

**Long-Term Economic Development Impacts of Highway
Projects: Findings from a National Database
of Pre/Post Case Studies**

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ABSTRACT

Highway projects can have a wide range of different economic development effects, depending on the type of project, objective, location, surrounding conditions and local business context. Yet most empirical analysis of highway economic impacts to date has been based on highly aggregate statistical studies, anecdotal observations or theoretical predictions. A national database of pre/post case studies offers the potential to more systematically observe and document the nature of local and regional economic impacts, and provide insight into factors affecting them. Real world observations can also serve as a useful complement to model predictions, and also provide a basis for refining them. Accordingly, the Strategic Highway Research Program funded 100 pre/post case studies of the economic impacts of highway and highway/intermodal projects, and assembled them to provide the start for a national database of observed impacts. This paper summarizes findings from the initial analysis of that database, presenting findings on the range of observed job impacts and land development impacts, and factors affecting the nature of those results.

INTRODUCTION

There are many reasons why pre/post case studies of transportation projects and their economic impacts can be useful -- either individually or as a pooled source of data. (1) For policy accountability, they can provide a form of audit assessment of the consequences of past investments. (2) For public information, they can be useful for communications to government officials and the general public regarding the nature of impacts that can actually result from transportation projects. (3) For impact prediction, they can aid initial sketch planning processes by defining the range of likely impacts (for early stage considerations, before further modeling is undertaken). (4) For research, they can provide a rich base of data for further statistical analysis, and those results can also be used to further improve the accuracy of predictive models. (5) For planning, they can be used to identify the types of local factors that need attention to maximize economic impact opportunities and minimize barriers to them. (6) And for public hearings, information on real world experience can be helpful to establish a range of reasonable expectations regarding local impacts, which typically are far less than either the fears of project opponents or the hopes of project proponents.

Unfortunately, relatively few pre/post case studies have been conducted on a systematic basis. Reasons likely include the cost of designing, collecting and analyzing such information, as well as fear of embarrassment if outcomes are found to fall short of expectations for project investment that have already been made.

To overcome these limitations and enable the advantages noted above, the US Strategic Highway Research Program (SHRP) funded development of 100 pre/post case studies of the economic development and land development impacts of highway and highway/intermodal projects, along with development of a database and web tool for viewing and using their findings. The project sought to include all major project types, spanning all regions of the continental US and both urban and rural settings. It also included a small number of available English language studies from Canada and abroad, in a format that would enable continuing expansion over time. The full results of that effort are provided in a final report and the TPICS (transportation project impact case studies) web tool [1].

This paper describes key findings from a statistical analysis of that case study database. It represents the first profile of the range of different economic and land development impacts found to result from individual types of highway projects, along with an analysis of the types of local factors that were found to either enhance or diminish the nature of economic impacts.

LITERATURE REVIEW

There have been two notable initiatives to conduct pre/post case studies of major highway project impacts in the past. First, the Federal Highway Administration (FHWA) funded development of a guidebook for conducting pre/post case studies, and case studies for around a dozen rural Interstate Highway routes built after 1990 [2],[3]. Second, the Appalachian Regional Commission (ARC) funded case studies of impacts for completed portions of the Appalachian Development Highway System and selected local access roads [4],[5]. In addition, various states have developed case studies for community bypasses and local industrial park access roads [6],[7],[8],[9],[10]. Since the SHRP effort sought to build a national database of available case studies, all the above-cited FHWA case studies (plus bypass and ARC access road cases that had sufficient data) were included and updated in the national database.

DATASET DESIGN

Selection of Cases

The case study dataset was designed to cover the full range of highway-related facilities, including intercity highways, urban beltways and local access roads, as well as local bridge and interchange projects. In addition to highway/rail projects intermodal freight terminals and intermodal transit terminals were also included. Cases were selected to cover a wide distribution of different project types, spanning different regions of the US and different types of urban/rural settings and economic distress levels. The initial 100 cases were distributed among ten project types as follows.

