Using Empirical Information to Measure the Economic Impact of Highway Investments

Volume 2: Guidelines for Data Collection and Analysis

final report

prepared for

Federal Highway Administration

prepared by

Economic Development Research Group, Inc.

and

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Table of Contents

List of Tables

List of Figures

List of Examples

Preface

There is considerable current interest in using investments in expanded highway capacity as a means of furthering economic development objectives. The economic effects of a specific new highway investment, though, can vary significantly from project to project depending on where the highway is located, the specific economic interests served, the travel markets served, and the road's affects on accessibility and systemwide connectivity. Simplistic generalizations that highways either do or do not affect business locations and growth are not sufficient to distinguish between specific project alternatives. This project addresses the need for an improved base of information addressing the specific nature of the different economic development effects that can be associated with investments in individual highway projects. The use of this information by state Departments of Transportation (DOT) and regional planning organizations will help inform transportation program and project investments that are intended to advance economic development.

The results of this work are documented in two separate volumes:

- **Volume 1: Review of Literature, Data Sources, and Agency Needs**, reviews the results of existing empirical studies examining the relationships between investments in highways and economic development, focussing in particular on work performed during the 1990s and highways located in rural areas. This volume also describes available data sources that can be used in conducting such studies, presents the results of interviews with staff of transportation agencies and leading researchers regarding potentially available analysis methods, and presents guidelines for the conduct of future economic impact measurement studies.

- **Volume 2: Guidelines for Data Collection and Analysis**, then builds on these findings and general principles to define a specific structure for measuring economic impacts associated with investments in expanded highway capacity, including temporal, spatial, and causality considerations. Three prototype study designs are presented: a regional study of broad-area impacts, a narrow highway strip where the concern is with impacts on businesses located immediately adjacent to a highway or interchange, and a community study where the primary area of concern is a specific town or neighborhood.

The currently available base of information includes a wide assortment of studies, ranging from extremely broad national studies, such as the literature on national productivity impacts of highway spending over time, to extremely narrow and not adequately controlled project assessments. While interesting, many of these studies are not sufficient by themselves to differentiate the advantages and disadvantages of alternative highway investments. Measurements of highway-related economic impacts, in a range of contexts and using a variety of data sources and methods, will expand this existing knowledge base and provide a more credible foundation for making highway investment decisions based on sound economic development criteria.

The recommendations presented are those of the consultant team and do not necessarily reflect those of the Federal Highway Administration (FHWA).

Acknowledgments

The principal investigator for this project, and lead author of this two-volume final report, is Glen Weisbrod of Economic Development Research Group, Inc. Additional major contributors are Margaret Collins and Jinevra Howard of Economic Development Research Group; and Christopher Porter, John Suhrbier, and Christopher Wornum of Cambridge Systematics, Inc.

Martin Weiss of the Federal Highway Administration oversaw the project effort, and played a critical role in defining the project's direction.

For this second volume, the authors are indebted to three agency practitioners, who reviewed an initial draft and provided important suggestions for improvement:

- Greg Bischak of the Appalachian Regional Commission;
- Jim Gillespie of the Virginia Transportation Research Center (VDOT);
- Dennis Leong and Robert Russell of Wisconsin DOT.

1.0 Introduction and Overview

1.1 Project Background

This report is the second of two reports on the use of empirical information to measure the actual economic impact of built highways:

- **Volume 1** provides a review of existing empirical studies, currently available data sources, and information needs for improved research on the economic development impacts of mostly rural highway projects; and

- **Volume 2** provides three prototype designs for empirical studies of the actual economic development impacts of specific highways.

The long-term economic development benefits associated with new highway construction and continued highway system expansion have been an issue of continuing debate. Proponents of new highway investments often cite anticipated benefits such as local or regional job creation, business attraction, and income growth. Opponents often argue that new highway investments may redistribute jobs and business activity and lead to more traffic generation without any real economic benefit to the local area or region.

This debate has been further clouded by a disconnect between public arguments about the merits of specific highway projects and research studies on the merits of expanding investment in the capital stock of the nation's highway system. In particular, studies of the general relationship between highway investment and national or regional economic growth are too broad to shed light on the effects of specific individual highway projects. It is this latter subject, the effects of specific individual highway projects, which is crucial to project development (e.g., environmental impact statements) and programs (e.g., state transportation improvement programs).

This situation leads to three key observations, which form the premise for this study:

1. ***The economic effect of a specific highway can vary from project to project*** (depending on the context of where the highway is located, who it serves, how much it is used, and how it affects local accessibility and/or broader systemwide connectivity). Simplistic generalizations that highways do or do not affect business locations and growth are not helpful for decision-makers trying to distinguish between specific project alternatives. There is a real need for a database of information on the nature of economic effects associated with individual highway projects.

2. ***The potential economic effects of a specific new highway can be local*** (e.g., redirecting economic growth to depressed areas where it is needed and desired), ***corridor-wide*** (e.g., focusing economic activity along a highway strip), ***and/or regional*** (e.g., expanding the productivity and income-generating ability of industries through scale

economies or improved supplier-buyer links). Both the localized and regional effects can be of interest for public policy, so there is a real need for a database of information on how local and regional effects of highway projects can differ.

3. ***There has been a lack of post-project studies documenting the actual economic impacts of built highway projects***. Without much of a base of empirical information on actual impacts of past projects, the accuracy of methods for projecting economic effects of proposed new highway investments remains uncertain. Collecting empirical data to document the extent of any actual economic impacts following completion of individual highway projects will lead to better methods and more reliable data.

This project was undertaken to address existing limitations on empirical data regarding the lasting economic impacts of individual highway projects. The project is intended to help staff of federal, state and regional agencies develop a more consistent and accurate base of information on how, and under what circumstances, highway improvements can provide desired economic development benefits. These types of studies (that assess actual changes) are sometimes referred to as "ex-post" studies. They provide a base of information useful not only for assessing the results of past highway investments, but also to improve the accuracy of future "ex-ante" studies – which aim to predict future changes associated with planned or proposed projects. The results of empirical studies can be used in a number of ways to inform studies of planned or proposed projects:

- The studies help planners better understand how various factors, including highway investment, interact to stimulate economic development;
- Empirical results from a specific highway project can be used to infer the potential benefits of a planned project having similar characteristics;
- The results can be used to develop and improve economic forecasting models; and
- The results can demonstrate the value of investing in transportation corridors to support local or regional economic growth.

The ultimate objective of empirical studies is to improve the judgment of planners and decision-makers as to when, and to what extent, a proposed highway investment will result in economic benefits to the communities and regions that it serves.

1.2 Use of This Guide

This document establishes a set of best practices to inform practitioners of efficient and thorough methods for conducting empirical studies of the actual economic development impacts of specific highways. It is not meant to be a how-to handbook, and it does not lay out step-by-step instructions for conducting such studies. Rather, it seeks to set basic standards for what constitutes a reasonable study, suggests options available for collecting and analyzing data, and provides guidelines for interpreting and presenting results. While developing more accurate and comprehensive measurements in their own right is a

primary goal, this report should help raise the standard for economic impact analysis and thus improve the body of knowledge and data available to practitioners.

The report provides three prototypes for in-depth studies to document and analyze the actual, observed economic development impacts of highway projects. These prototype study methods are developed for a rural highway, in which the project improves connections to smaller cities and towns. This can be contrasted to a highway improvement within a metropolitan area, where the benefits occur primarily within the metropolitan region. The current report focuses on rural highway projects because: 1) they are more likely to be motivated by economic development aspirations than by congestion reduction, and 2) impacts on small towns and rural regions can be less complicated to assess than urban highway projects in major metropolitan areas.

The data sources and evaluation methods described in this report, however, have broader applicability. With some modification, they also could be applied to a metropolitan area, a neighborhood within a city, or another geographic unit affected by highway improvements of significant magnitude. Many of the data sources and methods could also be used to evaluate other types of transportation projects, such as an airport expansion, freight improvements, or transit investments. Therefore this report may be of broad interest to anyone considering measuring the economic impacts of transportation projects using empirical data.

1.3 Summary of General Framework

1.3.1 General Principles for Data Collection and Analysis

The following are a set of general principles for data collection and analysis. These principles are intended to differentiate the various ways in which highway investments affect economic development.

- **Spatial Level of Economic Impacts –** A highway project may have different impacts at different geographic scales. The project may increase total *regional* economic activity, by improving connections to the region. The improvement may also increase business activity at *specific places* within the region, by improving local access or by increasing traffic volumes in some locations. Therefore, data collection and analysis designs need to cover small as well as large areas, in order to distinguish localized effects from regional effects.

- **Connection of Economic Changes to Transportation System Changes –** A new or improved highway connection may create potential for economic growth through any of four ways: 1) expand customer or supplier markets, 2) expand labor markets, 3) reduce business operating costs through lower direct expenses or increased economies of business operation, and 4) increase the volume, visibility and/or access of pass-by traffic. Therefore, any analysis design should attempt to establish a causal linkage between highway changes and observed economic impacts by demonstrating improvement in one or more of these four areas.

- **Spatial Redistribution of Economic Activity –** A highway connection may also lead to economic decline in an area if that area loses business and labor to the place to which it is connected. For example, retail businesses that can benefit from pass-by traffic may spring up along a new highway corridor, while other businesses along old traffic routes may lose pass-by traffic and have to close down. Therefore the negative and redistributive impacts of a highway also need to be considered. Data collection, however, should be sufficiently long in duration to capture the long-term land use transformations stimulated by the highway investment. The closed pass-by retail activity along the old right-of-way, for example, may simply relocate and may transition to local-serving retail.

- **Distribution of Impacts Among Economic Sectors –** The impacts of a highway improvement may vary for different types of industries. For example, access to supplies and markets matters most to manufacturers, while for commercial businesses pass-by traffic can be more important. Therefore, a data collection and analysis design should examine differences in economic growth by type of business in order to accurately measure benefits and establish causality.

1.3.2 General Framework for Impact Assessment

Highway impact assessment has three parts: 1) measuring gross change in economic growth, 2) isolating the component of change that is over and above existing trends, and 3) determining causation between the highway and the economic change.

- **Gross Change in Economic Growth –** Economic growth does not take place overnight, but rather manifests itself in a series of steps. A typical progress may be: 1) property is purchased at higher prices; 2) construction begins as companies build new facilities or expand existing facilities; 3) businesses which benefit directly from improved access start to open up in the new and expanded facilities with additional jobs; and 4) ancillary business (i.e., suppliers to the directly attracted businesses or others attracted by the "agglomeration economies" of an emerging business cluster) follow and generate additional local economic activity. Since economic changes occur over time, the analyst should measure and observe the various economic impacts of a highway over a sufficiently long time horizon and use a diverse set of variables (e.g., income, output, jobs, property values, retail and wholesale sales).

- **Distinguishing Net Economic Change from Existing Trends –** Even though economic changes may follow a highway project, this could be a continuation of prior trends in an industry and geographic area, or a reflection of broad trends occurring across the state or nation. Therefore the analyst should compare trends before the project with trends after the project to distinguish the elements of change that differ from prior trends, and then compare them to the corresponding changes occurring in other similar areas (that did not receive highway improvements). In some cases it might also be appropriate to compare industry growth changes in the affected area to broader trends for those specific industries.

- **Establishing Causal Relationship of Highway to Economic Changes –** Even if there is a component of measured change that is not explained by prior trends or broader

changes also occurring elsewhere, the analyst cannot conclude that the highway is the sole reason for this change. There are three possible sources of information which can help establish causality between a highway and economic change: 1) statistical analysis of highway versus other factors driving economic change, 2) direct business surveys of perceived roles played by the highway and other factors, or 3) indirectly, through business customer surveys and shipping data to establish the extent to which business growth relies on the highway.

1.3.3 Prototype Study Areas

There is a relationship between the scale of impact studied and the primary measurement methods available. This is most apparent in the differences in analysis emphasis and data availability in three prototype studies – representing 1) region, 2) highway corridor, and 3) local community levels of analysis.

- **The regional prototype** is applicable for studying broad-area impacts of a highway corridor project that has a potential impact area at least the size of one county and possibly as large as a multi-state region. Regional impacts are most commonly measured using business establishments, employment, and income data, which are widely available for counties and aggregations of counties. Changes in these measures tend to occur over a long time horizon, and thus regional studies generally focus on long-term impacts (five to ten years or more following the highway improvement). In contrast, short- and medium-term impacts – those observable during or immediately following the highway improvement, such as property values and private investment – are not very easy to measure at a regional level. This is because these data must generally be gathered at a very local level, and the number of jurisdictions within a region will make collecting data for each locality within the region overly expensive and time-consuming.

- **The highway corridor prototype** is applicable for studying impacts of a highway project on adjacent businesses, including those located along the highway and at its interchanges (or intersections). Unlike the regional or town-level impact areas, the geography of a highway corridor makes it amenable to direct observations (i.e., windshield surveys) and direct distribution of surveys to selected businesses and their customers. Its geography, however, does not typically correspond to political jurisdictions (such as counties or towns), so published economic data are typically unavailable. Property transaction and development data also can be difficult to assemble if the corridor spans multiple communities.

- **The local community prototype** is applicable for studying small area impacts of a highway corridor project, in which the area being studied is a specific city or town, or a specific neighborhood within it (such as the downtown area). Measures of short-term and medium-term impacts, such as land sales and construction starts, are most easily available at the local level since only one jurisdiction may be involved. The longer-term impact measures of employment and income change, however, are typically less complete and less detailed at the local level, so studies at this level must rely more on business and customer surveys.

Each of the three prototype studies presented in this report focuses on issues, impact measures, and data sources that are most applicable for the given level of geography. However, these prototypes are not mutually exclusive, and a researcher may choose to use two or all three of the prototype methods in order to cover different levels of geography.

1.4 Report Overview

The sections of this report are as follows:

- Section 2.0 describes the *basic features* of any study that seeks to measure the economic development impacts of past projects;
- Section 3.0 presents a prototype data collection and analysis plan for studying *region-wide impacts*, which focus on a broad region served by a highway that is of the scale of a county or larger (including multi-county, state or multi-state regions);
- Section 4.0 presents a prototype data collection and analysis plan for studying *highway corridor impacts*, which focus on businesses located along an existing or new highway and its interchanges;
- Section 5.0 presents a prototype data collection and analysis plan for studying *localized impacts*, which focus on a community or neighborhood that is served, cut-through or bypassed as a result of a highway project; and
- Section 6.0 presents guidelines for the interpretation and application of findings from economic impact studies, regardless of the spatial level of measurement, and suggests directions for future research.

2.0 Basic Measurement Structure

2.1 Overview

This section describes the basic components needed to conduct a before-and-after measurement of the economic impact of built highways. It summarizes key factors to consider in any analysis, options for data collection, and steps needed to distinguish net effects attributable to the highway project. It focuses on six basic factors that must be addressed in any successful study of project impacts. They are:

- **Impact Measures –** There are several different measurement indicators of economic activity, spanning property values, construction, employment, and income. Although these indicators are often correlated, this is not always the case. It is important to understand the advantages and disadvantages of the various indicators for measuring changes in economic activity. The use of multiple indicators provides for a more thorough and robust understanding of economic changes, and can also help to identify structural changes in the mix of economic activity occurring. The selection of appropriate impact measures should also consider the purpose of the highway project (e.g., to promote economic development, reduce congestion, or the special needs of specific groups or areas) in order to distinguish direct success in achieving intended impacts from secondary impacts.

- **Data Sources –** Data sources for indicators of economic impacts include public data at the local, regional, state, and federal levels, and private data. Some data are published while others require direct observation, surveys, or interviews. Understanding the availability of data is an important part of designing an effective ex-post study of economic impacts.

- **Time Dimension –** Economic impacts of a highway project have a time dimension that is important to take into consideration during an ex-post study. Property transactions tend to be a leading indicator, followed by building permits, private investment and construction activity. This is followed later by jobs, income, and business establishments. Impacts must be measured over a time span that will most effectively capture the changes in each indicator. Failure to do so can result in measurement error – e.g., when a study concludes that there has been no significant job impact because it covered too short of a time period.

- **Spatial Dimension –** The geographic scale of study also is important, since it can affect the magnitude of observed impacts and the extent to which they reflect distributional shifts between areas. This issue is the basis of the three prototype studies, each of which represents a typical geographic scale of analysis. Different areas (e.g., regions, corridors, and towns) can have different needs and opportunities for economic development, and different levels of existing accessibility, that influence the nature of the impacts of a highway project. In addition, data availability differs depending on the

geographic scale of analysis. Therefore the issue of geographic scale should be made explicit, and different prototypes should be used to guide analysis of impacts on each level of study area.

- **Causality –** A simple measurement of the economic changes in an area before and after a highway project is not adequate to establish that the highway project had a causal influence on the economic changes observed in an area. Measuring changes in trends rather than levels, using comparison areas, and gathering behavioral information are all methods of developing a case for causality.

