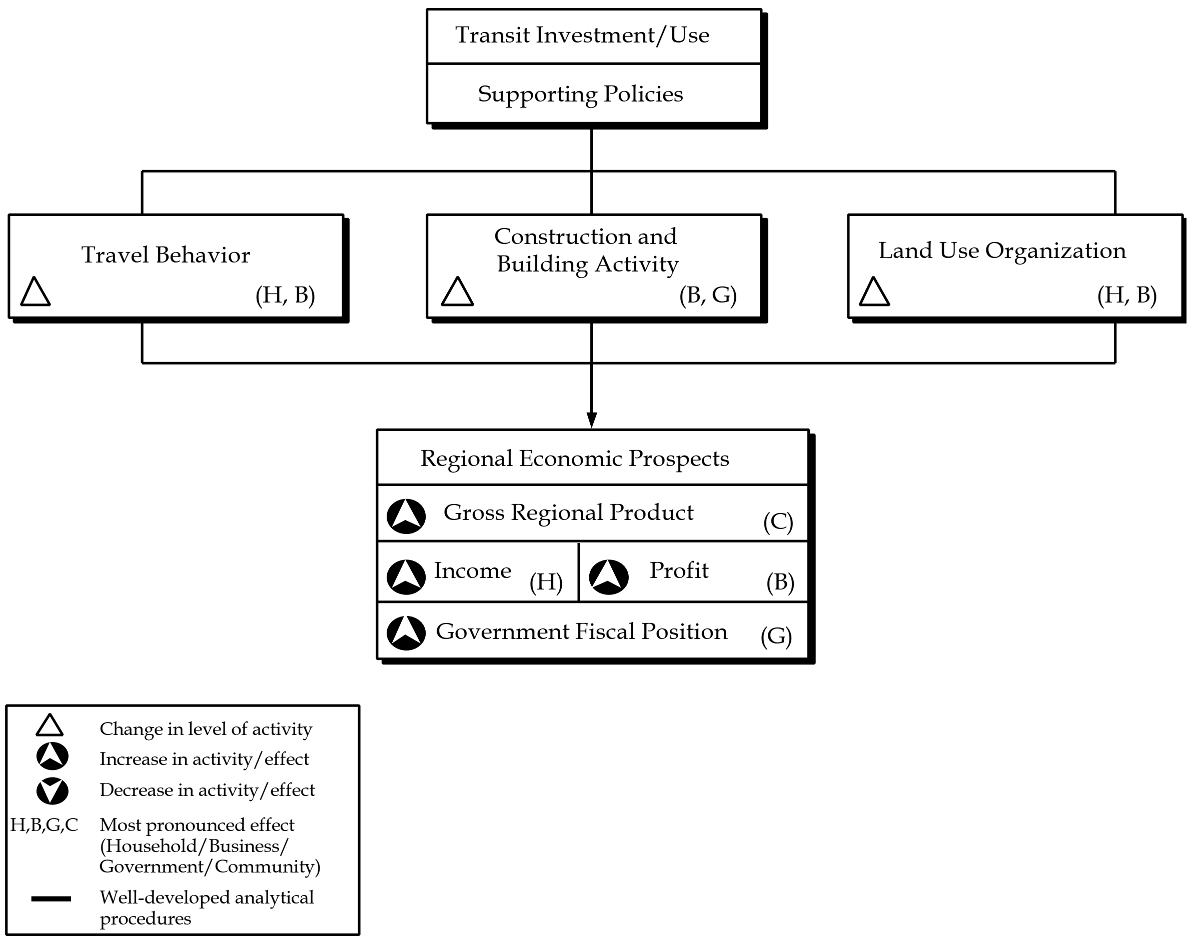
These impacts, in turn, have an effect on variables that traditionally are used to measure the economic health of a region, including Gross Regional Product (GRP), household income, business revenue or profit and fiscal impacts on area governments.

The basic relationships captured in Figure 6.1 represent a "logic diagram" intended to illustrate broad cause and effect relationships that are logically or intuitively sound. The lines that connect boxes in the diagrams represent the relationships (known and unknown) that must be measured, i.e., a change in one variable causes a specific change in another. As indicated earlier, in some cases we can be confident of these relationships, describe them mathematically and have access to large amounts of data. In other instances, we do know the direction of the linkages, but we can only make educated guesses about their exact nature, i.e., an increase in one variable is bound to result in an increase or decrease in another, though the amount of change may be uncertain.

In this framework, however, it is important to note that while transit investment and use can and does represent a positive influence, there are factors that may have a stronger effect on a region's economic performance, both positive and negative. In addition, transit investment and use by itself is neither an absolute prerequisite for regional economic growth, nor can transit investment and use by itself necessarily counter-balance or compensate for the negative effects of other factors that may be part of a region's economic profile.