- New Highways (14 cases)
- Beltways (8 cases)
- Bridges (10 cases)
- Bypass Routes (13 cases)
- Connector Roads (8 cases)
- Highway Interchanges (12 cases)
- Industrial Access Roads (7 cases)
- Highway Widening (9 cases)
- Intermodal freight (road/rail) (10 cases)
- Intermodal passenger (road/rail) (9 cases)

The selected projects represented capital investments intended to either enhance access to locations (via new routes and intermodal facilities) or expand effective traffic flow where it has been adversely affected by congestion or sub-standard operating conditions (via added lanes, interchanges, bypasses or intermodal facilities). These are the types of projects for which economic development objectives are most commonly claimed. (Other types of highway investment, such as rehabilitation, reconstruction, safety and environmental enhancement projects were not covered in the case study database because they are seldom intended to have any economic development impact, and it was deemed preferable to focus funds on collecting more relevant case studies.)

Data Collected.

For each the 100 selected projects, data was collected to facilitate: (a) comparison of pre-project and post-project changes in economic and land development conditions, (b) contrast of observed project area changes with underlying state population and economic growth patterns trends occurring over that same period, and (c) inclusion of both quantitative impact measures derived from available public sources, and qualitative assessments derived from local interviews. Five categories of data were assembled for each case study; these data items are listed below and described in further detail in the project report [1]:

- (1) *Project characteristics* -- type of transportation facility, years built, cost, size (length, lane-miles), and level of use (AADT);
- (2) *Project objectives* -- congestion reduction or access enhancement;
- (3) *Impact metrics* – pre/post change measures in employment, population, land values, building development (for points in time just before project initiation and at least 5 years after project completion);

- (4) *Quantitative explanatory data* – data on project setting in terms of region of the US, population density, urban/rural class, topography, economic distress, market size, distance to key transportation destinations;
- (5) *Qualitative explanatory data* – local interview findings on project setting, regarding local land use regulations, use of business incentives; presence and use of support programs for economic development, and other local factors that can enhance or reduce observed economic changes.

PROJECT IMPACT MEASUREMENT

The first step in estimating the economic impacts is to understand the process in which they develop. Economic impacts of transportation facilities typically unfold in a sequence, affecting different impact metrics and spatial scales over time, as noted in the FHWA guide to case study measurement of economic impacts [2]. Acknowledging these effects, the SHRP case studies (completed in 2010) were restricted to projects that had been completed at least five years earlier in order to have sufficient time for the impacts to be manifested. In addition, the case studies sought to measure land value and building construction effects at the level of highly localized areas, while employment, income and tax impacts were measured for both local areas and larger areas (ranging from individual municipalities to multi-jurisdictional corridors or counties). The case studies confirmed the following typical sequence of impacts:

Transportation Impact. Initially, a highway project is initiated to affect travel-related costs or accessibility for some area, by enabling faster or more reliable travel to and from that area, or enabling access to a broader set of origin or destination opportunities. The benefitting area may be adjacent to the project, or it may include areas well beyond the endpoints of the project corridor. There are occasionally adverse impacts on adjacent areas, which tend to be offset by benefits elsewhere.

Land (Property) Value Impact. Upon project completion, or in anticipation of it, demand starts to grow for land at benefitting locations, typically leading to higher property values and transaction prices there.

Building Construction and Investment Impact. Increased demand leads to added investment in the form of building construction. That effect is reflected initially in terms of building permits and later in terms of new or upgraded building structures.

Employment, Income and Output Impacts. Once buildings are occupied, there can be measurable increases in population or business activity. The latter can be measured in terms of added jobs, income, value added or output growth.

Tax Revenue Impacts. The added land value, building structures, population and business activity together can show up as increases in property, income and/or sales tax collections.