- **Analysis Methods –** There are different approaches to the analysis of project impacts, ranging from complex statistical models to straightforward survey comparisons. In fact, the choice of analysis methods is usually determined by the nature of the project, its spatial scale, its timing, and the nature of available data. The three prototype situations addressed in this report illustrate how analysis methods can be tailored to different situations.

The remainder of this section summarizes these basic factors and identifies their importance for analysis, as well as their constraints and requirements for measurement.

2.2 Impact Measures

There are many ways to measure economic impacts. The measures that have been used to assess economic impacts (as discussed in the literature review in Volume 1) include changes in the following indicators:

- **Property Demand Impact Measures**
  - Property transactions
  - Property values, prices or rents
- **Private Investment Impact Measures**
  - Building permits, construction activity
  - Capital investment
- **Business Growth Impact Measures**
  - Business establishments
  - Sales volume
  - Employment
  - Income

- **Other Impacts Measured in Prior Studies**
  - Population
  - Tax revenues

While these measures are generally correlated, each gives a different perspective on the economy of an area. Land transactions and prices are typically leading indicators in demand for locations, following transportation access improvements. Transactions and changes in price often imply that private investment in buildings is planned on that land. Private investment in buildings generally leads to construction and the opening of new businesses or the expansion of existing businesses. That, in turn, leads to employment growth. Increases in employment will generally be accompanied by increased income and business sales, leading to an increase in tax revenues. A growing economy also is generally associated with an increase in the population of the area.

Although these measures are all interrelated and often tend to increase or decrease together, this is not always the case. Sometimes one measure can increase while others are decreasing. For example, private investment could hypothetically be followed by a decrease in employment as labor is replaced with capital. Measuring changes in several indicators gives a broader picture of economic conditions and the economic impacts of highway investment.

Each indicator of economic impacts is useful in its own way. Jobs, for example, are a useful measure because they do not change with inflation variation, as do income, business sales, and property values. The prototype studies defined in this report are designed to reflect a broad use of these impact measures.

2.3 Data Sources

To collect information on the various impact measures discussed in Section 2.2, a variety of public and private data sources are available with different costs, timeframes, spatial detail and business sector detail. The various sources fall into four basic groups: 1) published sources available free from public agencies, 2) published sources available at a fee from private companies, 3) survey and interview data, and 4) site observation and field work. The major sources of data for each of the impact measures are examined in depth in the Volume I report and summarized in Table 2.1 and the text that follows:

Table 2.1 Sources of Data by Type

Type of Data	Sources of Data			
	Free Public Data	**Published (Fee/Private)**	**Surveys/ Interviews**	**Site Observation**
Property values	X	X		
Private investment			X	X
Employment	X	X	X	
Number of businesses	X	X		X
Business sales	X		X	
Income	X			
Population	X			

- ***Property values*** are not available from state or federal government sources; they must be obtained at the local level. There are three options for obtaining property values: assessed valuation, available from the assessor's office; sales prices, available from the registry of deeds; and current offering and sale/rental prices, available from local real estate agents. Assessed valuations tend to be a poor indicator of change over time, since they may be updated infrequently and often do not reflect the sales prices of properties in some states. Offering prices can vary a lot depending on the current competitive state of the local real estate market. Therefore, it is recommended that the actual sales prices or rental rates of properties be used as a measure of property values, when possible. Private real estate brokers and appraisers maintain databases of real estate transactions in order to help clients find, sell, or rent property. Although these databases are usually proprietary, clients of these brokers can request access.

- There are few good published sources of data on ***private investment*** in property development by new and expanding businesses. Data may be observed directly by the analyst or gained through discussions with developers, redevelopment agencies, lending institutions, economic development authorities, building industry associations, or a chamber of commerce.

- Data on ***employment, number of businesses, and income*** are published by several public agencies at the federal and state level, and by at least one private company (Dun & Bradstreet). However, the level of sectoral detail of employment data depends upon the geographic unit of analysis. Employment is the most widely used measure of economic impacts.

- Business surveys can be used to gather ***employment and sales*** information directly from business owners and operators. Surveys also can be used to collect information regarding the perceived impacts of highways on those indicators.

- Information on ***business sales*** is collected in the Economic Census with some delay in publication; sales volumes can also be calculated using information on retail sales tax revenue. Business sales can be especially useful for cases in which private investment is not accompanied by increases in employment, since business sales may still be increasing even as employment stagnates or decreases.

- ***Population*** data are available as published data with yearly estimates from the Census Bureau or from state demographic analysis agencies. Population increases generally indicate more employment opportunities. If possible, it is useful to analyze the change in population characteristics such as educational and skill levels in addition to raw population figures.

Published data sources, by themselves, are most often insufficient to portray the full nature of impacts that highway investments can have on economic growth. In particular, local changes in land prices, local construction (investment), and mix of economic activities locating along a highway corridor typically require data from local sources (e.g., property sale transaction data, building permits, newspaper clipping files, windshield surveys, business directories). In addition, to make the case that there is some causal connection between business growth and new highways, some statistical analysis may be required, which may in turn require survey data.

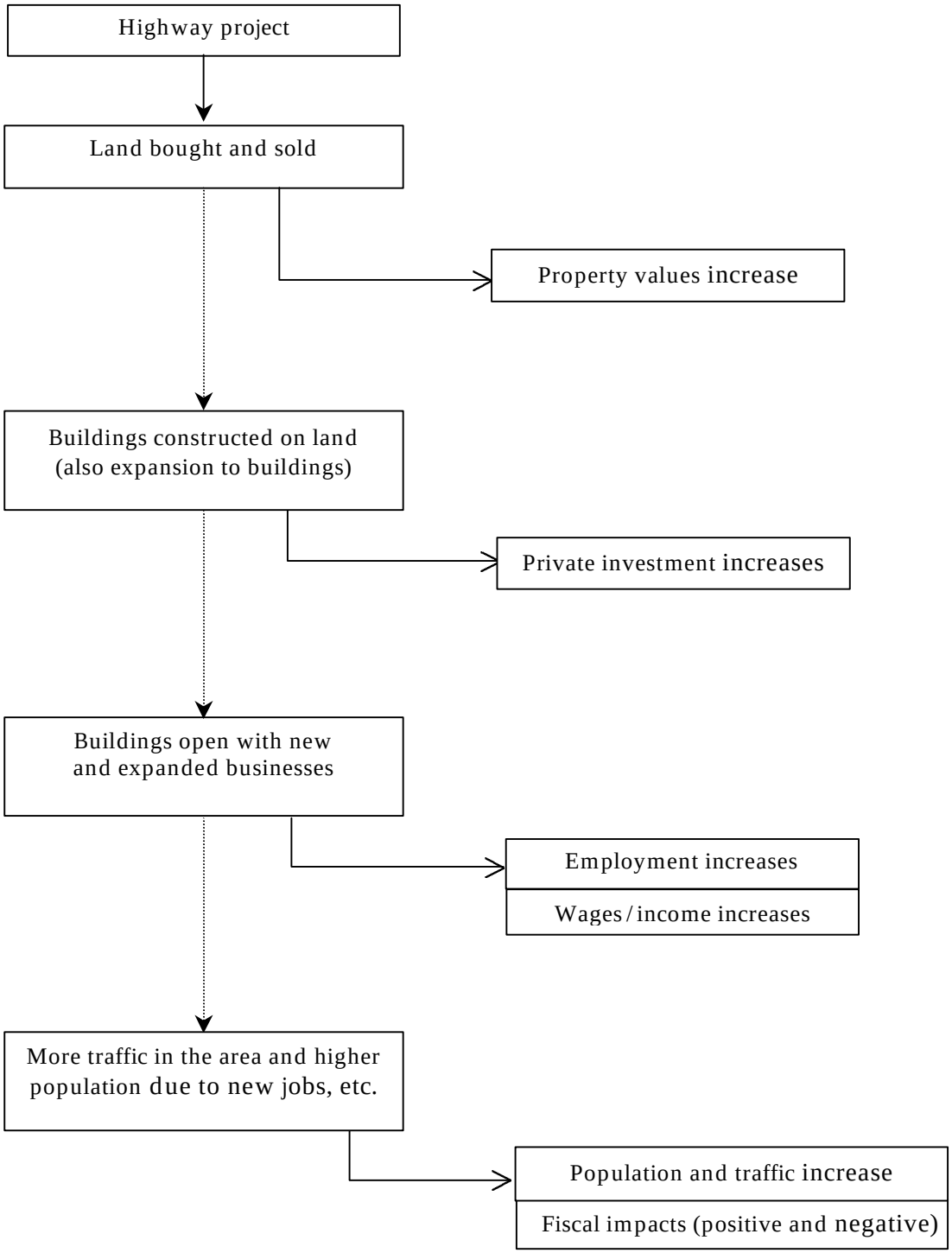
The availability of data on different impact measures depends on the timeframe and spatial area being studied. That is one reason why this report provides different prototype formats for using the various types of economic data in the analysis of project impacts.

2.4 Time Dimension

2.4.1 Process for Evolution of Impacts

The economic indicators discussed above tend to proceed in a general order in time, as illustrated in Figure 2.1. In the short term, property transactions tend to occur. In fact, an initial round of property transactions may occur in advance of a highway improvements, as speculators anticipate the impacts of a new highway. Once property is acquired by developers and businesses, physical structures may be built on that property. Once those structures are built, new businesses can open with increased employment, and other impacts may follow. As shown in Figure 2.1, the observable impacts may be classified into four general stages:

Figure 2.1 Example of Time Phasing for Economic Development Impacts



- **Stage 1 – Property Demand –** In the short term (starting within a year after or even prior to actual initiation of the highway improvement), property may start to be sold and purchased at higher prices by companies or individuals anticipating increased demand for the affected location.

- **Stage 2 – Building Construction –** In the medium term (typically starting within the first five years after completion of the highway improvement), construction may begin as companies locate new facilities or expand existing facilities to exploit better access to their markets and/or meet emerging demand for their services in that area.

- **Stage 3 – Business Growth –** In the longer term (starting within the first five years, but often extending 10 years or more after completion of the highway improvement), businesses start to operate in the newly constructed (or expanded) facilities and thus generate additional jobs in that area.

- **Stage 4 – Other Regional Change –** Ultimately, personal income levels may rise due to the increase in available jobs in the area, ancillary activities may co-locate with the initial business growth, additional population may be attracted to move in and local tax revenues may rise. Business activity may evolve as the area develops a new tourism base or new technology cluster, building upon market access changes made possible by the highway.

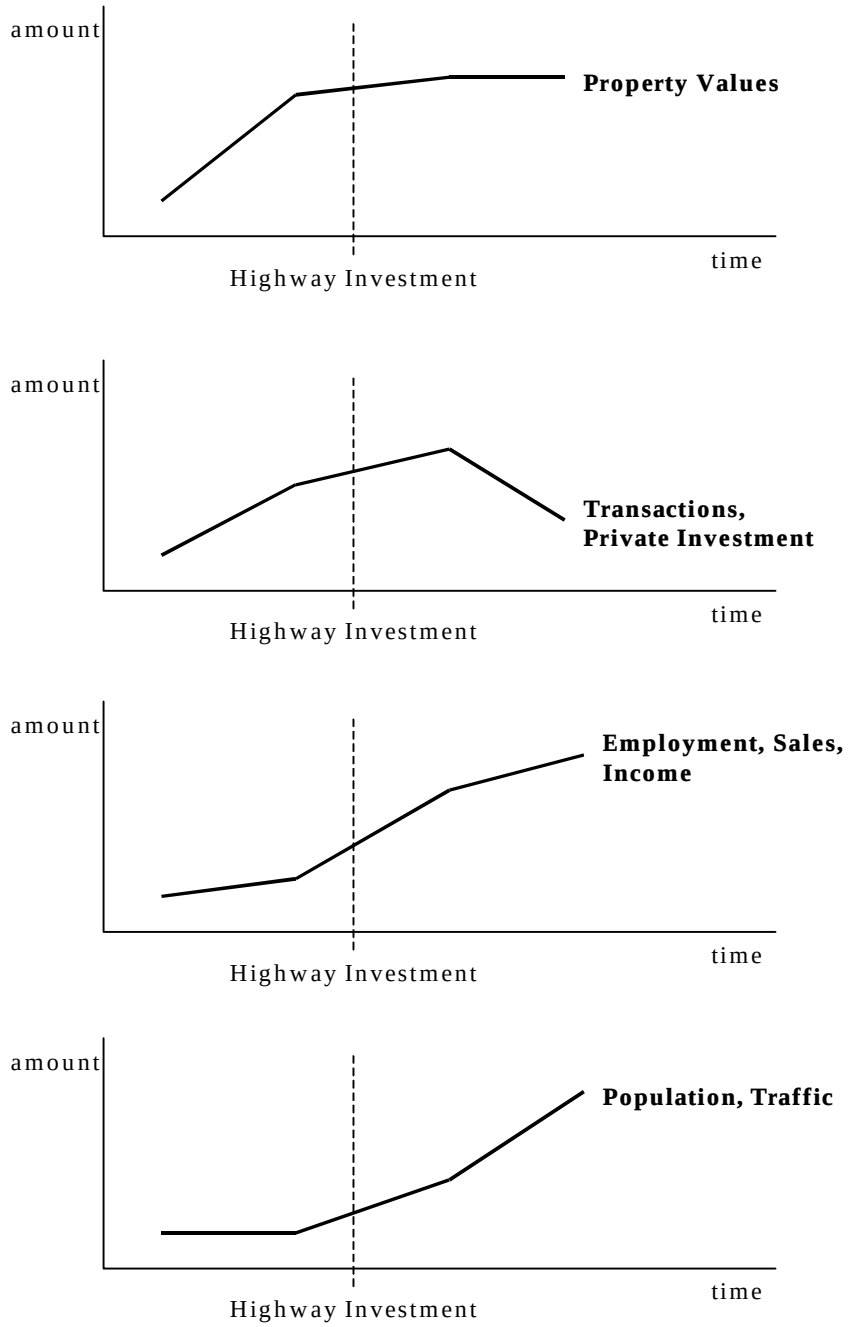
In several studies, the third stage took 10 or more years before there were measurable employment and income effects. In other cases, new jobs were added more quickly. In any case, since economic changes occur over time, it can be useful to observe the various types of highway impacts using different measures at different points in time.

Figure 2.2 provides an illustration of how the different changes might occur over time, based on measurement at four points in time (two before and two after completion of the project). In this hypothetical example of a new regional access highway, property values increase in anticipation of the completed highway improvements, and remain at a higher level. Transactions and private investment increase in the short term, about the time the highway investment takes place, as businesses begin to expand or relocate adjacent to the highway. Employment, business sales, and personal income increase later, after the highway improvements have been made and business expansions completed. Even after completion of the project, these measures continue to increase at a faster pace than prior to announcement of the highway improvement, due to the greater attractiveness of the region. Finally, population and traffic continue to grow as people are attracted to the region for its new jobs.

In some rural situations, highway improvements may be made in recognition of ongoing growth in an area, as a means of relieving or preventing congestion delay. Even then, the evolution of development and business growth may occur as described above.

The prototype studies described in Sections 3.0 through 5.0 reflect the fact that the small area impacts along a highway route can show up before broader regional impacts become measurable.

Figure 2.2 Hypothetical Timing of Impacts in Response to Highway Investment



2.4.2 Selection of Measurement Years

The analysis prototypes described in Sections 3.0 through 5.0 recommend that data collection of impact indicators cover *at least* four points in time: 1) at least one before

project construction, 2) at the time of project completion, 3) within a year after project completion to capture short-term effects, and 4) between five and 10 years after project completion to capture longer-term effects. These are minimums, based on the fact that it is frequently not possible to obtain data for multiple pre-project points in time, nor is it possible in many cases to commit to a data collection process exceeding a decade. For some project impact studies, it can be preferable to collect data for additional years, as discussed below.

Pre-Project Measurements. To ensure that pre/post trend comparisons are not distorted by business cycles or other anomalies, it can be advantageous to conduct data collection for at least two (rather than one) pre-project point in time. This helps insure against distortion of results by either accidentally or intentionally "fine tuning" the choice of observation years so that results better agree with prior expectations. However, when post-project impacts are measured 10 to 15 years after project completion, information on conditions 10 to 15 years prior to the project may not be available. There are likely to be many cases in which it is not possible to have the foresight to measure the economic indicators relevant to a highway study 10 or more years before the project is implemented, perhaps because the project has not even been conceived of or planned at that point. If published or other data are accessible for multiple pre-project periods, then it can be useful to compare pre- and post-project conditions and trends over equivalent time periods. However, this will not always be feasible.

Handling of Construction Period. The points in time at which indicators are measured for an impact study depend partly on the nature of the highway project in question. The prototype studies laid out in Sections 3.0 through 5.0 assume a relatively brief (e.g., one-year) construction period, and hence impacts are measured prior to project start and after project completion, but not during project construction. However, some projects will have a much longer construction period. If there is interest in trends during the construction period, then additional measurement of economic indicators should be made during this period.