Logic diagrams have been drawn at a much greater level of detail. As one example, Figure E.3 (see page E-7) illustrates that linkages exist between transit investment and use, changes in travel behavior, effects on the natural environment and their economic consequence for the region. We can accurately estimate, for instance, the change in tail pipe emissions from a shift from personal vehicles to transit. A decline in emissions reduces the cost of compliance with air quality standards for business and industry and it reduces property damage and health risks and costs from air pollution. These effects also can be estimated, although with somewhat less precision and certainty. Each, in turn, has a positive effect on household income, the cost of doing business and business profitability in a region, as well as other dimensions of economic performance.

Figure 6.1 Framework for Analyzing the Economic Impacts of Transit



In addition to the framework described above, there have been other efforts in recent years to illustrate the full scope of transit's impacts – social, economic and environmental.[3]

None, however, have focused as extensively on the long-term, region-wide economic impacts of transit investment and use as is shown in the approach highlighted above.

The importance of properly framing and illustrating the full scope of transit's economic impacts cannot be overstated. While the concepts and relationships to be measured, assessed and communicated are complex, logic diagrams can provide simple insight into the heart of a complex set of relationships and analyses, regardless of what technical methods may be used. Even if the actual analytical concepts to be applied do not cover the full range of impacts noted on Page 6-3, an effort should be made to illustrate them conceptually to help audiences develop an understanding of the full extent of transit's economic benefits.

Types of Impacts

While the logic diagrams described on Page 6-5 provide a way to frame and illustrate key linkages issues in the broadest possible terms, the types of economic impacts resulting from transit investment (or any public investment for that matter) can be described technically in a variety of ways. Fundamentally, transit investments provide impact through two primary effects:

- Transportation spending effects on the economy, leading to changes in jobs; and
- Travel-related impacts leading to travel time and cost changes for people and business.

These direct effects lead to further impacts on many different levels, affecting the revenues and costs for households, for businesses and for governments (the latter are referred to as "fiscal impacts"). Thus, we distinguish between direct, indirect and induced economic effects.

- ***Direct Economic Impacts*** are those changes in flows of dollars that result directly from the initial spending in the transit project or activity, and the effect of the transit service on travelers. The spending effect includes the wages paid to workers on the project or working on the transit system, and revenue accruing to companies participating in the project or activity. Cost effects include changes in out-of-pocket expenditures for personal and business travel, which may affect business revenue and sales.

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[3] Litman, T.A., *Transportation Cost Analysis: Techniques, Estimates and Implications*, Victoria Transport Policy Institute, Victoria, BC, Canada, 1995.

Delucchi, M., *The Annualized Social Cost of Motor-Vehicle Use in the U.S., 1990-1991: Summary of Theory, Methods, Data and Results*, Institute of Transportation Studies, University of California-Davis, Davis, CA, 1996.

Lee, D., *Full Cost Pricing of Highways*, Volpe National Transportation Systems Center, U.S. Department of Transportation, Cambridge, MA, 1995.

- ***Indirect Economic Impacts*** cover additional changes in economic activity for businesses that supply services or materials to the directly affected businesses.

- ***Induced Economic Impacts*** result as household income changes (created by direct and indirect effects on wages) lead to further effect on consumer spending throughout the economy.

Indirect and induced impacts can represent "multiplier" effects that increase total economic impact. Such "multiplier effects" can make the overall economic impacts substantially larger than the direct effects alone. They occur insofar as the local area or state has the ability to provide additional workers and capital resources, or attract them from elsewhere, without taking them away from other existing economic activities within the area. The extent and size of multiplier effects depends on the specific area being studied. Estimates of the multiplier effects for any given county or state are available through economic "input-output" tables provided by the U.S. Department of Commerce and other private sources.[4]

Other Issues to Keep in Mind

Enumerating, Summing and Double-Counting Benefits. Stakeholders and others involved in deciding public investment priorities are frequently interested in different types of impacts. Local officials may be interested in population and employment impacts. Regional planners may be most interested in travel time savings and congestion reduction. State legislators may be most interested in impacts on their state's revenue and fiscal position. Developers may be interested in potential impacts on local land values. Transit investment benefits include:

- Time savings – motorists and transit users;
- Parking and travel cost savings – motorists;
- Avoided job loss;
- Avoided welfare payments;
- Avoided motor vehicle accidents;
- Avoided congestion and pollution;
- Central city labor market opportunities;
- Central city business attraction and retention;
- Local education – college attraction; and
- Other aspects of mobility for those without cars (poor, elderly, kids, etc.)

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[4] Weisbrod, Glen and Burton Weisbrod, *Assessing the Economic Impact of Transportation Projects: How to Match the Appropriate Technique for Your Project*, Transportation Research Circular 477, Transportation Research Board, Washington, DC, 1997.

Each of these interests is legitimate. Each has an economic dimension that can be expressed in monetary terms. Each can and should be measured to provide decision makers a basis for informed decisions. The result of all these "enumerated" impacts, however, cannot be simply summed and presented as a statement of the cumulative economic impact of investment in transit (or any other public facility or service). Simply summing these economic impacts would result in double-counting and an over-estimation of the economic benefit of transit investment. The following example was presented in a TCRP study on economic impact analysis of transit investment prepared by Cambridge Systematics, Inc.