The case studies also confirmed two key conclusions pertaining to this sequence of impacts. First, impacts unfold over time, so no single project will necessarily show every type of impact at the same time. For that reason, multiple impact measures and an appropriate broad period of observation may be needed to observe economic development impacts. Second, each of the various forms of impact can have a different spatial pattern of observation; some may be observed at a neighborhood level while others will be spread over a broader community or regional level. These effects also vary systematically by type of project. For instance,

connectors, access roads and interchanges tend to have localized impacts, while intercity routes and bypass projects can have broader impacts with some beneficiaries hundreds of miles away.

Direction of Impact

Table 1 shows case study findings for the various economic impact metrics. Focusing first on the most reliable and widely available impact metric -- employment impact, the results show that 85% of the cases showed net positive changes in local employment that were at least partially attributable to the highway project. Only one project had a net negative impact, while the remaining 14% found evidence of no net impact. The latter finding includes both cases where there was no evidence of job impact and cases where there were both negative and positive impacts that tended to cancel out.

Table 1: Results of Quantitative Economic Impact Measurement

Dimension of Impact	Positive Net Change	Negative Net Change	No Net Change	No Data Available
Direct Impact on Jobs	85	1	14	0
Direct Impact on Investment \$	30	NA	-	70
Direct Impact on Construction \$	36	NA	-	64
Direct Impact on Local Tax Revenue	14	NA	-	86
Change in Total Business Sales	8	7	-	85
Change in Property Values	42	5	-	53

It is important to note that the case study results show net effects. It is clear that in some cases, highway projects can cause negative visual, air quality or noise quality impacts on areas that are directly adjacent to them, while providing access benefits to broader surrounding areas. In some cases, highway projects can also cause localized negative job impacts, as would be the case if a highway construction or expansion project required the taking of some property with existing commercial activity. However, in nearly all cases, such takings are only done because the project will also enable new activity to occur somewhere else nearby. The incidence of any such impacts are noted in some of the case study text discussions, though we cannot make any conclusions on their severity because the empirical database of economic impact measures focused only on measurement of net changes for broader surrounding impact areas.

The incidence of direct impact measures other than jobs was spotty. Information on induced construction, private capital investment associated with the project and corresponding tax revenue generation was obtained from local planning officials and by definition could only be positive (or zero). When municipal data was available on pre- and post-project business sales and property tax generation in the vicinity of the highway project, it tended to show positive changes more often than negative changes. However, we cannot be sure how much of the observed shifts are attributable solely to the highway projects occurring in those areas. However, it is important to note that this study faced a challenge in obtaining pre-project data long after the projects had been completed, and it can be far easier to collect such data in future case studies if pre-project data is collected when projects have been planned but not yet been built.

EMPLOYMENT IMPACT RATIOS

The case studies overall had a ratio of 7 new long-term jobs generated per \$ million of highway investment, though the ratio varied from less than 2 jobs to nearly 90 long-term jobs per \$ million depending on the type of project and urban/rural setting. (See Figure 1.) The access roads, interchange and connectors tended to have the highest average ratio of long-term job growth per \$million of highway spending. At the other extreme, the beltway freeway (limited access highway) and widening projects tended to have the lowest average ratio of long term job growth per \$million of highway spending.