Post-Project Measurements. To fully capture the evolution of Stage 3 and 4 effects, it may be necessary to conduct at least three (rather than just one) long-term follow up – e.g., data collection at five, 10 and 15 years after project completion. Depending on the area, a highway project may have immediate impacts, or it may be that impacts do not appear until more than 10 years after the project was completed. There is no prescription for how many post-project measurements to make and at what intervals; knowledge and observation of a particular project and project area are the only way to determine the appropriate and desired points in time to measure project impacts.

2.5 Spatial Dimension

Federal and state agencies have legitimate interests in both overall economic efficiency and localized economic growth or decline. They must therefore ensure that economic impact studies distinguish localized economic development impacts of highway projects on communities or along highway corridors from their broader state and national impacts. This can include (among others) highway effects relating to:

1. Impacts on *adjacent businesses* which receive increased income from pass-by traffic;

2. impacts on *nearby businesses* which can grow and realize productivity benefits from expanded access to labor markets, customer markets and / or supplier markets;

3. impacts on *more distant businesses* that use the highway, or businesses whose workers or suppliers or customers use it and realize reduced travel costs; and

4. impacts which are redistributions of business activity and income between nearby and distant locations, caused by shifts in traffic patterns.

Depending on the geographic area for which economic impacts of a highway project are being assessed, different input measures will be more or less easy to use, and the time-frame of impacts must be considered somewhat differently. This report presents three prototypes of geographic areas for impact analysis: a region, a highway corridor, and a town. These are illustrated by Figure 2.3, which shows a highway passing through three counties. The first graphic shows the area over which impacts would be assessed for a regional study; the second (which has two variations) shows the impact assessment area for a highway corridor study; and the third shows the impact area for a local community study.

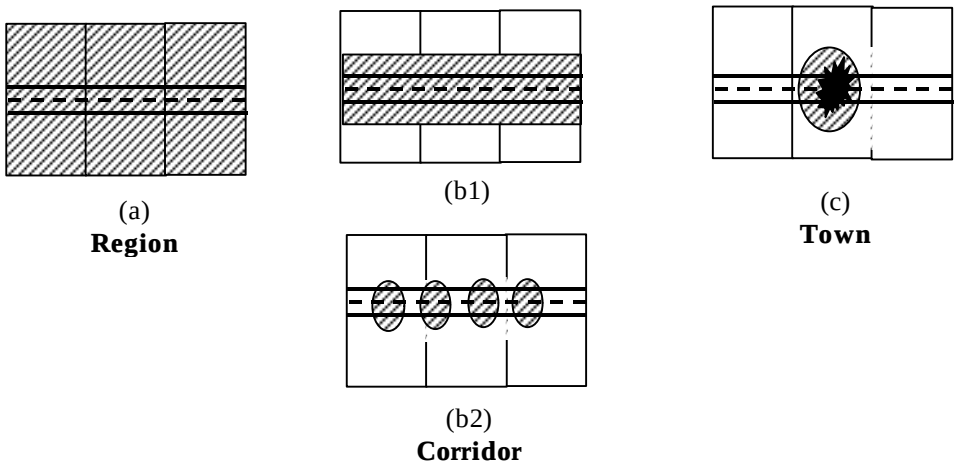
The choice of impact area is the first step in any economic impact study and depends on two factors:

1. **Jurisdiction of Policy Interest –** An analyst for a state government or for a multi-county agency might want to know the impacts of a highway project on a multi-county region. An analyst for a town or small localized area would be interested in the impacts of a highway project on that area. Another analyst might like to know what impacts occur along the land to either side of a highway corridor.

2. **Type of Project –** A large highway might affect a whole state or multiple states while a highway bypass or interchange might affect only one town or a single neighborhood.

Characteristics of the surrounding area also can influence the geographic scale at which impacts are measured. These include, for example, the population and employment patterns of the surrounding area and the existing transportation network. In an area with low population and employment, a highway project is likely to create impacts primarily along the corridor itself, particularly on businesses that serve pass-by traffic (e.g., truck stops, restaurants, gas stations, and motels). Therefore a study of the impacts on the area along the highway corridor may make the most sense. A highway project that bypasses a relatively isolated town may call for a study of the impacts on that town. Impacts may also evolve over a period of time such that, for example, they are first visible along a corridor and later can be measured regionally. Depending on the situation, and on the interest of the analyst, different geographic areas can be designated as study areas for measuring economic impacts of a highway project.

Figure 2.3 Prototypical Study Areas



(a) shows the impact area for a **regional study**, which covers all of the three counties that the highway is shown passing through. This means that the economic impacts of the highway project are measured and analyzed over three counties.

(b1) shows the impact area for a **highway corridor study**, which covers the area within a certain distance of the highway corridor itself and thus includes parts of three counties.

(b2) shows the impact area for a **highway corridor** study which focuses just on highway **intersections or interchanges**. This sort of a study is appropriate for limited access highways without driveways, as development will tend to occur at accessible points at and near the intersections.

(c) shows the impact area for a **local community study**, which measures the economic impacts of a highway project on one localized area which the highway passes through or makes more accessible.

The three prototypes of regional, corridor, and local community impact areas highlight the data constraints and opportunities for each of the three basic levels of analysis they represent. For example, a windshield survey is appropriate for a highway corridor impact study but probably would not be possible for a regional study. On the other hand, data on detailed industry employment breakdowns are readily available at the county level and thus easy to use for a regional study, but more difficult to assemble for a highway corridor, while local data are often available with little or no industry breakdown.

2.6 Causality

While it is possible to look at the before and after levels of indicators (e.g., sales, values, number of employees) and identify the extent of change before versus after the project, this approach by itself has been heavily criticized for failing to establish that the project was responsible for the observed changes. There are many reasons why an area's employment, population, property values, and other economic indicators can change over a period of time. One area could continue to grow at the same rate after a highway proj??ect, with no impact from the highway project. Another area might not have grown because a major employer withdrew for reasons unrelated to highway accessibility. Therefore it is highly useful to develop a causal theory that links the highway project to the economic changes observed and measured in an area.

There are three aspects of establishing causality: 1) gross change trends, 2) net impact comparisons, and 3) behavioral cause:

- ***Gross Change Trends – Was there a change between pre-project economic growth and post-project economic growth?*** Comparing only levels of an indicator before and after a project does not control for the possibility that the growth rate in the indicator could have been positive prior to the project, and thus that the increase in the indicator's level could have nothing to do with the highway project. By comparing the change in that growth rate over time for indicators such as employment, it is possible to see if there is a post-project difference in how quickly an indicator is changing.

- ***Net Impact Comparisons – Is the growth in the study area any different from what was happening in other comparable places?*** Comparing the study area to other areas helps to control for the larger economic trends responsible for some of the economic changes in the area. If the study area grew much more than comparable areas since the highway was completed, and there is no other major factor that also changed over the same time period, then it is possible that the highway project was indeed responsible for additional growth in the study area.

- ***Behavioral Cause – Why is growth different after the project and different from other areas?*** The finding of a net difference in economic growth associated with completion of a new highway does not in itself prove that the highway was the cause of that difference. There are two additional pieces of evidence that can help establish a true causal relationship. One is the "informed judgment" of local experts. Local community and business leaders who have observed the changes in the study area can provide valuable insight into the process of change, and help establish the extent to which the highway project was responsible for the area's economic changes. The other type of evidence is "highway dependence" – a finding that the timing and location of the business growth is consistent with highway impacts, and that the affected businesses do in fact depend on the road for some aspect of their customers, deliveries and/or workforce access.

The "highway dependence" aspect of causality focuses on the ability to show how the economic impacts link back to changes in highway use. These linkages may include:

- Creating new or improved connections for existing car and truck travel, leading to savings in expenses for individuals and businesses;

- Expanding the breadth of customer, labor or supplier markets, leading to additional market access for businesses (increasing productivity from scale and agglomeration economies) and personal opportunities for jobs and shopping (also leading to increases in income); and

- Shifting travel and activity patterns among alternative origins, destinations, and travel corridors, leading to net benefits to highway users and distributional changes (losses as well as gains) for businesses serving these users.

Business surveys or interviews, together with travel data, may be used to establish such links.

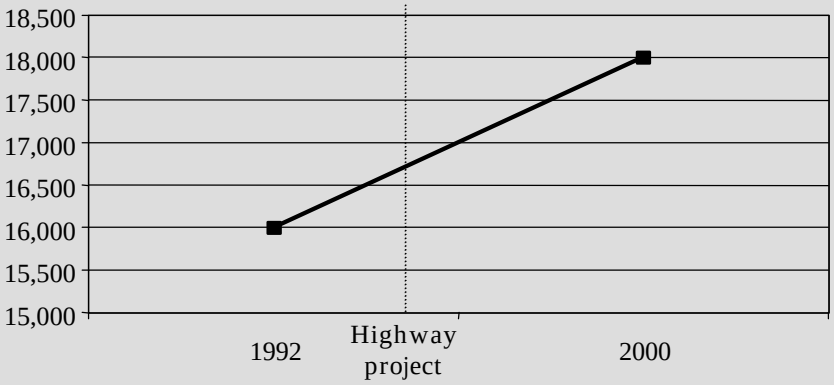
To address these multiple needs to measure trends, compare areas, and establish behavioral connections, this report presents methods for each of these aspects of impact analysis. The information developed through the use of these methods can be used to allocate a portion of the observed pre-post economic change to the highway project.

Example 2.1 is a fictitious case, named "Anytown, USA," which illustrates the pitfalls of not conducting a complete analysis that accounts for the various causes of economic change. The explanation for a change in employment in the vicinity of a highway project will rarely be as simple as Mr. Straightshooter's explanation in this example. However, the work of Mr. Straightshooter and Mr. J.T. Analyst illustrates both the pitfalls of a narrowly focused analysis and the benefits of using multiple data sources and methods. A comparison of employment across four time periods and four different geographic areas helped to isolate the effects of regional and industry trends from the effects of the highway improvements. Furthermore, discussion with a major local business helped to determine the extent to which the highway improvement was actually responsible for observed increases in employment. In a real-world study, analysis of employment trends by industry and geographic area, combined with additional interviews of local businesses and economic development officials, would further verify the extent to which the highway improvement led to changes in local and regional employment.

Example 2.1 Interpretation of Results from Different Measurement Approaches – Pitfalls of an Incomplete Data Analysis

Part 1: Before-After Comparison (two points in time). A highway interchange was added to Route 4001 in Anytown, a small town in Tennessee, in 1994. Mr. J.T. Analyst compared the number of jobs in Anytown in 1992, two years before the interchange project, to the number of jobs there in 2000, six years after the project. This comparison showed that the jobs in that community had increased by 2,000 (a). Mr. J.T. Analyst concluded that the interchange project resulted in 2,000 new jobs in Anytown, because the employment level increased by 2,000 jobs.

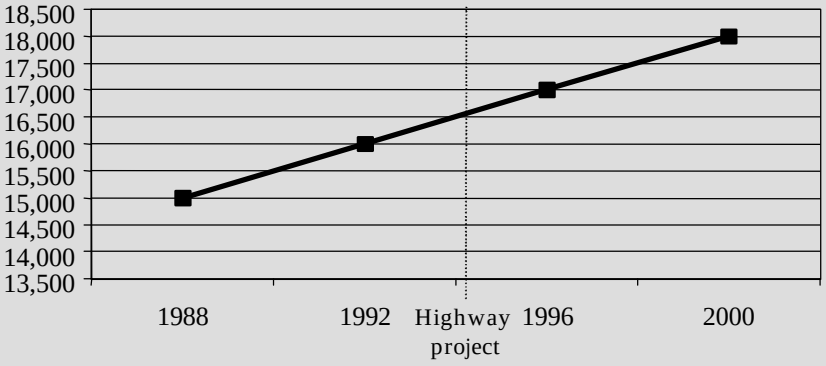
a. Two-Point Comparison of Employment in Anytown, TN



Year	Employment
1992	16,000
2000	18,000

Part 2: Analysis of Trends (four points in time). J.T.'s arch nemesis, Mr. R.V. Straightshooter, gathered employment data for four points in time, two before and two after the project (b). Mr. Straightshooter found that while employment had increased by 2,000, this was in line with the growth rate of employment before the project; that is to say, employment trends had not changed since before the highway project. Therefore, Straightshooter concluded that the highway project was not responsible for the increase in employment.

b. Four-Point Comparison of Employment in Anytown

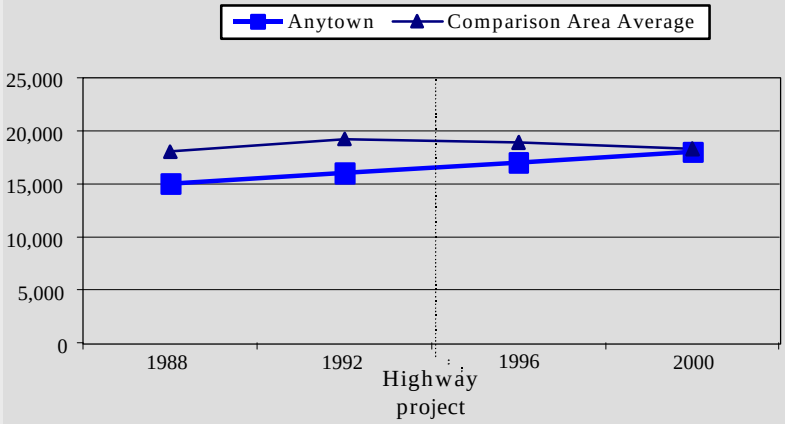


Year	Employment
1988	15,000
1992	16,000
1996	17,000
2000	18,000

Example 2.1 Interpretation of Results from Different Measurement Approaches – Pitfalls of an Incomplete Data Analysis *(continued)*

Part 3: Comparison to Other Areas. J.T. Analyst then did more research and found that employment in the broader region encompassing Anytown had a downturn in 1994, followed by continuing decline (c). The fact that Anytown's employment continued to grow at the same rate meant that there was, in fact, an improvement in Anytown over what would have otherwise been expected to occur. He chose three towns similar to Anytown but without highway interchanges, and compared the average rate of employment growth in those towns to employment growth in Anytown before and after the highway project. He concluded that the highway interchange project had indeed been responsible for net employment growth in Anytown between 1996 and 2000, compared to what otherwise would have been expected.

c. Anytown and Comparison Area Employment Trends



Area	Employment Growth Rate	
	1988-1992	1996-2000
Anytown	6.7%	6.7%
Comparison Areas Avg.	6.7%	-3.2%

Part 4: Interviews with Local Experts. Mr. Straightshooter, however, decided to make sure. He went to the local economic development department and the local chamber of commerce, and asked questions about what had changed since the highway project. He found out that a large company had moved into the area in 1993 and hired 1,000 employees. The company had then expanded in 1997, hiring another 500 employees. Mr. Straightshooter went to the company and interviewed the president, asking him questions about why he moved to the area and what role the highway interchange had in his subsequent expansion. The president said that he had moved his company to the area because he had wanted to live in the same state as Nashville, since he harbored secret desires to be a famous country singer someday. He said that he did not know that the highway interchange was going to be build the year after he moved his company to Anytown, but that the interchange had made it easier to attract employees from Fruitland, a few miles down the road, and so he had expanded the company and hired 500 additional employees. Mr. Straightshooter thus concluded that only 500 of the 2,000 new jobs in Anytown could be attributed directly to the highway.

2.7 Prototypes for Analysis Methods

There is a relationship between the scale of an impact study and the primary measurement methods appropriate for the study. This is most apparent in the differences in analysis emphasis and data availability in the three prototype studies representing region, corridor, and local community levels of analysis. Table 2.2 summarizes these relationships. It shows that small-scale projects lend themselves to small-area impact studies – where short-term impacts on property transactions and construction activity are easiest to obtain. It also shows that larger-scale projects lend themselves to wide-area impact studies – where longer-term impacts on employment and business sales tend to be easiest to obtain.

Table 2.2 Differences in Emphasis and Data Availability between Three Prototype Study Areas

	Regional Study	Highway Corridor Study	Local Community Study
Most Applicable Type of Project	Major statewide or interstate corridor	Short distance highway	Bypass or new access route
Scale of Study	County or multi-county	Custom area, multi-jurisdiction	Town or neighborhood
Comparison Areas	Other regions (counties)	Surrounding areas (e.g., rest of county)	Other towns or neighborhoods
Impact Data Collection Methods	Published data, state/county data	Business interviews and surveys	Published data Local government data
Causality Data Collection Methods	Expert interviews, business surveys	Expert interviews, business surveys, customer surveys	Expert interviews, business surveys
Impact Period Focus	Long-term	Short-term	Medium-term
Impact Measures: **A** = readily collectable, *B* = difficult but possible, *c* = not usually possible			
Property Sales, Prices	*B*	**A**	**A**
Construction Activity	*B*	**A**	**A**
Business Establishments	**A**	**A**	**A**
Sales Volume	**A**	*B*	*B*
Employment	**A**	*B*	**A**
Income	**A**	*c*	*B*
Population	**A**	*c*	A
Tax Revenues	*B*	*c*	**A**

Each of the three prototypes, described in detail in Sections 3.0 through 5.0, focuses on the issues, impact measures, and data sources that are most applicable at that level of geography. These prototypes, however, are not mutually exclusive. In other words, a researcher or agency does not have to select just one prototype method or approach for the analysis of any particular highway project. Rather, it is quite possible to have a hybrid study which 1) utilizes the region prototype for studying long-term, wide-area impacts, 2) utilizes the corridor prototype for studying impacts along the highway itself, and/or 3) utilizes the local prototype for studying short-term, localized impacts.