"As an example of double-counting, consider a case in which a transit investment is found to have yielded travel time savings worth $2 million annually, and property value increases (measured in terms of lease rates and sale prices) of $3 million annually. While it may be appropriate to discuss each of these impacts separately, it would be inaccurate to conclude that the transit investment produced a total annual benefit of $5 million. This is because the increase in property values is due, in large measure, to the travel time savings. That is, the value of the improved access to properties in the transit corridor is capitalized into the lease rates and sales prices of the properties. Thus, adding together the travel time benefits and the property value benefits would be counting the same impact twice, and would exaggerate the benefits of the transit investment."[5]

Enumerating and measuring individual types of economic benefit is an important and legitimate step. Simply summing them, however, is not and can invite legitimate challenges to the credibility of the analysis. Fortunately, there are analytical techniques available that can reduce the chance of double-counting while still providing a broad-based expression of transit's economic benefits.

The Present Value of Future Costs and Benefits. An analysis of benefits often involves a comparison of a multi-year stream of monetized benefits and costs, with the objective of determining whether, over time, benefits outweigh costs. Because the value of a benefit received in the future is not as great as the value today, future benefits and costs must be discounted to arrive at an expression of present value. Selection of the appropriate discount rate is an important and controversial analytical issue, reflecting political values and policy orientation. The lower the discount rate selected, the more likely it will be that investments with high initial costs but benefits far off in the future, like transit, will have higher or more favorable benefit/cost ratios. The principal criterion in setting discount rates is the "opportunity cost of capital", which may be judged to be any one of the following:

- the actual cost of borrowing money by the public sector agency (which is typically a low interest rate due to its tax free status); or
- the rate of return that the money could have earned in the private sector (the "social opportunity cost"); this is normally similar to the cost of borrowing in the private sector; or

[5] Cambridge Systematics, Inc. with Robert Cervero and David Aschauer, *Economic Impact Analysis of Transit Investments*, TCRP Report 35, Transit Cooperative Research Program, Transportation Research Board, Washington, DC, 1998.

- the *rate at which people effectively value receiving money now* rather than in the future (the "social rate of time preference").

Among these choices, an important consideration is the available alternatives for use of the real resources (labor, machinery, etc.) which can be paid for by the available money.

The "real" (constant dollar) discount rates used for benefit-cost analysis of transportation investments are typically in the range of four to eight percent. The U.S. Office of Management and Budget (OMB) recommends a seven percent discount rate, as representing the private sector rate of return on capital investment. Other agencies, recognizing the social rate of time preference, have adopted lower discount rates. For decades, the Army Corps of Engineers used a four percent rate, which had the effect of favoring long-lived projects with net benefits many years into the future. The State of Wisconsin adopted a five percent rate. The UK Department of Transport's NESA benefit/cost procedures call for a seven percent rate. Analyses for major projects in Massachusetts have generally used a seven percent rate. The BC Ministry of Transportation and Highways uses an eight percent rate.

The Multiple Missions of Transit in Metropolitan, Small Urban and Rural Settings. Public transit systems are expected or required to pursue missions and goals that are very often contradictory. Financial constraints force managers to live within limited budgets, while strategic goals call for service expansion and initiatives to increase ridership and market share.

Similarly, communities of varying size have different expectations and goals for transit. In larger communities, transit represents one of the few acceptable options available to add capacity to the regional transportation system during rush hours – when the street and highway system is at or over capacity. In serving this function, transit is playing a fundamental role in the provision of transportation capacity essential to sustain economic growth and expansion. The economic benefits of transit in this scenario are substantial and relatively easy to estimate.

In smaller urban and rural communities, the role of transit may be fundamentally different. Transit may play a smaller role in preserving or adding to highway capacity, but a large role in guaranteeing mobility and access for individuals and households that have no transportation options. In providing a transportation option, there are clearly social benefits accruing to individuals, the community and local governments as well as business and industry, but these remain difficult to measure in quantitative terms. Measurable economic benefits may also be less important in these settings than the more intangible quality of life benefits afforded by transit. The economic benefit in traditional terms in small urban and rural areas does not suggest, however, that these transit services are of less importance than transit services are in areas where economic benefits are substantial and can be easily measured.

Measuring Economic Benefits at the Local and Regional Level. The economic impact of transit investment and use will vary from region to region, because the structures of regional economies vary. For example, the region with a bus manufacturing plant will retain more of its transit investment in the local economy than a region whose transit vehicles are supplied from another area of the country.

This variability in regional impacts underscores two important points. First, there is a high degree of economic interdependence between regions and how they serve transit needs and make transit investments. Investments in one region provide direct and indirect economic stimuli to other regions. Second, this interdependence extends far beyond the local and regional transit investment transactions. Substantial transit investment and economic benefit in one region of the country, where it is considered critical, is likely, through federal assistance, to be matched by equally critical investments of another type in regions where transit needs are not as great. In both senses, this economic interdependence at the local and regional level indicates that there is a shared interest in promoting economic and social well-being in all areas of the country through investment in public transit.