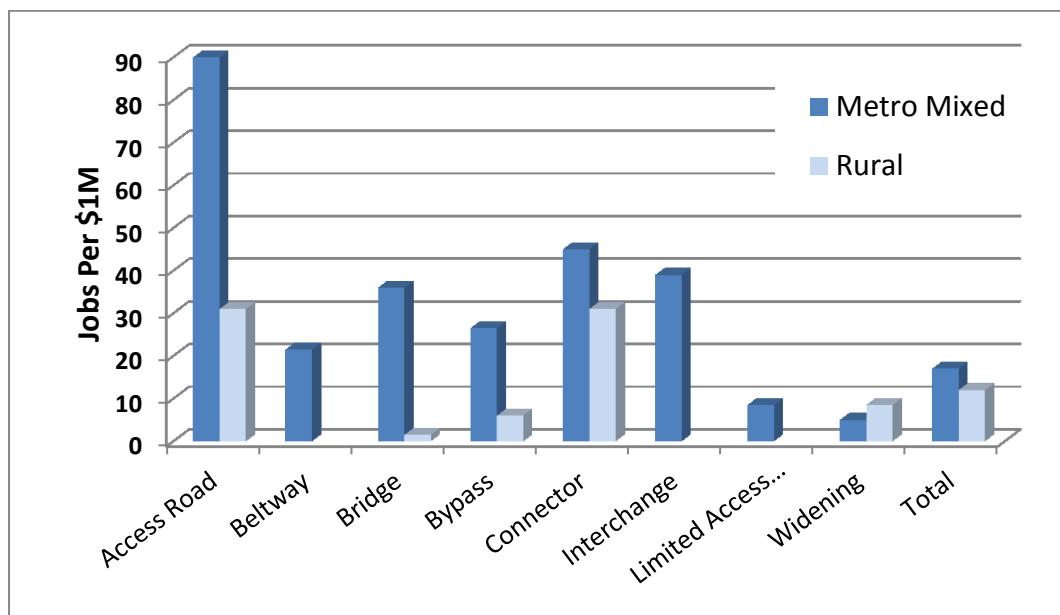


Figure 1: Total jobs per \$million project cost: metro & mixed and rural settings

These systematic differences occurred for some very good reasons. Project types with the highest ratio of long-term job growth per \$ million spent – access roads, interchanges and connectors –were often built specifically to facilitate specific business location or expansion activities that were contingent on having new access routes, interchanges or connectors built.

On the other hand, project types with lowest ratio of observed job growth per \$ million spent – urban freeway (limited access highways) and highway widening projects – often required the addition of costly land acquisition and neighborhood impact mitigation costs. And the beneficiaries of those projects were more likely to be through trips based at origins and destinations beyond the highway project endpoints (thus providing benefits beyond the areas immediately surrounding the highway project).

There were also substantial differences in the job generation ratio by urban/ rural setting. The ratio of long-term jobs per million dollars spent for projects in a metropolitan (or mixed urban/rural) area was more than three times than occurring in rural areas. Fully 22% of the rural projects but only 14% of the metro/mixed projects had zero job creation. And fully 50% of the rural projects but only 22% of the urban/mixed projects had 0 - 99 net jobs added. The upside potential was most evident for the metro area projects, as 66% of them had a long-term job growth impact exceeding 1,000 jobs. There are many possible explanations for this finding,

which will need to be further explored in future research. With differences in densities of population and jobs, one hypothesis is that many of the rural projects serve intercity travel whose beneficiaries are more broadly distributed outside of the project area. Or it may be that, as noted in an ARC study, rural projects also take longer for land development and private investment impacts to take place [10].

ROLE OF PROJECT MOTIVATION

As part of the data collection through interviews, designations were made to classify each project according to its purpose(s), which were classified into nine major categories. Six related to increasing access, which can help attract business activity. They were: improving access to terminals of air, rail and marine modes, international borders, labor markets, and delivery markets. Two were related to direct economic development, which includes tourism market and facilitating on-site development. The final motivation category was congestion management, which often represents an attempt to prevent further degradation in conditions rather than to enable positive enhancement compared to past or current conditions.

In the case study interviews for each project, both local planning officials and business representatives were asked to identify project motivations and they were allowed to choose multiple motivations. Overall, project motivation was obtained for all 97 North American cases (3 international cases were excluded). Fifty eight of these were motivated by an access factor, 65 by a direct economic development factor and 54 by congestion management (See Table 2). The motivation to mitigate congestion was most often reported for urban highway projects, while the motivation to facilitate site development was most often reported for interchange and access road projects.