Regardless of the spatial scale, timeframe or type of impact being measured, there are certain analysis requirements that are necessary to establish: 1) whether measurable changes occurred and 2) whether they were due (in part or in whole) to the highway proj??ect. Those requirements, reflected in the three prototype studies, are:

- ***Time Series Data (for Gross Impact Measurement) –*** representing conditions or trends for times both before and after the project is completed (with pre-project data collected either before the project or retrospectively after the project);

- ***Comparison Base (for Net Impact Calculation) –*** representing trends over the same time period for some other area (this could be accomplished through matching data for a specific comparison area, or through statistical controls to adjust for differences between areas); and

- ***Behavioral Base (for Assessing Causal Roles) –*** distinguishing the effect of the highway project from that of other factors occurring over the same time. (This could be accomplished through qualitative survey or interview data from informed observers, or through empirical data concerning changes in highway reliance and use.)

2.8 Other Considerations

The prototype studies describe basic requirements and methodological options for assessing the impacts of highway investments on various measures of economic development. The goal of these studies is to improve the methods used to conduct local and regional assessments of the economic impacts of transportation projects. The studies do not address the *desirability* of the economic impacts that occurred, or whether the investment was worth making. While it is beyond the scope of this report to discuss these issues in detail, some additional questions that might also be relevant for analysis include:

- *What types of jobs were created, and how did they relate to the skills of the area's workforce*? For example, in an area with a historically strong base of manufacturing industries, high-skill manufacturing jobs may be seen as more desirable than additional jobs in the retail sector.

- *What other impacts occurred*? Highway user benefits, especially time savings, are likely to be partially but not fully captured in the measures of regional economic benefits. Additional development will have fiscal implications for local government, as a result

of additional tax revenues as well as need for additional service provisions. The net impact on local government revenues may be either positive or negative. Land use and environmental impacts associated with development also may be important to assess.

- *How did the net economic benefits compare to the costs of the project*? If a highway project was justified primarily on economic development grounds, it could be useful to evaluate the return on the investment, and whether it was reasonable compared to the expense. However, this is difficult because it could take 10 or 20 years, or more, before the full economic impacts of a highway are realized. In most cases, the highway is likely to have been justified by other considerations in addition to economic development, such as mobility and safety.

- *What other economic development strategies might be considered in conjunction with – or as an alternative to – the highway investment*? For example, could other infrastructure investments (e.g., water and sewer), a regional marketing campaign, or workforce training programs also lead to an increase in jobs, income, etc.? Could those strategies, in combination with a new highway, potentially result in a much better return than a highway alone?

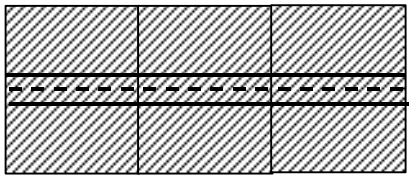
Depending on the context of the study, some consideration of these other issues can be important, in addition to the measures of overall economic growth and change which are the subject of this guide.

3.0 Regional Study Prototype

3.1 Applicable Situations

The regional prototype is applicable for studying broad-area impacts of a highway corridor project that has a potential impact area at least the size of one county and possibly as large as a multi-state region. The example offered here is for a three-county corridor within a single state (Figure 3.1). This type of study area is typical for major highways projects that serve multiple communities and the rural areas between them. It is not applicable for studying local impacts, which could apply to individual towns, their downtowns or neighborhoods, strips of land adjacent to highways, or areas adjacent to highway interchanges.

Figure 3.1 Regional Study Example



(Regional study area encompassing three counties through which the new or improved highway passes)

There are necessarily tradeoffs involved in studying a broad area rather than a local area. Business employment and income data are widely available for counties and aggregations of counties. Short- and medium-term impacts such as initial changes in property values and increases in private investments, though, are not practical to measure at a regional level because these data generally must be gathered at a very local level and the number of jurisdictions within a region will make collecting data expensive and time-consuming. Nevertheless, long-term impacts (e.g., business establishments, employment, and income) can be assessed at the regional level at a higher level of detail than at the corridor or local levels. Thus, regional studies tend to focus on measuring these long-term impacts of highway projects.

3.2 Measurement of Gross Change

The measurement of gross change represents the difference between post-project conditions and pre-project conditions. For a regional study, the calculation of change should at a minimum quantify the change in the number of business establishments, employment, and payroll. Ideally, it should include data from a minimum of four points in time:

1. Conditions prior to any real estate or investment speculation during the pre-project period;

2. Conditions at the start of construction to capture the amount of speculation;

3. Condition within a year after the project completion to measure the short-term impacts, and

4. Conditions roughly five to 10 or more years after project completion to assess long-term adjustments.

It would then be possible to establish the direction and magnitude of economic changes and isolate specific phases of economic impact. For a regional impact study, these measures typically have the following availability:

- *Short- and medium-term impacts* on property transactions and construction activity can be obtained at a county-wide level (or summed from property sales and construction permit data supplied by local government agencies), but these types of impacts are expected to be highly localized near the highway and thus of interest primarily at the local rather than the regional level of analysis. It also can take substantial effort to collect such data at a regional level if the information has to be assembled from many local jurisdictions.

- *Long-term impacts* can be measured in detail, as data on employment, business establishments, sales, and income are available by detailed industrial sector at the county-wide and larger level.

For use with county business data, Table 3.1 shows an example of a gross impact data collection form for tracking pre-post business changes. It is equally applicable for data on the number of business establishments, business output, value added, employment, or payroll, all of which are readily available for counties in the U.S. When possible, it is desirable to have the data stratified by type of business. That can be very important, since a highway proj??ect can help some kinds of business, hurt others and be irrelevant to yet others.

Table 3.1 Sample Summary Data Collection Form for Regional Impact Measurement

Category	Before2	Before1	After1	After2
Construction Starts (# / yr.)	124	118	140	350
Capital Investment ($millions / yr.)	160	142	269	800
Population (thousands)	156	157	163	195
The following indicators can be measured in aggregate as well as stratified by business type (see Table 3.3)				
Employment (thousands)	85	86	88	100
Income ($millions)	3,825	3,870	3,650	4,800
Business Establishments (#)	5,500	5,520	5,866	6,000
Sales Volume ($millions)	4,850	5,980	6,840	8,400

In Table 3.2, the data form is filled in with employment data (obtained from County Business Patterns) stratified by business type for a two-county area in New York. The form is applicable for employment, payroll, output, value added, and number of establishments.

Table 3.2 Sample Data Collection Form for Measuring Employment by Business Type

		Employment			
SIC	Industry	Before2	Before1	After1	After2
7-9	Agricultural services, forestry, fishing	105	100	95	90
10-13	Mining and extraction	200	200	200	200
14	Nonmetallic minerals, except fuels	18	18	18	18
15	General contractors	2,400	2,320	2,630	3,270
16	Heavy construction	730	710	760	880
17	Special trade contractors	6,010	5,990	5,907	6,050
20	Food products	14,350	14,310	14,400	17,500
Etc.					

3.3 Comparisons to Establish Net Change

3.3.1 Basic Methodology

The measurement of net change represents the adjustment for underlying changes that would have happened anyway, without the highway investment. There generally are four ways to accomplish this adjustment:

1. **Matched Areas –** The first type of comparison is to a similar area to the project impact study area in characteristics such as geographic scale, population density, industry mix, and proximity to a metropolitan region. (Reference Example 3A on page 3-8.)

2. **Surrounding Areas –** The second type of comparison is to an area immediately adjacent to the study area. Often, trends in the project impact study area are compared to the "rest of the state," or to the "rest of the state outside of its large urban areas." (Reference Example 3B on page 3-8.)

3. **Statistical Controls (Regression) –** The third type of comparison does not seek to select strictly similar areas or adjacent areas. Rather, it seeks to obtain trend data for many different areas, and then utilizes statistical methods (usually multiple regression analysis) to separate out the impacts of demographic and economic factors from impacts of the highway. This type of analysis is, in effect, comparing observed economic trends in the study area (after completion of the new highway project) to a statistically–created trend line that represents what would have been the expected trend for that study area without the highway. (Reference Example 3C on page 3-8.)

4. **Structural Economic Models –** The fourth type of comparison makes use of an economic simulation model, working with observed data on state and national trends, to estimate what would have been the *expected* trends for that study area without the highway. The model then compares that expected trend to the observed, actual economic trends in the study area (after completion of the new highway project). (Reference Example 3D on page 3-9.)

There are pros and cons regarding each of these four comparison approaches, as discussed in the Volume 1 report, and there is currently no consensus regarding the "best" approach. The approach that is used is often dictated by the constraints of data and resource availability. (Further details about the specification and application of these four approaches is available in the studies which cited in the literature review and discussed in the Volume 1 report.)

Regardless of which of these four comparison approaches is used to estimate net impacts, it is still necessary to collect parallel information on indicators of economic growth and change (as shown previously in Tables 3.1 and 3.2) for other area(s). That information can then be used either for direct comparison or as the basis for a statistically adjusted comparison.

3.3.2 Net Change Calculation

Table 3.3 illustrates how this comparison process can distinguish the observed trend in the highway impact area from the expected trend over one time period. (In a full study, this process would be repeated for multiple time periods.) In this example, the basic data are the **observed change** in employment (in each industry) in the study area over a given time period (columns 3 and 5), plus corresponding data for other areas over that same time period (column 4). As previously noted, the **"comparison"** trend from other areas (column 4) could be either 1) the actual change observed for one or more other areas, or 2) a statistically calculated trend derived from observations of other areas. Either way, the comparison data is used to calculate what would have been the **expected change** in employment in the study area if it had exhibited the comparison trends (column 6). If this analysis is being conducted for a post-project time period, and the comparison trend is considered to represent what would have been expected to occur in the study area without the highway project, then the difference between observed and expected changes (column 7) could be interpreted as the difference attributable to the highway project.

Figure 3.2 graphically shows the percentage change in employment in a given industry for the *Study Area* (line labeled as "SA") and the *Comparison Area* (line labeled as "CA") over a period from before the project (labeled as "B1") to after completion of the project (labeled as "A1"). These examples show that a *positive* impact could come from either larger than otherwise-expected growth in the study area (graph "a") or smaller than otherwise-expected loss in the study area (graph "b"). Similarly a *negative* impact could come from either smaller than expected growth (graph "c") or larger than expected loss (not shown). With a more sophisticated analysis of five points in time (as recommended), short-term impacts can be further differentiated from long-term impacts, as shown in graph "d."

Table 3.3 Example of Regional Trend Comparison for One Time Period*

SIC (1)	Industry (2)	Percent Change		*Observed* Change in Study Area (5)	*Expected* Change in Study Area (6)	*Deviation* from Expected Change (7)
		Study Area (3)	Comparison (4)			
7-9	Agriculture, forestry, fish	-5.26%	-2.00%	-5	-2	-3
10-13	Mining and extraction	0.00%	0.00%	0	0	0
14	Nonmetallic minerals	0.00%	0.00%	0	0	0
15	General contractors	24.33%	10.00%	640	263	377
16	Heavy construction	7.03%	5.00%	130	93	38
17	Special trade contractor	2.42%	2.00%	143	118	25
20	Food products	21.53%	10.00%	3,100	1,440	1,660
	Total	**15.97%**	**7.62%**	**4,008**	**1,912**	**2,096**

(3) This is the percentage change in each indicator taking place within the **study area**, over the given time period.

(4) This is the percentage change in each indicator taking place for the **comparison** situation over the same time period, where the comparison situation is either (a) the actual change observed for other areas (either matched areas or surrounding areas), or (b) a statistically-calculated trend derived from the observations of those other areas.

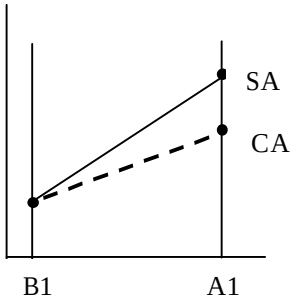
(5) This is the **observed (actual) change** in each indicator within the highway impact study area, over the given time period.

(6) This is the **expected change** in each indicator within the highway impact study area, over the given time period. It is calculated by applying the percentage change for the comparison situation (column 2) to the actual starting year employment in the study area.

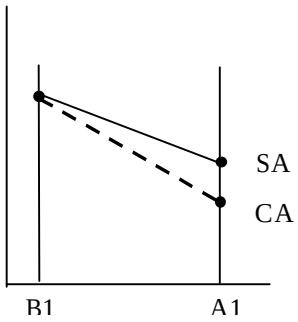
(7) This is the **difference** between the observed change in the study area (column 3) and the expected change in the study area (column 4).

*Notes: In this illustrative example, study area changes were obtained from values in Table 3.2 for the After-1 versus After-2 time period. Comparison area changes also are hypothetical.

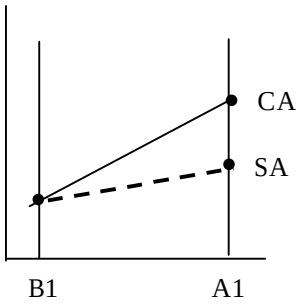
Figure 3.2 Possible Outcomes of a Comparison



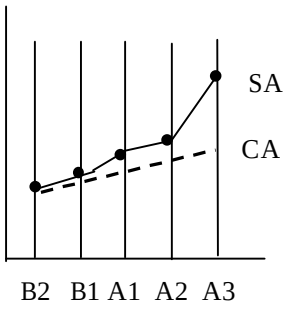
(a) Positive Impact: study area growing more quickly than comparison area



(b) Positive Impact: study area declining, but less quickly than comparison area



(c) Negative Impact: study area growing, but less quickly than comparison area



(d) Rate of growth of study area increasing relative to comparison area

3.3.3 Examples of Methods for Deriving Net Changes

Example 3.1 illustrates applications of the four methods for net change analysis. Examples a, b, and d are excerpted from Weisbrod, Glen: *Current Practices for Assessing Economic Development Impacts from Transportation Investments*, National Cooperative Highway Research Program Synthesis 290.

Example 3.1 Deriving Net Change in a Regional Comparison

a) Regional Comparison to Matched Areas (Control Group)

Rephann, Terance J. and Andrew M. Isserman. *New Highways as Economic Development Tools: An Evaluation Using Quasi-Experimental Matching Methods*, Regional Science and Urban Economics 24:6, 1994.

The purpose of the study was to measure the economic growth impacts of the Appalachian Regional Commission (ARC) and its Appalachian Development Highway System (ADHS). The researchers identified 391 counties in the Appalachian region, and for each one, a county outside of the Appalachian region which was matched to be its nearest twin in terms of population, economic profile, income level, distance from larger cities and access to interstate highways as of 1959. These twins represented a control group. The study then tracked the income growth of the Appalachian and control counties over a period preceding the start of ARC programs (1959-1965), during the initial start of ARC programs (1965-1969) and subsequent 21 years (1969-1991) during which there were continuing ARC investments in highways and other programs. It further distinguished counties that had an interstate highway and those that had Appalachian Development Highways built during the period.

b) Regional Comparison to Surrounding Areas (State and National Trends)

Lower Mississippi Delta Development Center, Inc., *Linking the Delta Region with the Nation and the World*, 1995; and update report, Federal Highway Administration, 1996.

The purpose of the study was to measure the economic development impacts associated with a series of highway, seaport, and railroad improvements made in the Mississippi Delta region between 1990 and 1995. The study examined the rate of growth in regional employment from 1990 through 1995 for all counties within the Mississippi Delta Region, and compared them to changes occurring for the rest of the seven-state region, as well as at the national level. The study also recorded changes in labor force, unemployment, gross domestic product, population, international visitations, state tourism, public roads, miles of state roads, annual vehicle miles of travel, motor fuel tax rates, capital outlays for roads and port tonnage.

c) Regional Comparison Through Statistical Controls (Regression)

Aldrich, Lorna and Lorin Kusmin. *Rural Economic Development: What Makes Rural Communities Grow?*, Agricultural Information Bulletin 737, Economic Research Service, U.S. Dept. of Agriculture, 1997.