Analytical Methods and Applications

Analysis of the economic benefits of transit investment is generally conducted for one of two reasons – to ***predict*** the consequences of investments yet to be made, or to ***evaluate*** the consequences of investments already made. A variety of methods are commonly used to assess the economic benefits of transit investment.

TCRP Report 35, *Economic Impact Analysis of Transit Investments: Guidebook for Practitioners,* provides an in-depth description of the characteristics of many such methods and techniques, with examples of where and how the techniques have been applied, and with what result. The most significant points from those descriptions are summarized below.

Travel Demand Models	Used basically for predictive purposes; among the best tools for measuring changes in regional system performance and travel behavior; complex, data-intensive, costly software requiring high levels of expertise; less effective in forecasting changes in transit performance; and used in virtually all major system and corridor planning programs.
Benefit-Cost Analysis	Primarily for predictive purposes; widely accepted, well-developed procedures; use travel demand model outputs; balance of benefits/costs dependent on key assumptions (value of time, specification of other variables, discount rates, analysis period, etc.); potential bias against long-term benefits; and cost-effectiveness analysis is an alternative when monetizing benefits is difficult.
Input-Output Models	Primarily for predictive purposes; used to estimate transit's economic benefits; measure job and dollar flows between industries as demand and consumption change; several widely available models; limited to inter-industry transactions, impacts; static – do not account for long-term changes; and key features of I-O models included in other tools.

Forecasting Economic and Simulation Models	Primarily for predictive purposes; used to re-estimate employment and business revenue impacts (techniques used in *Public Transportation and the Nation's Economy*); typically include I-O inter-industry links and more features that allow a larger range of benefits to be estimated; somewhat costly to purchase or rent; often require extensive data acquisition efforts; provide short and long-term impact assessment; and provide estimates of generative impacts, labor costs and taxes.
Multiple Regression Models	Primarily for evaluative purposes; measure causal relationships between a dependent variable and various explanatory variables; used for evaluating generative impacts; may reveal cause and effect relationships for predictive analyses using other methods; well-established software packages exist; difficult to include and get data on all relevant variables; and sensitive to sampling and measurement errors.
Statistical Comparisons	Primarily for evaluative purposes; include before/after comparisons ("longitudinal"), and place comparisons ("cross-sectional") for redistributive impacts; provide probabilities and evaluations of differences as a surrogate for cause and effect; low data, budget, skill requirements; and use of actual cases enhances transparency.
Case Comparisons	Primarily for predictive purposes; often used for public information purposes; inputs include literature reviews, interviews, surveys, etc.; low data, budget, skill requirements; and use of actual cases enhances transparency.
Interviews, Focus Groups, Delphi Methods	For both predictive and evaluative purposes; used to elicit insights from personal experience; provide observations on redistributive and transfer effects (direction and magnitude of effects); low data, budget, skill requirements; based on opinion and perception, i.e., limited accuracy; and results potentially compromised by personalities.
Physical Conditions Analysis	For both predictive and evaluative purposes; provides a basis for assessing developmental impacts; low data, budget, skill requirements; and results are speculative.
Real Estate Market Analysis	Used to predict development potential and redistributive and transfer effects; low cost with potential data shortcomings; and results are speculative.
Fiscal Impact Analysis	Primarily for predictive purposes; spreadsheet models available for estimating public revenue and expenditure effects; provides long-term cost implications and proportion costs and benefits; often difficult to conduct

	on a multi-jurisdictional basis; and risks implying that investment decisions be based on fiscal impacts alone.
Development Support Analysis	Primarily for predictive purposes; combines conditions analysis, market analysis, interviews and highway capacity analysis to gauge development capacity; most effective at corridor, subarea or site level; as a composite approach, shares disadvantages of several techniques; and reliant on assumptions and consensus.

Selecting the Best Methods

The selection of appropriate and effective analytical techniques for use in assessing the economic benefits of transit investment depends on two sets of considerations. The first is how well the various techniques satisfy four basic criteria intrinsic to all analytical procedures:

Validity	How accurately does the method represent the feature in question? Does it identify/imply cause and effect (internal validity)? Are findings generalizable (external validity)?
Reliability	Does the method yield consistent results in comparable circumstances?
Resources Requirements	What level of money, time, skill, and data is required?
Transparency	The ease with which methods, assumptions and results can be understood.

The second set of considerations has to do with how well various analytical methods match up with the concerns, capabilities and requirements of the organization conducting the analysis.

- ***Data Requirements.*** Considerable time and expense can be involved in the development of data necessary to support the use of selected analytical techniques. The availability and quality of data should be reviewed, and the level of effort to be made in the development of supporting data should be decided prior to selecting analytical techniques.

- ***Analyst Skills.*** The level of technical expertise required to apply various techniques varies considerably. Staff skills and capabilities and those of contractors should be carefully assessed before selecting analytical techniques to be applied.