Table 2: Transportation Motivation for Projects

Project Motivation	Projects	Category Type	Total
Improve Access to Airports	20	Improving Access	58
Improve Access to Rail	10		
Improve Access to International Border	3		
Improve Access to Marine Port	9		
Improve Labor Market Access	30		
Improve Delivery Market Access	32		
Facilitate Site Development	52	Economic Development	65
Facilitate Tourism	26		
Mitigate Congestion	54	Congestion Mitigation	54
All Projects Reporting Motivation	97		97
All Projects	100		100

Figure shows how the transportation motivation of these projects varied by setting. Many projects had more than one motivation, so they do not sum to 100%. Focusing just on the highway projects (excluding intermodal terminals), the chart shows that the most common project motivation in both rural and metro areas was congestion mitigation. Site access and delivery market access were the next two most frequent reasons in metro/mixed and rural settings, while tourism was an important motivator in rural areas and labor market access was also key in metro/mixed areas.

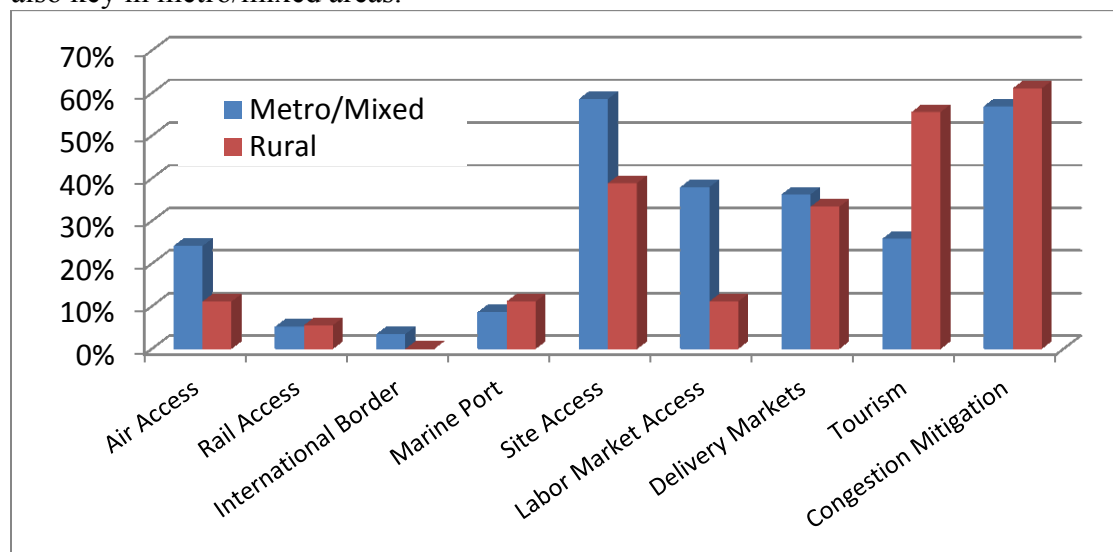


Figure 2: Project Motivations.

(Percentage of highway cases with each motivation, excluding intermodal projects)

ROLE OF NON TRANSPORTATION FACTORS

The economic impact of highway projects was often also affected by non-transportation factors, most commonly as the presence of other infrastructure investments, land use policies and/or business development incentive programs. In some cases, the synergy among multiple factors created a positive economic development climate that lead to further job creation. Yet in other cases, a lack of complementary infrastructure and supportive policies diminished job impacts. Table 3 shows the frequency with which these non-transportation factors that were cited in case study interviews as affecting the long-term job growth impacts of highway projects.

Table 3: Non-Transportation Factors that Influenced Job Creation

	Factor	Incidence
Positive Local Factors	Available Infrastructure (sewer, water, telecom)	33
	Land Use Management	45
	Financial Incentives/ Business Climate	46
Negative Local Factors	Lack of Infrastructure (sewer, water, telecom)	10
	Lack of Land Use Management	6
	Lack of Financial Incentives/ Neg. Business Climate	5
ALL PROJECTS		100

For the US highway projects, Table 4 shows a tabulation of the total job impacts for projects that were strengthened by positive local factors or impeded due to lack of supportive local policies. It confirms that more long-term job growth was reported for highway projects with positive local factors than occurred with projects lacking those supportive factors. The average job creation is 850 from projects where the lack complementary infrastructure or policies inhibited economic development, compared to almost 6,100 where positive factors were reported.