The purpose of the study was to assess the relative roles of highways and other public policy factors in promoting rural economic growth. The study examined 2,346 non-metropolitan counties, and for each one, it tracked annual rates of income (earnings) growth among 75 industries and seven occupational categories from 1979 to 1989. The study then used regression analysis to statistically measure the strength of relationship between those measures of income growth and various explanatory factors for each county. The explanatory factors included: interstate highway access, intersections of major U.S. highways, airport access, tax rates, wage levels, unemployment levels, education levels, proximity to higher education, per capita family income, population density, energy prices, industry mix, labor productivity, retirement population, right-to-work laws, average temperature, and public education expenditures. The regression results indicated the incremental impact of interstate highways and airports for these counties, holding all other factors constant.

d) Regional Comparison Through Economic Models (REMI)

Wilbur Smith Associates, Appalachian Development Highways Economic Impact Study, prepared for the Appalachian Regional Commission, July 1998.

The purpose of the study was to measure the extent to which the completed portions of the Appalachian Development Highways System (ADHS) have contributed to the economic well-being of Appalachia. The researchers used a special version of the REMI forecasting and simulation model, which was designed to allow for "backcasting" of prior year scenarios under alternative assumptions – a necessary step to estimate how past regional economic growth would have been different had the ADHS never been built. The study estimated the difference in travel efficiencies and business cost competitiveness that would have not occurred without completion of segments of the ADHS, and then used the economic simulation model to calculate implications for the region's economy.

3.4 Behavioral Data to Establish Causality

The comparisons described in Section 3.3 establish the magnitude of net economic growth coinciding with the completion of highway projects, which are not explained by local area characteristics or broader economic trends. However, that does not prove that the highway projects *caused* the resulting impacts. In fact, the example offered in Section 2.0 illustrated that economic growth could also occur due to other factors not connected with the highway.

Actual cause-and-effect can be demonstrated by assessing: 1) perceptions of local economic development experts, and/or 2) perceptions of new and pre-existing businesses regarding the highway reliance of particular businesses. The first approach requires interviews with individuals known to have a sound understanding of economic development within the region, while the latter requires surveys of key regional businesses. The two approaches are not mutually exclusive. Either can be used to help determine the portion of observed change which is due to the highway project. They can be used in combination to "triangulate" the magnitude of credit due to the highway, and to provide greater confidence about the finding of highway impact.

3.4.1 Interviews with Economic Development Experts

For a major highway project, county and state economic development officials, and in some cases also regional economic development officials, can be interviewed to provide a perspective concerning:

- The region's degree of success in retaining, expanding and attracting business;
- Factors enhancing or constraining further success in those goals;
- Whether changes in those conditions occurred following completion of the highway project;
- The factors which together caused those changes, and the relative importance of the highway project itself in making them occur;
- The sources of any business attraction (i.e., whether gains in the study region offset by losses in other regions); and
- Names of key businesses which have expanded, contracted or been attracted to the area, and names of their staff contacts who can attest to the role of the highway and other factors in constraining or enhancing business opportunities.

Figure 3.3 provides a sample *interview guide* that lists the type of questions to be covered in an interview of state, county or regional economic development officials. The actual interview can follow a wide range of possible formats. It can be conducted in the form of a personal meeting, telephone discussion, group roundtable discussion or formal focus group.

3.4.2 Interviews of Key Regional Businesses

Formal mail-back surveys of area businesses are most practical as a means of studying highway impacts when the impact area is a well defined and limited size area such as a strip of land (corridor) or a local community. They are often not practical for county, multi-county or statewide areas due to the much larger number of potential businesses involved. In these latter situations, the interviews of economic development officials can help identify *key businesses* which have expanded, contracted or been attracted to the area, and names of their staff contacts. In some cases, a regional or state economic development authority also may maintain a database of business attractions and expansions. That information can then be used to set up personal or telephone interviews with those business representatives, and to query them about the relative role of the highway and other factors in affecting their business expansion, contraction or market/location decisions. These interviews can provide information on:

- Business ratings of the regional factors constraining or enhancing their continuation and expansion opportunities (including role of the highway among those factors);
- Actual business growth/decline changes over the pre-/post-highway periods, and the reasons for those changes (including role of the highway among those reasons);
- Changes in business focus and competition over the pre-/post-highway periods, and the reasons for those changes (including role of the highway among those reasons);
- The extent of changes in reliance on the highway corridor for labor access, supplier access or customer deliveries (and the role of the highway in those changes); and
- The area's non-transportation constraints that would need to be resolved to allow the highway investments to provide the maximum effects.

Figure 3.4 provides a sample interview guide for key businesses in the region. This version focuses particularly on the impacts to industrial businesses, although it can be applied to any large business. (A separate mail-back survey form for local businesses is provided in Section 5.0.) Interviewing should consider time constraints and also the proprietary nature of business information.

Figure 3.3 Interview Guide for State and Regional Economic Development Officials

Interviewer _____
Date _____

1. Name and Title of Interviewee: _____
2. Name of Organization: _____
3. Address: _____
4. Phone: _____
5. Purpose of Organization: _____
6. Jurisdiction: _____

General Description of Business/Economic Base

7. What are the major industries in the region / along the corridor?

8. Who are the biggest employers?

9. a) How is the region's economy changing?
   b) What forces are responsible for these changes?

Existing Business

10. a) In your view, what types of existing businesses in the region have benefited most from the highway improvement, considering only the time since construction ended? How have they benefited?

    b) In your view, what types of existing businesses in the region have suffered most from the improvement, considering only the time since construction ended? How have they suffered?

11. a) Prior to construction, what were the businesses' perceptions of how the proposed highway improvements might help businesses already in the area once construction was completed? What were their expectations?

    b) Prior to construction, what were the businesses' perceptions of how the proposed highway improvements might harm businesses already in the area once construction was completed? What were their fears?

12. a) Before the project was built, what individuals or groups expressed the most support for the project? What are their views today?

    b) Before the project was built, what individuals or groups expressed the most concern for the project? What are their views today?

New Business Attraction

13. a) What businesses have been attracted to the area in the past five years?
    b) Where did these businesses come from?
    c) What factors have contributed to business attraction and economic growth in the area?

Figure 3.3 Interview Guide for State and Regional Economic Development Officials (continued)

New Business Attraction (continued)

14. a) What businesses have been lost in the past five years?
    b) Where did these businesses relocate to?
    c) What factors have inhibited business attraction and economic growth in the area?

15. Did the improvement to highway access improve economic development/business attraction? If so, how?

16. a) Have any particular businesses specifically mentioned (the improved) highway access as a contributing factor in their decision to locate in the region (or relocate within the region)?

    b) What types of businesses? Are any of them entirely new industries?

17. a) Have any particular businesses specifically mentioned (lack of) highway access as a contributing factor in their decision not to locate in the region?

    b) What types of businesses?

Tourism

18. How important is tourism to the area's economic base?

19. What forms of existing tourism have expanded as a result of the highway improvement?

20. Were any new forms of tourism attracted/created as a result of the highway improvements? What kinds?

Economic Development Programs

21. What type of business assistance and attraction programs are currently offered by your organization? By other local organizations?

22. Are these programs used? Any comment on the extent of usage and success of programs? Do businesses feel the programs address needs?

23. Are there specific gaps to be filled? What are these gaps?

24. Have the highway improvements enhanced existing economic development programs or initiatives? How?

25. Have any new programs or changes in economic development programs been developed to enhance the economic impact of the highway?

Other Resources and Contacts

26. Who else should we talk to in the economic development and tourism fields?

27. Key businesses in the region?

28. What reports/data sources should we obtain?

Figure 3.4 Interview Guide for Key Regional Businesses

Interviewer _____
Date _____

1. Contact Name(s): _____
   Name of Company: _____
   Address: _____
   City / State / Zip: _____
   Telephone: _____
2. What does your company do? What are your principal products / services?

Customer Access

3. Which of the following categories best describes the primary market for your product? *(circle one)*
   -local -regional -statewide -within 500 miles -national -international

If manufacturing/production company ask the following:

4. a) How are goods shipped from the company? Road? Rail? Air? (approximate percentages)
   b) (If roads) Which highways do you use most frequently? What portion of your outbound shipments use the highway that was improved?

If retail/service company ask the following:

5. Which highways, if any, do most of your customers use to purchase goods or services from your company?

Supplier Access

6. Where are your principal suppliers or vendors located?
7. a) How are goods / supplies shipped to the company? Road? Rail? Air? (approximate percentages)
   b) (If roads used) Which highways do you use most frequently? What portion of your inbound shipments use the highway that was improved?

Worker Access

8. Roughly, how many people do you employ?
9. From what area do you draw the majority of your labor force? (probe for specific cities, counties)?
10. Which highways do your workers use most frequently? What percentage of your workers commute on the improved highway?
11. a) Have the highway improvements affected your ability to retain your employees? If so, how?
    b) Have the highway improvements affected your ability to recruit new employees? If so, how?

Impacts of Improved Highway on Your Business

12. a) In general, were you satisfied with the existing roadway and traffic conditions in the area before construction? What concerns did you have?
    b) In general, are you satisfied with roadway and traffic conditions after the improvements? What concerns do you now have?
13. Since the completion of construction, how have the highway improvements impacted your operations? (probe for benefits and drawbacks)

Figure 3.4 Interview Guide for Key Regional Businesses (continued)

14. a) Have the highway improvements opened up new markets for your products and services?
    b) [If new markets] In what way?
    c) [If new markets] Where have these new markets come from? Please be specific.

Business Location

15. How long has your company been at its present location?
16. Is this your original location? If not, where did you move from?
17. Why did you choose this location?
18. Have you made use of any local, state, or federal economic development services or incentives? If so, which ones?
19. Do you plan on moving from this location within the next two years? If yes or possibly, why?
20. What other business locations would you consider:
    a) In the adjacent area? Why?
    b) Outside the adjacent area? Why?
21. What do you like best about your current location as a place to do business?
22. What do you like least?
23. Are there specific programs or incentives which would help your business which are not available?

Regional Competitiveness

24. What are the region's strengths as a business location?
25. What are the region's weaknesses as a business location?
26. In general, where do you feel companies in your line of business have concentrated most within the surrounding region? Why?

Highway Corridor Competitiveness

27. In the highway corridor, are the number of companies in your line of business increasing? Stable? Decreasing? Did you notice any changes after the highway improvements?
28. In the business community, how is the highway corridor perceived as a place to locate a business? Did this perception change after the highway improvements? If so, how?
29. What are the benefits of the corridor as a place to do business?
30. What are the disadvantages?
31. a) Do you feel that improvements to the highway corridor have influenced any company's decision to locate here? To relocate within the region?
    b) What was the relative importance of the highway improvement in the company's relocation decision?
32. What types of companies do you think will be more attracted to the area as a result of highway improvements? (probe for specific businesses and why so)

Other

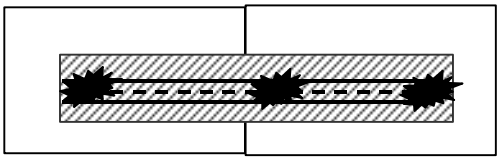
33. Is there anything else you would like to say about this topic?
34. Is there anyone else with whom we should speak?

4.0 Highway Corridor Study Prototype

4.1 Applicable Situations

The highway corridor prototype is applicable for studying impacts of a highway project on businesses located adjacent to the highway, including those located along the side of the highway and those located around its interchanges (or intersections). The length of the highway corridor can span multiple towns and multiple counties, or it can span a distinct part of one town. The example offered here is for a two-county highway corridor connecting three towns within a single state (Figure 4.1). This prototype is not appropriate for studying broad, statewide or multi-state impacts of a highway because the localized data collection necessary would become too large for this approach to be practical at a larger geographic scale. For such situations, the regional prototype covered in Section 3.0 is more applicable. This prototype also is not appropriate for studying in-depth impacts on a single town or its business district, where parcel-level data may be needed. For those situations, the local community prototype covered in Section 5.0 is more applicable.

Figure 4.1 Corridor Study Example



(Corridor study area encompassing property adjacent to the highway and its interchanges, connecting three towns in two counties)

As with the other prototypes, there are necessarily tradeoffs involved in studying a highway corridor rather than a broader region or a single town. Unlike the regional or town-level impact areas, the geography of a highway corridor makes it amenable to direct observations (i.e., windshield surveys) and direct distribution of surveys to selected businesses and their customers. Its geography, however, does not typically correspond to political jurisdictions (such as counties or towns), so published economic data are typically unavailable for the corridor as a whole. Property transaction and development data also can be difficult to assemble if the corridor spans multiple communities and rural areas. (See the prototype for local community studies, in Section 5.0, for a discussion of how these data can be tracked for individual communities along a highway corridor.) It also becomes more labor intensive to administer local business surveys and collect local property data as the corridor becomes longer.

4.2 Measurement of Gross Change

The measurement of gross change represents the difference between post-project conditions and pre-project conditions. For a highway corridor study, this should include measures of short- and medium-term localized impacts, such as real estate transaction data and construction data, as well as longer-term impacts, such as employment and business sales data. The measurement of gross change should quantify the change in property use and business growth at a minimum of four points in time:

1. Conditions prior to any real estate or investment speculation during the pre-project period;

2. Conditions at the start of construction to capture the amount of speculation;

3. Condition within a year after the project completion to measure the short-term impacts; and

4. Conditions roughly five to 10 or more years after the project completion to assess long-term adjustments.

It would then be possible to establish the direction and magnitude of economic changes and isolate specific phases of economic impact. For a highway corridor, these measures typically have the following availability:

- *Short-term impacts* on property transactions (property sold and sales/rental prices by location) can be measured, but the data are often difficult to assemble for a highway corridor. Such data, covering current and historical time periods, can usually be obtained from the local or county registry of deeds, or from local real estate boards (through brokers). Many times, the information is obtainable only by personally visiting the office and reviewing records there. This can become an onerous task if it is difficult to isolate transactions occurring along the highway from others occurring elsewhere in the community. It can become particularly onerous if the highway corridor spans many different jurisdictions, requiring data requests from multiple local governments or real estate boards. In theory, though, it could be possible to obtain property transaction and price data spanning a period of time with addresses geocoded and input to a Geographic Information System (GIS). Using the GIS, it could then be possible to identify transactions within any specified corridor.

- *Medium-term impacts* on private investment and construction along the corridor can also be measured, but these data can be difficult to assemble from published sources since the highway corridor does not correspond to town boundaries. Nevertheless, major construction can be tracked by conducting a "windshield survey" – driving along the corridor at multiple points in time and observing the existence of new buildings, as well as those still under construction.

- *Long-term impacts* on employment, income, and population are typically not available from published sources or public agencies for a highway corridor. Nevertheless, data on openings and closings of business establishments can be obtained through direct observation, by conducting a periodic windshield survey. Direct surveys of businesses along the highway corridor can also provide data on changes in numbers of employees

and estimates of percentage changes in sales volumes. It is also possible, though often expensive, to obtain data on individual business establishments and their employment levels from proprietary sources (such as Dun & Bradstreet) and then geo-coding their addresses to track changes in the profile of business activity and employment along the specified corridor.

4.2.1 Inventory of Property Use Changes

Figure 4.2 shows an example of a "windshield survey" form that can be used to observe both property investments and types of business activity along a highway corridor. (The survey is performed "through the windshield," i.e., by driving along the highway corridor and noting characteristics of the businesses along the corridor.) It also can be done by videotaping the properties along the highway route and later filling out the observation form. Alternatively, some proprietary data sources including business lists derived from telephone listings can be mapped to provide a profile of business activity along the corridor for multiple times.

In terms of property investment, the windshield survey form itself provides the most complete means for identifying construction of new buildings, demolition of old buildings, and occupancy / vacancy of existing buildings. In terms of business activity, the form also provides a means for identifying the mix of store types and other business facilities locating and operating along the highway. If this survey is repeated before and after construction of the highway project, it can be used to track three types of situations: 1) growth and change in adjacent business on an existing highway corridor that is upgraded, 2) loss and change in business activity on an older highway corridor that is bypassed by a new highway, and 3) new development along an area that previously had no highway at all. In this example, the data form is filled for an existing highway at one point in time. The form would be filled in again at a later time in order to provide a measure of change over time.

4.2.2 Business Employment and Sales Changes

The number of businesses located along a highway corridor will vary depending on the setting and length of the corridor, but is likely to be no more than a couple of hundred businesses (and quite possibly, much less). In that case, it is often feasible to collect data on changes in the employment and payroll or sales volume for individual businesses located along the corridor, and compare these to corresponding changes elsewhere in the community.

There are three ways of assembling such data:

1. Purchase data, for two points in time, for all businesses located along specified roads, or within specified ZIP codes or other geographic information. Proprietary sources such as Dun & Bradstreet have sold such data for some past economic impact studies (see Example 4A on page 4-10).

2. In states where available, obtain special tabulations of the ES-202 employment security files, which provide monthly information on business establishments, employment and payroll by location and type of business.