- ***Technical Requirements.*** Available analytical techniques require a wide range of technical skills. Technical requirements should be fully understood before analytical techniques are selected.

- ***Cost.*** There is a fundamental trade-off between the validity and usefulness of the analytical results and the cost of applying various techniques. Simple, less costly techniques generally have more obvious shortcomings; more rigorous analytical techniques generally provide more credible results, but at significantly higher cost.

- ***Time Required.*** A similar trade-off exists between the degree of complexity and cost of various techniques and the time required to apply them and validate results. A clear sense of the analytical timetable will help determine what techniques might be selected.

- ***Ability to Differentiate Between Types of Impacts.*** Various analytical methods provide varying ability to distinguish between types of impacts (generative, redistributive or financial transfers). The importance of these types of impacts will, in turn, reflect the motives for the analysis.

- ***Scale of Analysis.*** Some methodologies are most effectively used at the national, regional or county-wide scale; others can be effectively used at the corridor or site-specific scale. The techniques to be applied must be matched to scale and the purpose of the analysis.

Over time, it has become obvious that no single analytical technique can satisfy all of the criteria or characteristics of every situation for which analysis of transit's economic benefits is desired. As a result, it is increasingly common for more than one analytical technique to be used, particularly in analyzing the region-wide, long-term economic impacts of transit investment.

Other Sources of Information on Transit Impact Analysis

This section has presented an overview of the many issues to consider when framing a transit impact study. There are other sources of information available, including, TCRP 35, *Economic Impact Analysis of Transit Investments (1999): Guidebook for Practitioners,* and *Economic Benefits of Transit in Indiana: Technical Report (1994).* The Indiana study, produced by McDonald Transit Associates for the Indiana Transit Association, is a very practical guide that offers a "cookbook" approach to the estimation of transit impacts. Worksheets to estimate the effects of transit investments in a number of discrete impact areas are provided. For organizations considering conducting their own study of transit impacts, both of these publications are worth taking a look at. Transit agencies planning economic studies can obtain further information about these and other volumes from the American Public Transit Association, 1201 New York Avenue, N.W., Washington, DC, 20005; telephone (202) 898-4000.

Applying the Results of Recent Analyses

At the federal, state and local levels of government, decision makers face the challenge of identifying and prioritizing the needs of their constituents and generating the support and resources to meet those needs. Transit investment is but one of many potential budget items on the fiscal balance sheet. When the prevailing perception of transit funding is that such investments will take away valuable resources from other pressing needs, create financial liabilities and not address problems for which it is designed, initiatives to promote transit are unlikely to succeed. Bringing to the table credible evidence supporting claims of an economic pie that can grow rather than shrink through transit investment, however, can counter those perceptions or prevent them from developing.

Public Transportation and the Nation's Economy adds to the body of evidence that transit investment sustains and enhances the economic well-being of communities that make those investments. Policy-makers at all levels of government can use the findings of this report to rally support for continued or enhanced funding for a variety of transit projects.

The findings of the study can and should be cited as representative of the positive economic impacts that can be achieved through proper planning, design, engineering and implementation. The study focused upon data and analysis at the national level. Of course transit projects vary considerably in their scope, purpose, funding level and a number of other key dimensions, so no single community can claim that precisely the same results found in the study will apply to their project.

It is contingent upon policy-makers to make the case why the transit investments they support are likely to yield benefits along the lines cited in *Public Transportation and the Nation's Economy*. The likelihood of these benefits being realized depends directly upon the presence of certain background conditions and complementary actions which foster the success of transit investment. Citing the background conditions and complementary factors relevant to a particular investment scenario make the results of the *Public Transportation and the Nation's Economy* more appropriate to their situation and will strengthen claims of economic benefits similar to those found in this report. Several of these background conditions and actions are briefly cited below:

The economic impacts associated with transportation investments are likely to be greatest:

- In urban areas with moderate to high congestion in corridors designated for transit investment;
- Where there is limited ability for highway capacity improvements;
- There is good access to significant land use activity at the destination end and residences at the origin end;
- There are public policies that support and abet transit usage such as zoning and land use policies, transit-supportive parking policies and employer-based commute options; and

- The transit service is competitive with the highway alternative in terms of time and cost. Systems operating on dedicated rights-of-way, for example are likely to be more time-competitive with auto times as compared to bus systems running in mixed traffic.

The economic impacts of capital investment are likely to be greatest when:

- For existing systems, there are opportunities to increase reliability of service through rehabilitation/replacement; and

- Manufacturers and suppliers of goods and services needed for expansion/new system are located within the region.

The economic impacts of operating system investments are likely to be greatest when:

- The investment creates direct employment to operate and manage the system. In this light, more labor-intensive operations, such as new bus systems, would create the relatively more economic impacts than other types of transit investments.