Table 4: Job Creation and Non-Transportation Local Factors (US Highway Projects only)

Non-Transportation Factors	Number of Cases	Total Direct Jobs	Mean Average Direct Jobs
Positive	45	273,358	6,075
Negative*	9	6,812	852
Mixed Positive & Negative	4	11,600	2,900
Not Reported	20	109,566	5,478
Totals**	78	432,132	5,540

* Excluding Interstate 26 project, which reported nearly 31,000 jobs yet local officials reported that the project never reached its full potential due to lack of adequate infrastructure and land use management

**Note: Total excludes 3 non-US projects and 19 intermodal terminal projects

The intermodal terminal projects are excluded Table 3 because they reported substantially higher job impacts but it was uncertain just how much of that reported job impact was due to the road access component of those projects. However, it is notable that 14 of the 19 intermodal cases had positive (non-transportation) factors that supported project development, without any negative factors. The others had both positive and negative factors reported.

The influence that local factors can have on economic outcomes is even more apparent when grouped by level of economic distress, as shown in Figure . Non-Distressed areas with positive local factors resulted in higher median jobs per \$ million than distressed areas.

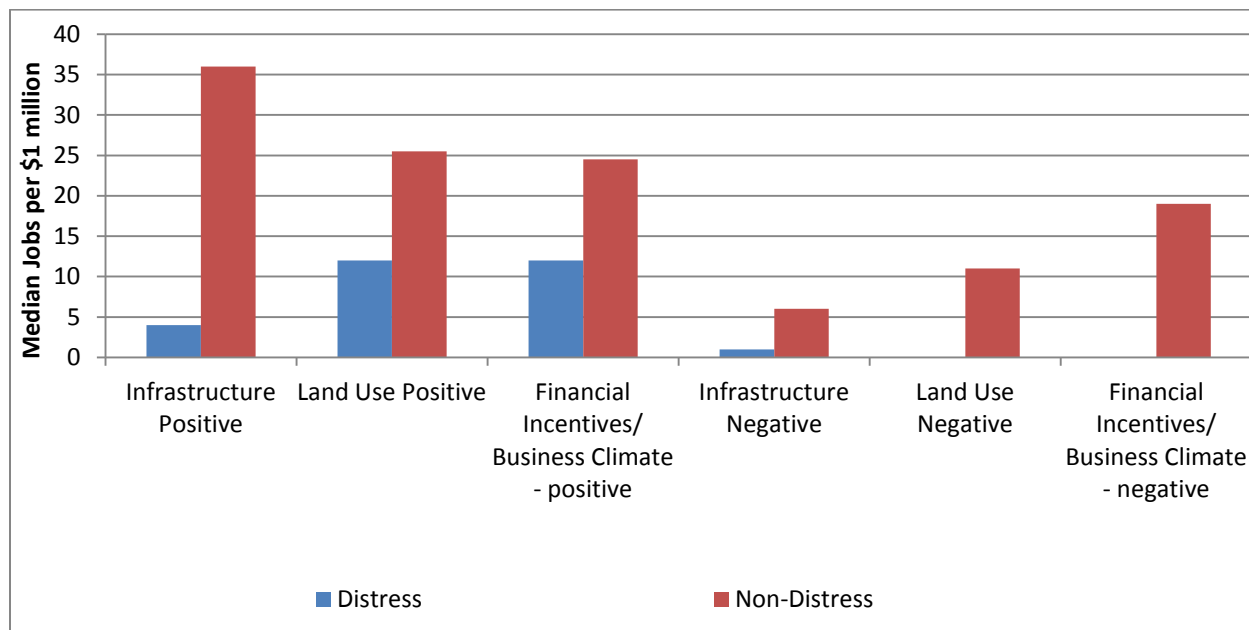


Figure 3: Non-Transportation Local factors, by distress level.