Figure 4.2 Sample Windshield Survey

Business (1)	Location (Intersection, Cross-road, Mid-block, Other) (2)	Status (Occupied, Vacant, New construction) (3)	Access (Curb, Frontage Road, Turn) (4)	Size (Large or Small) (5)	Pass-by Market (H, M, L) (6)
Start – Highway A Crossing					
Gas station	I	O	T		H
Hamburgers	M	O	C		H
Dairy Queen	M	O	C		H
Wholesale – tractors	M	O	C		L
Abandoned store	C	O	C	S	–
Cross Highway B					
Motel	C	O	T		M
Italian restaurant	I	O	T		M
Gas station	I	O	C		H
Auto assembly plant	M	N	F	L	L
Office building	M	O	F		L
Plastics company	M	O	F		L
Stoplight – BZ Road					
Video store	I	O	T		M
Clothing store	M	O	C		M
Abandoned gas station	M	V	C		–

Instructions for filling out the form:

The "drive-by" process should collect the following information on each business located along the highway or at major intersections (facing the cross road).

(1) **Business –** Note the major business type in words (e.g., gas station, farm implements wholesale, office building.

(2) **Location –** Note whether it is located: 1) INT: on highway – at intersection, 2) CROSS: on cross-road – at intersection, 3) MID: on highway – middle between intersections, 4) OTH: elsewhere nearby (specify).

(3) **Status –** Describe the status of the building as: 1) occupied, 2) vacant, or 3) new construction.

(4) **Access –** Note whether its access from the highway is: 1) CURB: via curb cut entry from highway, 2) FRONTAGE: via parallel frontage road, 3) TURN: via turn onto cross-road.

(5) **Business Size –** Leave blank unless it is particularly LARGE or SMALL. From this, we can estimate typical square feet per establishment, employees per square foot and sales per square foot if necessary.

(6) **Pass-by Market –** Need to note whether its dependence on pass-by traffic (as opposed to special destination trips) is 1) HIGH: nearly all, 2) MXD: mixed – somewhat, or 3) LOW: little or none. In many or most cases, this is obvious, so you can add this in later on if you do not have time to do it while driving by. It can especially be mixed for restaurants, clothing, and gifts stores.

3. Pass out a survey to businesses at two points in time (pre- and post-construction) and ask businesses to mail or fax them back. The survey can ask businesses to report their business sales and employment patterns, and can be used together with the business inventory (windshield survey) data to show the pattern of changes in business mix and growth patterns over time. However, some businesses may not be willing to give this information out, so it may be necessary to assume that the partial sample collected is representative of all businesses along the highway. It is important to develop profiles of overall business activity along the corridor for both pre- and post-project times. Reliance on just a retrospective survey that asks about changes over time is more problematic, as it is likely to miss businesses that moved out or closed during the intervening years.

The data items to be collected to measure gross changes in business activity over time are summarized in Table 4.1, along with their availability from alternative sources. The questions covered here focus specifically on the documentation of business changes. (Additional questions can be asked in a business survey that addresses causality issues; such a survey is shown later in Figure 4.4).

Table 4.1 Basic Data Collection to Measure Business Activity Changes Over Time

	Business Survey[1]	Tabulations from State ES-202 Files	Private Vendor (D&B)
Business establishment name	x	x	x
Business location (address)	x	x	x
Type of business	x	x	x
Years in place	x	-	x
Employment at this location	x	x	x
Payroll for workers at this location	x	x	-
Sales volume at this location	x	-	x[2]
Expected change in next two years –sales	x	-	-
Expected change in next two years –employment	x	-	-

[1] These are basic questions to document business changes; see Figure 4.3 for additional survey questions regarding causality of highway corridor impacts.

[2] Available for single-location businesses (not chain stores).

4.2.3 Property Sales and Building Permits

As previously noted, a highway corridor can span multiple jurisdictions, yet encompass only parts of each one. For that reason, it is often problematic to obtain data on property

sales, prices, and building permits from public agencies for the strip of land adjacent to a highway. In some jurisdictions, property transaction data may be available from either public or private sources in a geographically referenced database format. A geographic information system (GIS) then can be used to summarize data separately for properties falling within the study area. If property-specific transaction data cannot be obtained, then direct observations and surveys can be used to obtain data on changes over time preceding the highway project and changes over time following completion of the highway project. Table 4.2 shows a table for tracking changes in these measures over time.

Table 4.2 Sample Data Collection Table for a Rural Highway Corridor

Category	Before2	Before1	After1	After2
Property sales	13	14	21	24
Average price per acre (thousands)	$21	$22	$26	$30
Number of building permits	6	8	8	12
Number of businesses by type (summary of data from Windshield Survey)				
Gas stations / truck stops	13	15	16	19
Restaurants	6	7	9	12
Hotels / motels	9	9	11	14
Stores	7	9	10	15
Vacancies	11	12	10	7
New construction	7	6	7	10

4.2.4 Uses of Geographic Information Systems (GIS)

A GIS can be a useful tool for analyzing and illustrating changes in economic activity at any scale, particularly because it can track spatial distributions of activity and identify concentrations of business focusing on a highway corridor. For that reason, GIS may be particularly useful in assisting with a highway corridor study. This tool may be used to identify and portray the locations of businesses that are obtained in disaggregate, geographically referenced databases, such as privately available business databases or county tax assessor records. A GIS database of existing businesses along the highway strip can be created using global positioning systems (GPS) equipment in conjunction with a windshield survey. With any of these databases, GIS can be used to identify the businesses or properties falling within a defined highway corridor area (for example, a radius of one-half mile around the highway) versus outside the area. Additional statistical tests also can be performed, such as regressing changes in property values before and after the improvement against distance from the highway to determine whether a positive or negative correlation exists. Applications of GIS for corridor analysis are illustrated in the two examples which appear in Section 4.3, and are summarized in Table 4.3.

Table 4.3 Use of GIS for Economic Impact Analysis

Data Inputs. Since economic impact studies of highway investments are inherently geographic, a geographic information system –which is a database intended to store, analyze and display geographic data – can serve as a useful resource in such studies. The data that can be arranged as layers of information in the GIS, including the following:

- **Businesses –** Each business can be recorded as a point in a point layer. The data table corresponding to this layer can include information on number of employees, average salary, number of square feet, and other characteristics of each business, for each year in which data are collected.
- **Property Values –** The addresses of properties can be geocoded, mapped, and stored in a GIS point layer. The property values for each point can be stored in the layer's table.
- **Frequency of Property Sales** can be stored in a GIS layer – by neighborhood, town, or county.
- **Population and Other Demographic Data –** Census data can be stored in a polygon layer of blocks, block groups, census tracts, or counties.
- **Data from Windshield Surveys and Interviews** can be stored in a GIS, allowing the results from the surveys and interviews to be viewed in a map, where visible patterns may emerge that tell something about the highway project's impacts.

Report Outputs. Once all the data are in a GIS, each layer can be mapped alone or overlaid (for both the study area and comparison area). The maps then can be used to observe data, create hypotheses, and identify places where data are missing. For example:

- The GIS could generate grid cells to separate observation areas for use in a cross-sectional regression or linear model.
- Relationships between changes in indicators and distance from the highway can be examined, through use of regression techniques or by creating buffers or rings around the highway proj??ect and comparing data tabulations in the different buffer zones.
- The error or residuals from a cross-sectional regression can be mapped in a GIS and tested for auto correlation or heteroskedasticty.

4.3 Comparisons to Establish Net Change

4.3.1 Basic Methodology

The measurement of net change represents the adjustment for underlying changes that would have happened anyway, regardless of the highway project. The usual way to do this for a highway corridor is to compare changes occurring along the highway corridor with corresponding changes occurring in the surrounding area – the rest of the applicable towns (in the case of a small highway) or the rest of the applicable counties (in the case of a major statewide corridor). An alternative is to compare these changes to a similar corridor that did not have any highway improvements or changes occur, and is not directly affected by the highway project being studied. It is often not possible to find such a situation, and the costs of parallel data collection (windshield and business surveys for comparison or control areas that did not receive highway improvements) may be judged to be too high.

The comparison process is most problematic for highway corridors (assuming that the comparison area is defined as the surrounding area), since the project area data and comparison area data may not come from identical sources. For instance, a windshield survey is not practical for all of the roads in a town, let alone all of the roads in a county. Similarly, a business survey may not be applicable for all of the other businesses in a town or county, though it might be possible for a very carefully selected subset of them. In any of these cases, the data on observed changes from windshield surveys or business surveys can still be compared to changes in aggregate published data on town-wide or county-wide land prices, building permits or employment levels. While there are potential sources of error associated with mixing data sources, the analyst can only obtain what is possible.

Alternatively, a regression analysis can be used to separate the relative effects of the highway project from the effects of other locational attributes that distinguish the corridor from comparison areas. The results of a regression analysis can provide a synthetic comparison base, by providing predicted values for how the study corridor would have been different without the highway. However, regression analysis becomes feasible only if the study area contains a sufficiently large enough number of businesses to be a statistically significant sample. Sample sizes below 40 are usually insufficient, and sample sizes above 200 are preferable in order to obtain statistically significant results. In addition, regression requires reliable data on locational attributes of the different areas. All of this can be problematic. As a result, relatively few statistical studies of highway corridor impacts have been conducted to date, and those that have been done have tended to be academic research projects involving special datasets, as demonstrated by the two examples which are presented later in this section. For a further discussion of alternative comparison methods for distinguishing net changes, see Section 3.3.

4.3.2 Net Change Calculation

Table 4.4 shows an example of how the observed changes in a highway corridor can be compared to the otherwise expected changes in the absence of a highway in a spreadsheet analysis to distinguish differences in growth rates over the pre-/post-project periods.

Table 4.4 Example of Corridor Trend Comparison for One Time Period*

Label	Percent Change		*Observed* Change in Study Area (3)	*Expected* Change in Study Area (4)	*Deviation* from Expected Change (5)
	Study Area (1)	Comparison (2)			
Property Sales	14.3%	12.7%	3	2.7	0.3
Avg. price per acre (thousands)	7.1%	5.6%	$4	$3.14	$0.86
No. of building permits	50.0%	21.8%	4	1.7	2.3
Gas stations / truck stops	18.8%	13.0%	3	2.1	0.9
Restaurants	33.3%	20.4%	3	1.8	1.2
Hotels / motels	27.3%	16.9%	3	1.9	1.1
Stores	50.0%	8.1%	5	0.8	4.19
Vacancies	30.0%	2.6%	3	-0.26	-2.74
New construction	42.9%	20.4%	3	1.4	1.6

(1) This is the percentage change in each indicator taking place within the **study area** over the given time period.

(2) This is the percentage change in each indicator taking place for the **comparison** situation over the same time period, where the comparison situation is either (a) the actual change observed for other areas (either matched areas or surrounding areas), or (b) a statistically-calculated trend derived from the observations of those other areas.

(3) This is the **observed (actual) change** in each indicator within the highway impact study area, over the given time period.

(4) This is the **expected change** in each indicator within the highway impact study area, over the given time period. It is calculated by applying the percentage change for the comparison situation (column 2) to the actual starting year employment in the study area.

(5) This is the **difference** between the observed change in the study area (column 3) and the expected change in the study area (column 4).

*Notes: In this illustrative example, study area changes were obtained from values in Table 4.2 for the After-1 versus After-2 time period. Comparison area changes also are hypothetical.

4.3.3 Examples of Studies to Derive Net Changes

Two examples of statistical studies to determine the net impacts of highway improvements on businesses are presented in Example 4.1. The first (a) examines businesses located along highway routes that are not limited access and are lined with commercial businesses. The second example (b) examines changes at exit areas of limited access freeways.

Example 4.1 Deriving Net Change in a Corridor Comparison

a) Corridor Comparison Through Statistical Controls (Regression)

Weisbrod, G. and R. Neuwirth. *Economic Effects of Restricting Left Turns*, Research Results Digest #231, National Cooperative Highway Research Program, August 1998.

The purpose of this study was to measure the actual impact on business activity from highway improvements that limit vehicle turn access into stores. The study examined highway corridors in Iowa, Arizona, New Mexico, Georgia, New Jersey, Pennsylvania, Oregon, and New York. The researchers purchased Dun & Bradstreet data providing business sales and employment for all commercial businesses in the affected communities for 1980, 1986, and 1993 – covering pre- and post-project years. An address database was used to classify the businesses and track changes among three types of locations: 1) midway between highway intersections, 2) in the vicinity of highway intersections with turns allowed, and 3) elsewhere in the community (not on the highway). The data covered 820 businesses located along these corridors and another 8,400 located in the larger surrounding areas. It provided indicators of business entry and exit, as well as growth and decline, for different types of businesses in those various areas. Statistical regression analysis was then applied to estimate the relationship between the observed changes in business sales and explanatory factors including (1) the types of business, (2) size of business, (3) pre- versus post-project year, and whether the business was located (4) mid-block, or (5) at a highway intersection (or elsewhere off of the highway). Coefficients for factors (3) through (5) indicate the net impact of the highway projects, holding all other factors constant.

b) Corridor Comparison for Highway Exits, Using GIS and Statistical Controls

Hartgen, D. and J.Y. Kim. *Commercial Development at Rural and Small Town Interstate Exits*, Center for Interdisciplinary Transportation Studies, University of North Carolina, Charlotte, 1997.

The purpose of this study was to measure the impact of Interstate Highways on development within one mile of their exit locations. The researchers identified 63 highway exits along interstate highways covering every state in the U.S. Since the study focused on rural areas, the researchers assumed that there was essentially no existing commercial development at those locations before the construction of the interstate highways and their exits. They then collected information on the number and types of commercial activities now taking place at those locations, including gas stations, convenience stores, motels, fast food, and sit-down restaurants. They used a GIS to map the locations, classify the businesses, and associate them with data including traffic volumes at those exits, distance from town, distance from the next exit, and local population size and wealth. A combination of classification and regression techniques was used to measure the relationship between the growth of commercial development and the exit area characteristics.

4.4 Behavioral Data to Establish Causality

Causality can be established by: 1) synthesizing the knowledge of local economic development experts – planners or chamber of commerce representatives, 2) surveying new and pre-existing businesses, and 3) documentation of highway reliance by businesses using a customer survey. Any one of these can be used to provide some basis for determining the portion of observed change which is due to the highway project. Together, all of them provide greater confidence about isolating the impact of the highway from other causes.

4.4.1 Interviews with Local Experts

For a highway corridor, there may or may not be any local chamber of commerce, planner, or economic development professional (at the community or county level) who is an expert on business activity changes along the entire highway corridor. If available, then the person can be interviewed to provide a perspective concerning:

- The corridor's success in retaining, expanding and attracting business activity;
- Whether changes in those conditions occurred following completion of the highway project; and
- The factors which together caused those changes, and the relative importance of the highway project.

Figure 4.3 provides a sample *interview guide* to be used in interviewing knowledgeable experts on local business and development, such as representatives from the local chamber of commerce, planning department, economic development agency, real estate broker community, etc. This is similar to the interview guide used for local areas (in Section 5.0), but this version excludes questions about visitation, commuting, and population, which are most relevant for specific communities.

4.4.2 Post-Project Business Survey

The business corridor survey was previously suggested as an option for measuring gross changes in sales and employment, if conducted both before and after completion of the highway project. Regardless of whether or not that method is used as the vehicle for collecting information on gross and net impacts, there is also a need for a follow-up business survey that provides insights into how and why the highway caused any business changes. This can include information on:

- The *reasons* for those changes in business sales and employment (including role of the highway among those reasons);

- Changes in the types of *goods and* services being offered and sold by businesses located along the highway;

- Changes in the frequency and type of *customers* patronizing businesses located along the highway;

- Changes in business *customer focus and competition* over the pre-/post-highway periods, and the reasons for those changes (including role of the highway among those reasons);

- Changes in business *reliance on the highway corridor* for labor access, supplier access or customer deliveries (and the role of the highway in those changes); and

- Expected impacts on *future business* expansion or relocation decisions.

Figure 4.4 provides a sample *business survey* which can be distributed to all businesses along the corridor, and then mailed or faxed back. This survey is designed to be quickly completed by small business owners and managers, and is focused largely towards commercial businesses since they most frequently dominate highway strips and interchanges. (A separate business interview form, which is more oriented towards industrial businesses, is provided in Section 3.0.)

4.4.3 Customer Survey

For retail businesses (including stores, gas stations, hotels and restaurants), a customer survey can be used to obtain information on the extent to which new pass-by customers came to businesses along the highway corridor, and new or existing customers from elsewhere in the region were attracted to come due to improved access. It is possible that some existing customers changed the frequency of their visits due to changes in the ease of access to the stores – which could be made easier by improved speeds, but also made more difficult by the need to use new interchanges and access roads. Such surveys can be passed out by cooperating businesses. An example of a customer survey is shown in Figure 4.5.

Figure 4.3 Sample Interview Guide for Local Planners, Real Estate/ Development Professionals

Interviewer _____

Date _____

What changes have you observed in the study area *since the highway was built*?