■ Findings from Other Studies

Over the past decade, studies examining transit's worth from several perspectives have shown that transit provides measurable economic and transportation benefits. It is emphasized that each of those studies was conducted under unique circumstances and assumptions, and cannot always be used for comparative purposes. The studies we summarize below, however, examine transit systems in all sizes and shapes and from several different angles, and carry a consistent positive message that builds upon the body of evidence showing that transit is a sound public investment.

The economic impact studies are grouped by: large metropolitan areas, medium metropolitan areas, small and rural areas and national studies.

Economic Impacts – Large Metropolitan Areas

Philadelphia, PA, Southeastern Pennsylvania Transportation Authority (SEPTA), ***Public Transportation Renewal as an Investment*****, Urban Institute and Cambridge Systematics, Inc. (1991).**

Scenario: Immediate Shutdown

- 175,000 loss in employment
- $10.1 billion loss in annual personal income
- $16.3 billion loss in annual business sales
- $632 million loss in combined state and local revenues
- 9:1 Benefit/cost ratio

The Philadelphia metropolitan area is a large, economically diverse region with a large central business district and a transit network of nearly 3,000 vehicles. This study examined the region-wide transportation and economic impacts of diminished investment levels in the transit system. Employing sophisticated dynamic simulation models similar to the one used in *Public Transportation and the Nation's Economy*, the research focused on several "shutdown" scenarios: immediate, gradual and partial. The results above present year 2020 annual impacts from the immediate shutdown scenario, compared to a base case transit system in a state of good repair.

Chicago, IL, Regional Transportation Authority (RTA), ***Investment in Public Transportation*****, Cambridge Systematics, Inc. (1995).**

Scenario: Restore System to State of Good Repair

- 41,209 gain in jobs (2020)
- $4.6 billion gain in business sales (2020)
- 6:1 Benefit/cost ratio

The Chicago Regional Transportation Authority operates commuter rail, subway and bus service in the third largest metropolitan area in the United States. The RTA study investigated the impact of a disinvestment scenario as well as a scenario that would restore the system to a state of good repair. The study employed sophisticated transportation and economic analysis techniques similar to the ones used in the SEPTA study, and received substantial review and input by all partners in their respective technical review committees. The study affirmed the vital *regional and state* economic contribution of transit – and the interdependence between the central business district and the surrounding region.

New York, NY, Metropolitan Transportation Authority (MTA), ***Lasting Economic Benefits of Public Transportation Investment - Phase*** **2, Cambridge Systematics, Inc. (1997).**

Scenario: System Disinvestment

- 319,800 loss in jobs (2016)
- $18.9 billion loss in business sales (2016)
- 4.3:1 Benefit/cost ratio

Roughly a quarter of all U.S. transit boardings occur somewhere on the New York Metropolitan Area's vast system of transit services. Transit is especially vital in Manhattan and the inner boroughs, where transit is a necessity, not an option, for many people. The MTA study examined the impacts, over a 20-year time horizon, of a 50 percent reduction in spending for capital needs. The study estimated the decreased reliability in constituent system components, such as rolling stock, tracks and signals, the resulting loss in ridership and the ripple effect on the highway system, including commuters, taxi drivers and truck operators and tourists. The study found that the loss in regional economic competitiveness, through the loss of accessibility, resulted in a substantial loss of business profits, jobs and income.

Los Angeles, CA, Los Angeles County Metropolitan Transportation Authority (LACMTA), ***Economic Impacts of the Long Range Transportation Plan*****, Cambridge Systematics, Inc. (1999).**

Scenario: System Investment with Rail/Bus Improvements

- 131,200-261,700 increase in jobs (2020)
- $8.9-16.0 billion increase in personal income
- 4.47-7.51:1 Benefit/cost ratio

Los Angeles is looking at transit investment as one approach to addressing the regions' formidable congestion and air quality issues. This study, conducted by Cambridge Systematics, Inc. and Economic Development Research, Inc., examined the benefits of four funding scenarios, ranging from a "status-quo" to an aggressive funding strategy. The results shown above represent the projected impacts of a $24 billion investment in capital and $50 billion investment in operating expenditures over 20 years. The scenario includes substantial rail expansion, and completion of the 1996 High Occupancy Vehicle Integration Plan. The REMI model was the primary analytical tool used in the analysis, similar to the other studies cited above. In contrast to those studies however, highway and transit investments – those comprising the long-rang plan – were included in the analysis.

London, United Kingdom, *The Economic Impact of the London Underground Core Investment Program*, Center for Economics and Business Research (1993).

Scenario: Modernization

- $6.9 billion increase in GDP (2003)
- $2.2 billion increase in fiscal revenues
- 36,000 increase in employment

Like New York, London is one of the economic and cultural centers of the world. To an even greater extent than New York, London is built around an efficient and extensive underground transit system. This study examined the impact of a $1.2 billion annual expenditure to modernize the underground system. The study looked at a full investment scenario, one that held service levels constant, and a third that held spending constant and caused service levels to deteriorate. Similar to the New York MTA study, economic impacts followed a chain of events, starting from changing conditions of individual system components, and leading to transportation and economic impacts. The study found that a sustained investment to modernize the underground system between 1990 and 1993 would yield positive net benefits both for London and the United Kingdom.

Economic Impacts - Medium-Size Metropolitan Areas

Dayton, OH, Miami Valley Regional Transit Authority (MVRTA), *Economic Impacts of the Miami Valley Regional Transit Authority on Montgomery County*, University of Dayton Center for Business and Economic Research (1995).

Scenario: Immediate Shutdown

- $3.8 million loss in annual direct and indirect spending
- 985 loss in direct and indirect jobs from RTA expenditures and employee purchases

The Miami Valley Regional Transit Authority (MVRTA) manages the regional transit system in the greater Dayton Area. This analysis looked at the value of transit to the economy by projecting a scenario in which all transit services were halted. The study looked at earnings and spending patterns of MVRTA employees living in Montgomery County, and used simple multipliers to estimate the indirect effects to the local economy of a loss of that employment.

Economic Impacts - Small and Rural Areas

Danbury, CT, Housatonic Area Regional Transit (HART), ***The Economic Impact of HART to the Housatonic Valley Region*****, Jack Faucett Associates (1997).**

Scenario: Immediate Shutdown

- $1.8 million loss in wages
- $1.3 million loss in direct HART expenditures
- 9.7:1 Benefit/cost ratio

HART, a regional transit authority serving western Connecticut, operates a fleet of 55 buses with fixed route and paratransit services. The role of transit in serving work trips is relatively small – accounting for 2.5 percent of all such trips. For this study, information about passengers from on-board surveys was augmented with Census data and data from the transit agency itself. Alternative modes chosen in the absence of transit service as indicated by survey respondents and their associated costs were the basis for developing cost estimates. The costs of foregone trips, and increased accidents, air pollution, employment, lost operating funds and employment, were considered in the analysis as well. Despite the modest role of transit in the region, the study found a benefit/cost ratio of 9.7 to 1, when accounting for local government expenditures against all financial benefits. Even when state and local subsidies are accounted for, benefits remained positive – amounting to $1.3 million per year. The $1.8 million represents the direct and indirect income impacts lost to resident workers and those who benefit from their spending in the local economy resulting from a total loss of transit services in the region. They would suffer a loss from the absence of HART expenditures in the region, amounting to $1.3 million annually. The wage and expenditure figures were estimated as net impacts, accounting for the benefits of welfare and unemployment payments that partially offset the loss of wages and local spending.

Rural Areas, ***Assessment of the Economic Impacts of Rural Public Transportation*****, Ecosometrics (1998).**

Scenario: Detailed Case Studies

- 1.67:1 to 4.22:1 Benefit/cost ratios for all systems
- 3.03:1 to 3.55:1 Benefit/cost ratios for four of eight systems
- 3.12:1 Average benefit/cost ratio

Scenario: Correlation of Transit Service to Economic Growth

- Net earnings in counties with rural transit systems are 16 percent higher than counties without transit systems

Rural communities are by definition low-density areas where access to transportation can mean the difference between isolation and having connections to jobs and services, especially for disabled, low-income and elderly persons. Almost one-third of the population of rural communities is transit-dependent. The majority of transit service operated in rural areas is demand-responsive, or a combination of demand-responsive and fixed-route service. The service emphasis varies from an almost exclusive emphasis on work trips to a primary focus on human service trips. The importance of transit to rural communities has not received the kind of attention reserved for urban areas. Economic indicators at the county-level were compared to the availability of public transportation in rural commuting zones. The researchers examined the types of trips served in various communities, ascribed (with a combination of actual and assumed data) a value and cost to them, and compared that value to the cost of private sector service costs. These results were extrapolated to the nation's rural communities as a whole.

Economic Impacts - National Studies

Areas with Commuter Railroad Service, *Commuter Rail: Serving America's Emerging Suburban/Urban Economy*, The Carmen Group (1997).

Scenario: Value of Current Services

- 420,000 increase in jobs over 1986-1996 (capital investment)
- $3.5 billion increase in federal, state and local tax revenue, 1885-1996
- $300-$450 million savings to truck and freight industry from reduced congestion
- $247-$865 annual time and fuel cost savings to each commuter rail rider.

Nearly fifty percent of the American workforce lives in the suburbs. Commuter rail services provide a critical link between suburban residential areas and employment centers concentrated in cities. In presenting facts and findings on congestion, taxes, job impacts and numerous other indicators of the positive benefits of commuter rail investment, this study provides a compelling case for its continued support.

7.0 References

American Public Transit Association, *Employment Impacts of Transit Capital Investment and Operating Expenses*, Washington, DC, 1983.

American Public Transit Association, *National Impacts of Transit Capital and Operating Expenditure on Business Revenues*, Washington, DC, 1984.

American Public Transit Association, *Transit Funding Needs, 1995-2004: Findings of an APTA Membership Survey*, Washington, DC, 1994.

Bureau of the Census, *Statistical Abstract of the United States 1997*, Washington, DC, 1997.