1. Have **property values** changed in the corridor?
   - How much?
   - How does this trend differ from trends in the surrounding area?
   - How much of the change is due to the highway and how much is due to other factors?
2. Has there been a change in the rate of **construction activity** in the corridor?
   - How much?
   - How does this trend differ from trends in the surrounding area?
   - How much of the change is due to the highway and how much is due to other factors?
3. Has there been a change in the rate of **new businesses** moving into the corridor?
   - How much?
   - How does this trend differ from trends in the surrounding area?
   - How much of the change is due to the highway and how much is due to other factors?
4. Has there been a change in the rate of **existing businesses** expansion / contraction or closure in the corridor?
   - How much?
   - How does this trend differ from trends in the surrounding area?
   - How much of the change is due to the highway and how much is due to other factors?
5. Has there been a change in the rate of business **start-ups** in the corridor?
   - How much?
   - How does this trend differ from trends in the surrounding area?
   - How much of the change is due to the highway and how much is due to other factors?
6. Has there been a change in the amount of **vehicular traffic** through the corridor?
   - How much?
   - How does this trend differ from trends in the surrounding area?
   - How much of the change is due to the highway and how much is due to other factors?
7. Has there been a change in the amount of **shoppers** patronizing businesses in the corridor?
   - How much?
   - How does this trend differ from trends in the surrounding area?
   - How much of the change is due to the highway and how much is due to other factors?
8. Has the mix of **business types** in the corridor changed?
   - How much, and how so?
   - How does this trend differ from trends in the surrounding area?
   - How much of the change is due to the highway and how much is due to other factors?

Figure 4.4 Sample Business Mail-back or Fax-back Survey Form for Highway Corridor Businesses

Business Profile

1. Name of Company:_____ Telephone:_____
   Address:_____ City / State / Zip:_____
   Contact Name(s):_____

2. What does your company do? What are your principal products / services? *(check one)*

restaurant or bar	gas station	hotel / motel
retail store	trucking / transportation	wholesale / warehouse
business services	personal services	banking / finance
manufacturing	other (specify) _____	

Customers

3. Which of the following categories best describes the primary market for your product? *(check one)*

pass-by traffic	local area residents	county / region
within 500 miles	national	international

4. **If manufacturing firm**: How are goods shipped from the company? *(enter approximate percentages)*
   Road? _____ Rail? _____ Air? _____
   What percentage of your outbound shipments use the highway that was improved? _____%

5. **If non-manufacturing**: How do customers get to your business or otherwise obtain your products or services *(enter approximate percentages)* Drive in _____ Bus passenger _____
   Air or Taxi _____ Mail, Tel or Internet _____

6. How have the highway improvements affected the overall size of your **customer base**?

Expanded customer base:	Large	Medium	Small	
Decreased customer base:	Large	Medium	Small	NO CHANGE

   Please explain: _____

7. How have the highway improvements affected your **total business sales** at this site?

Increase:	Large	Medium	Small	
Decrease:	Large	Medium	Small	NO CHANGE

8. Have the highway improvements had any impact on **retaining existing customer markets**?
   No Yes *Please explain*:_____

9. Have the highway improvements had any impact on **opening up new markets** for your business
   No Yes *Please explain*:_____

Suppliers

10. How are materials / supplies shipped to your company? *(enter approximate percentages)*
    Road? _____ Rail? _____ Air? _____

11. What portion of your outbound shipments use the highway that was improved? _____

12. How has the new highway affected ability to obtain materials and supplies:

Costs of Supplies:	Better	No change	Worse
Timeliness of Delivery:	Better	No change	Worse
Choice of Suppliers:	Better	No change	Worse

Figure 4.4 Sample Business Mail-back or Fax-back Survey Form for Highway Corridor Businesses (continued)

Workers

13. Roughly, how many people do you employ?

1-5	6-10	11-20	21-50
51-100	101-200	201-500	over 500

14. What percentage of your workers commute on the improved highway? _____%

15. How has the new highway affected your ability to **retain employees**:

Increased ability No change Decreased ability

16. How has the new highway affected your ability to **recruit new employees**:

Increased ability No change Decreased ability

Highway Conditions

17. (A) How satisfied were you with the existing roadway, traffic, and access conditions in the area **before** new highway construction?

Very satisfied Satisfied Unsatisfied Very unsatisfied

(B) What concerns did you have? _____

18. (A) How satisfied are you with the existing roadway, traffic, and access conditions in the area **after** new highway construction?

Very satisfied Satisfied Unsatisfied Very unsatisfied

(B) What concerns do you now have? _____

Business Operations

19. How have the highway improvements affected the **size** of your business operation at this site?

Increase:	Large	Medium	Small	None
Decrease:	Large	Medium	Small	None

20. How have the highway improvements affected the profitability of your business operation?

Increase:	Large	Medium	Small	None
Decrease:	Large	Medium	Small	None

21. How have the highway improvements affected the volume of your business sales at this site?

Increase:	Large	Medium	Small	None
Decrease:	Large	Medium	Small	None

Business Location

22. How long has your company been at its present location?

0-1 year 2-5 years 6 or more years

23. Is this your original location?

Yes No *From where did you move?* _____

24. Was the highway location a major factor in your decision to choose this location?

Major Factor Minor Factor Not a Factor

25. Has your total business sales volume at this location changed from what it was 2 years ago?

No Yes *How Much?* _____% larger _____% smaller

Figure 4.5 Sample Customer Survey for Highway Corridor

This survey is intended to help us better understand why people visit businesses located along the <<*highway corridor*>> and what can be done to improve their experience.

1. What types of businesses did you stop at today which are located in this area?

restaurant or bar	gas station	hotel / motel
retail store	trucking / transportation	wholesale / warehouse
business services	personal services	banking / finance
manufacturing	other (specify) _____	

2. Why did you come to this area today?
   - just passing through
   - special trip to visit a business

3. Did you buy anything in a business along the corridor today?
   - yes
   - no (*skip to #5*)

4. If so, how much did you spend in this area today?
   $ _____

5. Had you visited any of these businesses before?
   - yes
   - no (*skip to #8*)

6. When did you first come to visit businesses in this area?
   - this year
   - 2 – 3 years ago
   - 4 – 5 years ago
   - over 5 years ago

   (*representing time periods before and after the highway project was completed*)

7. How frequently do you stop at businesses in this area?

nearly every day	about once a week	1 – 2 times a month
once in a long while	never been in this area before	

8. Do you now come more or less frequently than *before the new highway project was completed*?
   - more often
   - less often
   - about the same

9. Is your travel time to and from this are now longer or shorter than it was at that time?
   - longer
   - shorter
   - about the same

   How much longer or shorter? _____ minutes for a one-way trip

10. What factors have made you visit this area more or less frequently now?

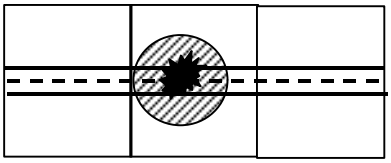
area image & looks	highway access	highway safety
crime	selection of stores	other (*specify*)

5.0 Local Study Prototype

5.1 Applicable Situations

The local community prototype is applicable for studying small area impacts of a highway corridor project, in which the impact area being examined is a specific city or town, or a specific neighborhood within it (such as the downtown area). The example offered here is for a small town served by a new highway (Figure 5.1). This type of study area is typical for sub-state highway projects that provide improved access to a particular community, or which bypass particular communities. It is not applicable for studying longer highway strips that encompass multiple local jurisdictions, or for studying major corridors whose impact areas encompass entire counties or multiple counties.

Figure 5.1 Local Study Example



(Local study area encompassing one town served by the new or improved highway)

As with the other prototypes, there are necessarily tradeoffs involved in studying a local area rather than a broader area. Measures of short-term and medium-term impacts, such as land sales and construction starts, are most easily available at the local level since only one jurisdiction may be involved. Typically, therefore, these studies rely on business and customer surveys.

5.2 Measurement of Gross Change

The measurement of gross change represents the difference between post-project conditions and pre-project conditions. For a local study, this should include measures of short- and medium-term impacts – such as real estate transaction and construction data, as well as measures of longer-term impacts – such as town-wide employment change. The measurement of gross change should quantify the change in property use and business growth at a minimum of four points in time:

1. Conditions prior to any real estate or investment speculation during the pre-project period;
2. Conditions at the start of construction to capture the amount of speculation;
3. Condition within a year after the project completion to measure the short-term impacts; and
4. Conditions roughly five to 10 or more years after project completion to assess long-term adjustments.

With this information, the direction and magnitude of economic changes can be established and specific phases of economic impact can be isolated. For a local community, these measures typically have the following availability:

- *Short-term impacts* on property transactions (property sold and sales data) at the town level are relatively easy to measure, as the data are available for small areas from local real estate boards and local (or county) registry of deeds.
- *Medium-term impacts* on business location and construction activity data at the town level can be gathered by talking with local developers and business owners, by reviewing records of local building permits, or by collecting newspaper files of new business activities.
- *Long-term impacts* on the number of businesses, their employment sizes and sales levels normally can be obtained at the local town level from a variety of government sources, including the federal Economic Census (for establishments and sales volumes), state employment office (for salaried employment) and state revenue office (for taxable retail sales). Annual population estimates are often available on a community level. Data on number and size of business establishments may be available for towns by using the Zip code business patterns data (from County Business Patterns) or from private sources such as Dun & Bradstreet.

5.2.1 Local Property Sales and Construction Data

Table 5.1 is an example of a gross impact data collection form for tracking pre-post property transaction and building construction data. It is equally applicable for data on square feet of new building space, square feet of newly leased office and industrial space, and tax revenues. In this example, the data form is filled in with typical data for a single town.

5.2.2 Employment Data

If there is any breakdown of employment and wage changes by type of business, such information is usually available on a town-by-town basis each month, from the state labor department. The data come from ES-202 Employment Security filings. Except for large cities, the breakdowns by type of business may be unavailable or severely constrained because too few businesses exist within a detailed business category – leading to withholding of data for confidentiality reasons. Table 5.2 shows a gross impact data collection form for tracking employment and wage changes by type of business. This form can be used when data is available (otherwise, gross employment and wage data can be incorporated into the form shown in Table 5.1).

Table 5.1 Sample Summary Table for Local Impact Measurement

Category		Before2	Before1	After1	After2
Property Sales	Retail	26	28	32	48
	Office	18	19	23	29
	Industrial	6	5	7	11
	Residential	16	18	20	29
Building Permits (new construction)	Retail	20	23	26	43
	Office	10	11	20	26
	Industrial	2	4	6	10
	Residential	10	13	14	21
Square Feet Sold (thousands)	Retail	260	280	320	480
	Office	180	190	230	290
	Industrial	120	100	140	220
Square Feet Leased (thousands)	Retail	520	560	640	960
	Office	360	380	460	580
	Industrial	0	0	0	0
Local Property Tax Revenue (millions)	Total	1.2	1.7	2.2	3.8
Population	Total	18,944	18,920	19,014	19,315

Table 5.2 Wage and Employment Impact Data Collection Form

		Employment (thousands)				Wages			
SIC	Industry	Before2	Before1	After1	After2	Before2	Before1	After1	After2
7	Agricultural services, forestry, fishing	0.56	.54	.52	0.50	16.8	16.2	15.6	16.0
10	Mining	.08	.07	.06	.06	2.4	2.1	1.8	1.92
15	Construction	3.2	3.3	3.9	4.5	97	99	117	144
20	Manufacturing	4.6	4.5	4.8	5.3	138	135	144	170
40	Transportation and public utilities	2.3	2.5	2.6	3.4	69	75	78	109
50	Wholesale trade	1.9	2.0	2.2	2.8	57	60	66	90
52	Retail trade	4.62	4.85	4.99	5.27	138.6	145.5	149.7	168.64
60	Finance, insurance, and real estate	4.85	4.92	5.06	5.97	145.5	147.6	151.8	191.04
70	Services	6.02	6.45	6.89	7.73	180.6	193.5	206.7	247.36
99	Unclassified establishments	1.23	1.25	1.84	1.95	36.9	37.5	55.2	62.4
	Total	**29.4**	**30.4**	**32.9**	**37.5**	**882.0**	**911.4**	**985.8**	**1,199.3**

5.2.3 Interview and Survey Data Collection for Smaller Communities and Neighborhoods

For *small communities*, formal datasets on land transactions, construction and employment may be kept at the county level, and may not be split out by local community. Similarly, for *neighborhoods* within a city, formal datasets on land transactions, construction and employment may be kept at the city level, and may not be split out by local neighborhood. In such cases, local planners, real estate agents, or community leaders may be used as knowledgeable observers. Questions can be asked concerning:

- Property sales;
- Construction activity;
- Business entrants, start-ups, and closures; and
- Business mix.

This information is essentially the same as that covered in a corridor study. An interview guide to collect such information from local planners and / or real estate development professionals is provided as Figure 4.3.

If the study area is a small town or a distinct neighborhood or business district, then it may be feasible to distribute a survey to all businesses requesting information on the percentage changes in business sales volumes and employment that they have experienced during recent years. A survey form for that application is provided as Figure 4.4.

5.3 Comparisons to Establish Net Change

5.3.1 Basic Methodology

The measurement of net change represents the adjustment for underlying changes that would have happened anyway, regardless of the highway project. The usual way to do this for a local community (small town) is to compare changes in the affected town with corresponding changes occurring in other similar towns. This can be accomplished in either of two ways:

1. **Matched Areas –** The first type of comparison is to a "matched area" – another town or neighborhood which has similar size, density, mix of business activities and socio-economic characteristics as the project impact area; and

2. **Statistical Control Areas –** This method examines trend data for many different towns in the same size range, and then utilizes statistical methods to separate out the effects of demographic and economic differences from effects of the highway.

With either of these types of comparisons, data for the preceding forms (Tables 5.1 and 5.2) also has to be collected for the comparison or control area(s).

5.3.2 Net Change Calculation

Table 5.3 illustrates how this comparison process distinguishes the observed trend in the highway impact area from the expected trend over one time period. (In a full study, this process would be repeated for multiple time periods.) In this example, the basic data are the **observed change** in a data item (in each industry) in the study area over a given time period (columns 1 and 3), plus corresponding data for other areas over that same time period (column 2). As previously noted, the **"comparison"** trend from other areas (column 2) could be either 1) the actual change observed for one or more other areas, or 2) a statistically calculated trend derived from observations of other areas. Either way, the comparison data are used to calculate what would have been the **expected change** in employment in the study area if it had exhibited the comparison trends (column 4). If this analysis is being conducted for a post-project time period, and the comparison trend is considered to represent what would have been expected to occur in the study area without the highway project, then the difference between observed and expected changes (column 5) could be interpreted as the difference attributable to the highway project.

Table 5.3 Example of Local Trend Comparison for One Time Period*

Label	Percent Change		*Observed* Change in Study Area	*Expected* Change in Study Area	*Deviation* from Expected Change
	Study Area (1)	Comparison (2)	(3)	(4)	(5)
Total property sales	42.7%	38.0%	35	31.2	3.8
Total building permits	51.5%	43.7%	34	28.8	5.2
Total square feet sold	43.5%	38.5%	300	265.7	34.4
Total square feet leased	40.0%	30.3%	440	333.3	106.7
Total property tax revenue	72.7%	48.0%	1.6	1.1	0.5
Total employment	14.1%	9.7%	4.62	0.4	4.2
Total wages	21.7%	13.5%	213.6	28.8	184.7

(1) This is the percentage change in each indicator taking place within the **study area** over the given time period.

(2) This is the percentage change in each indicator taking place for the **comparison** situation over the same time period, where the comparison situation is either (a) the actual change observed for other areas (either matched areas or surrounding areas), or (b) a statistically-calculated trend derived from the observations of those other areas.

(3) This is the **observed (actual) change** in each indicator within the highway impact study area, over the given time period.

(4) This is the **expected change** in each indicator within the highway impact study area, over the given time period. It is calculated by applying the percentage change for the comparison situation (column 2) to the actual starting year employment in the study area.

(5) This is the **difference** between the observed change in the study area (column 3) and the expected change in the study area (column 4).

*Notes: In this illustrative example, study area changes were obtained from values in Tables 5.1 and 5.2 for the After-1 versus After-2 time period. Comparison area changes also are hypothetical.

5.3.3 Examples of the Methods for Deriving Net Changes

Two examples of local comparisons as a means of determining the net change impacts of highway bypasses on small communities are presented in Example 5.1.

Example 5.1 Methods for Deriving Local Area Net Changes

a) Local Comparison to Matched Areas (Control Group)

Yeh, Daniel. *The Economic Impact of Highway Bypasses on Communities*, Wisconsin Department of Transportation, SPR-0092-45-93, 1998.