Cambridge Systematics, Inc., *Measuring and Valuing Transit Benefits and Disbenefits*, TCRP Report 20, Transit Cooperative Research Program, Transportation Research Board, Washington, DC, 1996.

Cambridge Systematics, Inc., and Economic Development Research, Inc., *Economic Impacts of the Long Range Transportation Plan,* Los Angeles County Metropolitan Transportation Authority, Los Angeles, CA, 1999.

Cambridge Systematics, Inc., et al., *Investment in Public Transportation: The Economic Impacts of the RTA System on the Regional and State Economies*, Regional Transportation Authority, Chicago, IL, 1995.

Cambridge Systematics, Inc. with Raytheon-Ebasco, *Lasting Economic Benefits of Public Transit Investment – Phase 2 Final Report*, Metropolitan Transportation Authority, New York, NY, 1997.

Cambridge Systematics, Inc., with Robert Cervero and David Aschauer, *Economic Impact Analysis of Transit Investments: Guidebook for Practitioners*, TCRP Report 35, Transit Cooperative Research Program, Transportation Research Board, Washington, DC, 1998.

The Carmen Group, *Commuter Rail: Serving America's Emerging Suburban/Urban Economy,* American Public Transit Association, Washington, DC, 1997.

Camph, Donald H., *Dollars and Sense – The Economic Case for Public Transportation in America*, Campaign for Efficient Passenger Transportation, Washington, DC, 1997.

Center for Economics and Business Research, Ltd., *The Economic Impact of the London Underground Core Investment Program*, London, UK, 1993.

Delucchi, Mark A., *The Annualized Social Cost of Motor-Vehicle Use in the U.S., 1990-1991: Summary of Theory, Methods, Data and Results,* Institute of Transportation Studies, University of California-Davis, Davis, CA, 1996.

Ecosometrics, Inc., *Assessment of the Economic Impacts of Rural Public Transportation*, TCRP Report 34, Transit Cooperative Research Program, Transportation Research Board, Washington, DC, 1998.

E. D. Hovee and Company, *Socio-Economic Benefits and Impacts on Transit*, Oregon Department of Transportation, Salem, OR, 1997.

Federal Highway Administration, *Estimating the Impacts of Transportation Alternatives, Participants Notebook*, Washington, DC, 1995.

Federal Highway Administration, *Nationwide Personal Transportation Survey: 1990 NPTS Databook*, Washington, DC, 1993.

Federal Transit Administration, *Fixed Guideway Capital Costs: Heavy Rail and Busway/HOV Lane,* Washington, DC, 1994.

Federal Transit Administration, *Modernization of the Nation's Rail Transit Systems: A Status Report*, Washington, DC, 1992.

Federal Transit Administration, *National Transit Database*, Washington, DC, annual.

Jack Faucett Associates, *The Economic Impact of HART to the Housatonic Valley Region*, Housatonic Area Regional Transit, Danbury, CT, 1997.

Lee, Douglass B., *Full Cost Pricing of Highways*, Volpe National Transportation Systems Center, U.S. Department of Transportation, Cambridge, MA, 1995.

Litman, Todd, *Defining and Quantifying Public Transit Benefits*, Victoria Transport Policy Institute, Victoria, BC, 1998.

Litman, Todd, *Public Transit Benefits in the Victoria Region*, BC Transit, Victoria, BC, 1996.

Litman, Todd, *Transportation Cost Analysis: Techniques, Estimates and Implications*, Victoria Transport Policy Institute, Victoria, BC, 1995.

McDonald Transit Associates, Inc., *Economic Benefits of Transit in Indiana: Technical Report*, Indiana Transportation Association, Bloomington, IN, 1994.

Skolnik, Jonathan, and Richard Schreiner, "The Benefits of Transit in Small Urban Areas: A Case Study," paper presented at the 77th Annual Meeting of the Transportation Research Board, Washington, DC, 1998.

Texas Transportation Institute, *Urban Roadway Congestion Annual Report*, Texas A&M University, College Station, TX, annual.

U.S. Department of Transportation, *Status of the Nation's Surface Transportation System: Condition and Performance*, Washington, DC, biennial.

University of Dayton Center for Business and Economic Research, *The Economic Impacts of the Miami Valley Regional Transit Authority on Montgomery County: A Quantitative and Qualitative Assessment*, Miami Valley Regional Transit Authority, Dayton, OH, 1995.

The Urban Institute and Cambridge Systematics, Inc., *Public Transportation renewal as an Investment: The Economic Impacts of SEPTA on the Regional and State Economy*, Delaware Valley Regional Planning Commission, Philadelphia, PA, 1991.

Urban Mass Transportation Administration, *Light Rail Transit Capital Cost Study*, Washington, DC, 1991.

Weisbrod, Glen and Burton Weisbrod, *Assessing the Economic Impact of Transportation Projects: How to Choose the Appropriate Technique for Your Project*, Transportation Research Circular 477, Transportation Research Board, Washington, DC, 1997.