The purpose of the study was to measure the economic growth or decline impacts of highway bypasses on small towns. The researchers studied 17 small communities in Wisconsin that had bypass highway routes built around them between 1980 and 1995. They also studied 19 other small communities that had no bypass highway routes built around them. The latter represented a "study control group," and they were matched to the bypassed communities based on population size, which was classified as small (under 2,000), medium (2,000 to 5,000) and large (5,000 to 11,000, plus one that was 28,000). For each bypassed and "control" community, data were collected on the change in traffic volumes, change in population, change in employment, and change in retail trade covering both pre- and post-project years. All of this community data were mapped using a GIS, and GIS was used to compare the changes in each bypassed community to the corresponding "control group" (which represented what would otherwise have been expected to occur in the bypassed communities if the bypass had never been built). The findings were then checked against those from focus groups of community leaders and from origin-destination mapping (using license plate matching) to assess the extent to which local versus outside traffic used the old travel routes through the downtown areas.

b) Local Comparison to Surrounding Communities

Economic Benefits of Investment in Transport and Communications Infrastructure: Berrima and Mittagong Bypasses, Australia Bureau of Transport and Communications Economics, 1994.

The purpose of the study was to measure the local economic effects of a major highway project on small towns in the study area. The researchers collected information on changes over the pre / post period in: 1) traffic volumes through the towns; 2) business sales and employment based on surveys of retail and tourism businesses; 3) manufacturing production and freight costs based on surveys of industrial businesses; and 4) property values and income tax revenues based on data from city officials and real estate brokers. Data were collected for the towns of Berrima and Mittagong, which were bypassed, and also for the neighboring towns of Moss Vale and Bowral, which were not bypassed. The researchers compared differences in economic changes over time among the four towns, and related the differences to the impact of the bypass and other community differences.

5.4 Behavioral Data to Establish Causality

Causality can be established 1) through interviews with local experts, 2) by determining perceptions of new and pre-existing businesses, and 3) documentation of highway reliance by businesses. The first approach requires interviews of economic developers, while the latter two require surveys of key regional businesses. These approaches are not mutually exclusive. Any of them can be used to help determine the portion of observed change which is due to the highway project. They can be used in combination to "triangulate" the magnitude of credit due to the highway, and to provide greater confidence about the finding of highway impact.

Broad-based surveys of area businesses are most practical for small towns, or local neighborhoods, as well as highway corridors – areas with a limited number of businesses to survey. The local Chamber of Commerce is often an excellent vehicle for distributing and collecting such surveys. These local business surveys can provide retrospective information on:

- Past location and expansion decisions, and anticipated future decisions;
- The extent to which the highway affected these decisions;
- The role of the highway versus other factors affecting these decisions; and
- Reliance on the highway corridor for access to labor markets, customer markets and supplier markets.

A mail-back business survey (for commercial and other local business establishments), that is appropriate for use in a small town or neighborhood study, would essentially be the same as the sample survey form provided for highway corridor areas in Figure 4.4.

An ***interview guide for key businesses***, that is appropriate for use in a larger community, would be essentially the same as the sample interview guide provided for regional studies in Section 3.0, Figure 3.4.

It is extremely important to collect survey or interview responses both shortly after completion of the highway improvement and five to 10 years later. This latter point may demonstrate significant longer-term adjustments that were not anticipated by local merchants, residents, and new businesses immediately following construction. For example, a bypass study could find that some highway-oriented commercial activities have relocated from the center of town to the new bypass highway interchange area. In the longer run, though, a follow-up study might find that the town has exploited the relocation of fast pass-through traffic to the bypass route to redevelop its town center as an historic tourist destination, a transition that may take a decade or more to occur. Thus, both short-term and longer-term follow-up data collection and surveys can be valuable.

6.0 Interpretation and Application

Within the basic framework and standards laid out in Section 2.0, the three prototypes described in Sections 3.0 through 5.0 illustrate options and approaches for collecting and analyzing data measuring the economic impact of highway investments. This section discusses:

- Interpretation of measurement data;
- The manner in which findings should be presented; and
- Needs and opportunities for future improvements to the state-of-the-art and knowledge base concerning the economic development impacts of highways.

6.1 Interpretation of Measurement Results

Depending on the size and scale of the project, as well as the interest of the audience, any one or more of the data collection and analysis prototypes may apply. Under any of the three prototype studies, the results should be interpreted so as to answer the same three basic questions:

1. What is the magnitude of gross economic change occurring in the study area between the pre-project and post-project periods?

The results may be measured in terms of: 1) property demand indicators (such as real estate transactions, sales prices or lease rates); 2) building construction indicators (such as building permits or capital investment); 3) business growth indicators (such as the number of businesses, employment, or total sales activity); and/or 4) other indications of regional change (such as population or personal income). In any case, the results should be presented in a way that distinguishes whether the economic indicators represent short-term or long-term changes, or both.

The measurement of gross changes for any single highway project is likely to look different depending on whether the changes are measured at the regional, the highway corridor, or the local community level. (They also would look different at the national level, but this guide does not address that perspective.) There are two reasons for this: 1) the wider the study area, the more business startups, expansions and closures are included; but 2) the wider the study area, it is less likely that business relocations can be counted as a gain or loss. The choice of the study area should depend on the nature of the project and the nature of the audience for the economic impact study. There often can be value in accounting for economic impacts at multiple levels of geography, particularly when there are audiences or constituencies interested in different areas. Table 6.1 illustrates how the accounting would differ for one typical case of a rural highway with a typical definition of study areas.

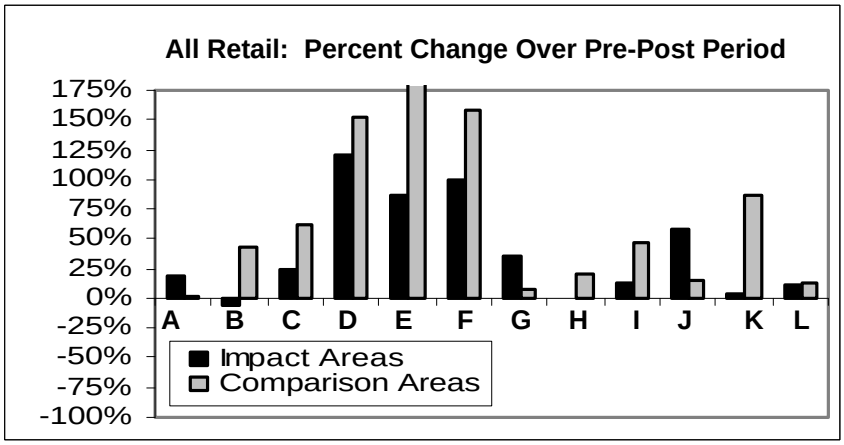
Table 6.1 Accounting of Gross Economic Change at Alternative Geographic Levels
(Illustrative Example, with Town Located along the Highway Strip)

Location of Business Expansion, Startup, Closure or Move	Impact on Total Economic Growth		
	Region View (e.g., State)	Corridor View (e.g., Highway Strip within State)	Local View (e.g., Town within Highway Strip)
Business moves to town along the highway strip			
From out of state	+	+	+
From elsewhere in-state (not along strip)	0	+	+
From outlying part of strip	0	0	+
Business moves to location along the highway strip (outside the town)			
From out of state	+	+	0
From elsewhere in-state (not along strip)	0	+	0
From town along the strip	0	0	–
Business moves to location in the state outside of the highway strip			
From out of state	+	0	0
From outlying part of strip	0	–	0
From town along the strip	0	–	–
Business expansion or startup			
Within state not along strip	+	0	0
Within state, along strip outside of town	+	+	0
Within state, along strip, in town	+	+	+
Business closure			
Within state not along strip	–	0	0
Within state, along strip outside of town	–	–	0
Within state, along strip, in town	–	–	–

2. What is the magnitude of net economic change, compared to what would have been expected to occur in the study area anyway (without the highway)?

The gross economic changes addressed in the first question must be restated in comparison to some "counter-factual" case, representing what would otherwise be expected to have occurred. This is normally done by comparing the observed actual changes to a comparison area, control group, statistically estimated baseline or structural economic model estimation of baseline expectations. Each of these methods attempts to distinguish local changes from broader economic changes affecting industries, regions, and comparable communities. The findings on net changes may differ by impact indicator. Figures 6.1 and 6.2 illustrate two ways to graphically portray differences in economic trends between impact areas and comparison areas.

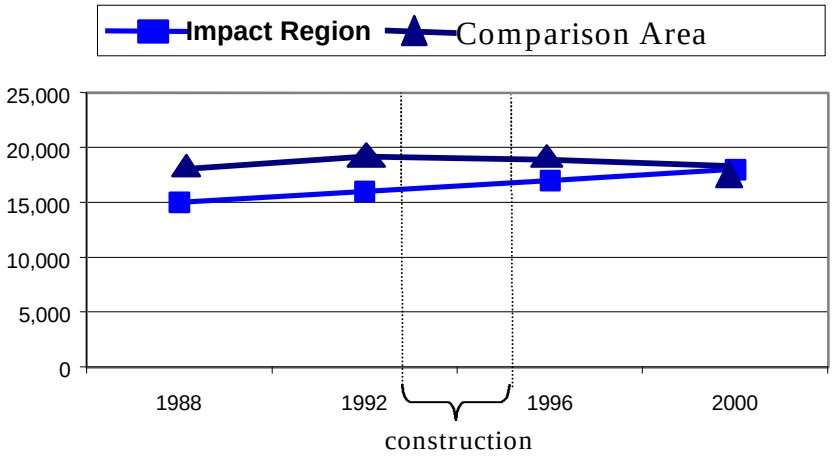
Figure 6.1 Sample Comparison of Retail Sales Trends between Project Impact Areas and Comparison Areas
(Pre/Post Changes after Highway Projects Reduce Access to Adjacent Businesses)



Note: A,B,C,…K represent different communities with highway corridor projects.

Source: Weisbrod, G. and R. Neuwirth. *Economic Effects of Restricting Left Turns*, Recent Research Digest RRD #231, National Cooperative Highway Research Program, 1998.

Figure 6.2 Sample Comparison of Employment Growth Trends between the Project Impact Region and Comparison Regions
(Pre/Post Changes after Completion of New Highway)



Area	Employment Growth Rate	
	1988-1992	1996-2000
Impact Region	6.7%	6.7%
Comparison Areas Avg.	6.7%	-3.2%
Net Difference	0%	+9.9%

3. What is the causal role of the highway project, relative to other factors also contributing to the net economic change?

The net economic changes estimated in responding to the second question must be further assessed in terms of the role of the highway project relative to other local factors taking place at the same time. They should specifically distinguish: 1) independent effects of the highway, 2) contributing effects of the highway acting in combination with other factors, and 3) roles of other factors. Other factors may include local economic development initiatives, programs, or incentives coinciding in timing with the highway project.

There are at least three forms of evidence that a highway project has helped cause the observed local changes. They are:

1. **Spatial Association –** evidence that spatial distribution of observed economic impacts is logically consistent with impacts of a highway project (based on GIS or other impact mapping);
2. **Temporal Association –** evidence that the timing of observed economic impacts is logically consistent with impacts of a highway project (based on time series data); and
3. **Views of Locally Knowledgeable Parties –** perceptions of local business and planning officials or others who are knowledgeable about the full range of highway and non-highway factors affecting local economic changes (based on survey results).

To the extent possible, these forms of evidence should be cited and presented in order to classify the extent to which the highway was a contributory cause of the net local economic changes. It is sometimes necessary to translate the analysis of causality into an assignment of the percentage of total net impact which can be assigned to the highway project, although there is clearly an element of judgment involved in that process. Consequently, the appropriate approach may depend on the particular situation. Table 6.2 provides one example of the types of categories that may emerge from causal analysis, and the types of corresponding impact credit assignments.

Table 6.2 Categorization of Highway Role in Economic Growth
(Illustrative Example of a Classification and Impact Assignment Scheme)

Reported Role of Highway Project in Causing Business Attraction or Expansion	Typical Assignment of Credit
Rating of Importance: Among Factors in Business Growth	
Highway was the sole factor.	100%
Highway was the primary factor, though other factors also helped.	80%
Highway was one of two key factors.	50%
Highway was one of three key factors.	33%
Rating of Role: Necessary versus Supporting	
Highway was a necessary factor; growth could not occur without it.	50-100%
Highway helped, along with a variety of other factors.	30-50%
Highway was a supporting factor, but not the key one.	10-30%

6.2 Presentation of Findings

The final step is to present the overall assessment of highway impacts, distinguishing gross changes, net effects and the causal role for each type of impact indicator.

6.2.1 Overall Assessment of Highway Economic Impacts

The effects of multiple impact indicators should never be added together, even if they are all in dollars. The different indicators represent different ways of measuring the same basic impact, and therefore adding the indicators likely will lead to double-counting.

In order to generate specific estimates of highway impact from a data analysis, it is necessary to translate the qualitative classification of causal relationships into assignments of the percentage of credit due to the highway. While this process can be arbitrary, there are generally accepted ranges of assignments (for instance, assigning 50 percent credit if the highway shared the impact with another equally important factor, or 70 to 80 percent credit if the highway is seen as being the most important though not sole factor). Table 6.3 illustrates a format for presentation of the overall calculation of highway impacts on a study area, for three common impact indicators: employment (jobs), income (earnings) and business output (sales volume).

Table 6.3 Illustration of Gross, Net, and Overall Impact Calculation

	Employment	Income	Business Sales
(A) Gross Impact	1,000	$50,000	$200,000
(B) Net Impact	1,500	$75,000	$280,000
(C) Percent Assignable to Highway Project	50%	50%	50%
(D) Overall Impact = (B) * (C)	750	$37,500	$140,000

6.2.2 Distinguishing Local, Regional and Statewide Impacts

Depending on the nature of the project and the audience for the economic impact analysis, the overall impacts may be measured at the local (town or corridor), the county, or regional level, the state level and/or the national level. A single project can have very different economic impacts at each of these spatial levels. This is because some of the economic growth observed in one area may be due to relocations of economic activity from other areas. Thus, for example, a business may move from one town in a state to another town in the same state. In this case, there are clear economic growth benefits for the town gaining the jobs, but a zero net change in jobs at the statewide level. This is not

to say that there is no statewide efficiency benefit, since no business would logically incur the costs of relocating unless there was some benefit to doing so, such as economies of scale or other operating efficiencies. In such cases, the statewide benefit may be more apparent in terms of productivity and income generation than in job generation. It also is possible that a relocation of economic activity within the state is desired as a means of assisting a depressed area and achieving more equitable statewide growth. Since any of these types of issues may be of policy interest, there can be great value in providing an explanation of the source of economic growth or decline in a highway impact analysis.

6.3 Next Steps

The underlying motivation for this study and the associated guidelines is to encourage and facilitate agencies to conduct more post-project economic impact measurement studies in a generally compatible way, that can:

- Provide decision-makers with a set of results from different situations from which a reasonable range of potential benefits from proposed new projects can be inferred; and
- Provide analysts with a base of data from which future economic impact forecasting models can be better calibrated.

The results, in turn, will help:

- Planners better understand how highway investments can be effectively leveraged to stimulate desired economic development; and
- Transportation funding agencies demonstrate the value of past investments.

The following four multi-year efforts are recommended as being useful in addressing these goals:

1. **Pilot Studies –** The general guidelines laid out in this document are meant to help guide and standardize future studies measuring the actual economic impacts of built highway projects. Pilot studies are needed to test (and demonstrate) the reasonableness and usefulness of these recommended data collection, analysis and presentation guidelines. The pilot studies ideally should be carried out by state or regional agencies that have previously funded highway projects based in part on expectations that these projects would have economic development benefits.

2. **Meta Analysis –** Upon completion of pilot studies, the results can be combined with already existing post-project impact measurement studies, as covered in the Volume 1 Report (as well as the examples provided in Sections 3.0 through 5.0 of this report). By pooling results of multiple studies, it can be possible to derive findings on impacts of highways which have a greater degree of validity and reliability than can be obtained from any one study alone. In this case, there is a need to conduct such pooled assessments separately for a) large, regional highway projects, b) town bypass highway projects, and c) highway upgrades that affect rural strip development.

3. **Training Courses –** Interviews with transportation agency staff, discussed in the Volume 1 report, indicate a need for enhancing staff knowledge at three levels:

   - To enhance the *understanding of managers* concerning the advantages and possibilities provided by "taking the plunge" into looking at economic development impacts of their projects;

   - To enhance the *capability of analysts* to take on responsibilities for collecting and analyzing data on economic impacts; and

   - To enhance the *ability of planners* to use information from prior economic impact measurement studies as a basis for identifying opportunities and concerns facing proposed new projects.

   A series of training courses or seminars can help to address needs at all three of these levels. By serving to encourage, facilitate, and empower agency staff to address economic development issues, these courses can assist staff persons in helping to improve future transportation planning and decision-making.

4. **Contribution to Benefit-Cost Analysis –** Economic development impacts are just one category of the total benefits and costs of highway projects. Transportation agencies have a remaining need for guidance on how findings on economic impacts help inform future policy regarding fiscal, land use, environmental justice, and other social and economic considerations in decision-making.