ANALYSIS CONCLUSIONS

This study sought to establish standards for a national database of pre/post case studies. In doing so, it included requirements for: (a) pre/post impact comparison, (b) coverage of both local and regional level impacts, (c) a wide range of alternative perspectives for viewing and measuring impacts, (d) comparison of local changes over time relative to reference sources such as state and national trends, and (e) reliance on both quantitative data and qualitative observations regarding local economic conditions. In this way, the case studies highlighted the multi-faceted ways in which economic development impacts can occur, depending on the type of project and its setting.

Using this approach, the case studies showed that there is wide variation in observed in economic impacts among the 100 projects and within each category of projects, explained by multiple factors including the following:

- Job impacts vary tremendously by size and type of project. To enable comparison, long-term job growth impacts were shown relative to the size of the project investment. Of course, projects are built for many reasons other than just economic development, so one cannot simply conclude that projects with the highest job impact ratio are most needed or desired.
- There are systematic differences in the nature of job growth impacts among different types of highway projects. Smaller and lower cost projects that enable planned business locations at specified sites (sometimes referred to as “contingent development”), such as access roads and interchanges, naturally tend to show the highest long-term job growth/cost ratio. Larger and more costly projects such as major new highways, urban freeways and beltways tend to have more diffused regional impacts including benefits not fully captured because they may occur outside of the study area. The urban projects also tend to be most expensive, due in part to land acquisition and externality impact mitigation costs. Together, those factors tend to make the larger projects appear to have a lower ratio of measured long-term job growth/cost, even though

they had the largest absolute numbers generated for long-term jobs growth. So care must be taken in using either absolute or ratio metrics to conclude that some types of projects are better than others in generating economic development.

- Project location matters. More jobs were generated by project in metro settings than in rural settings. Though rural projects take less time to build than those in metro settings, job development in rural areas generally takes a longer time to mature than in metro areas.
- The economy and business climate of the project impact area is a critical factor affecting the magnitude of project impacts. Projects in economically vibrant areas with complementary infrastructure and supportive local policies tend to generate more long-term jobs than areas where those supportive factors are not yet in place.
- Motivations for developing projects differ, and projects with a coordinated economic development effort (involving complementary policies) generally facilitated more long-term job growth than projects lacking those local supporting policies.

METHODOLOGICAL CONCLUSIONS AND NEED FOR FURTHER RESEARCH

Data Coverage

The individual case studies, available via the TPICS web tool (www.tpics.us), are notable for their standardized approach and attempt to isolate the incremental economic development impacts of highways and highway/intermodal projects. This latter objective was addressed in three main ways: (1) through inclusion of pre/post comparison utilizing multiple impact metrics, to capture different facets of economic impact, (b) through inclusion of interviews with local planners and business representatives, to help determine causality and presence of non-transportation impact factors, and (c) through inclusion of data on broader statewide employment trends, to control for external changes in economic conditions over time. The data tabulation analysis reported in this paper made use of the first two elements. However, it did not utilize the statewide comparison data because it was felt that further statistical analysis would be required to appropriately control for factors also affecting statewide changes over the long pre/post study periods. However, there is opportunity for further analytic work on this topic.

A further limitation of this analysis, and indeed a limitation of the current case studies, is that data is lacking to compare pre/post changes in traffic volumes and speeds over time. Availability of such data would have enabled further analysis of how economic impacts are affected by different magnitudes of traffic change. In nearly all cases, the relevant transportation agencies could not provide pre-project data on traffic volumes, speeds or access conditions, as that called for data covering periods now ten to twenty-five years ago. This is a limitation of constructing case studies after the fact. Since enhancing traffic movement and access conditions are frequently cited as project objectives, it would be useful for transportation agencies interested in monitoring project impacts to more systematically collect and retain measures of these conditions before future projects are started. That would enable more complete case studies in the future.

Use of Results

Despite some limitations, the development of this case study database and analysis methodology has value in two ways. First, it provides a basis for distinguishing the extent to which the highway project was actually responsible for observed economic development

impacts. Second, it serves to highlight the ways in which local economic and institutional factors served to either reduce or expand the magnitude of observed economic development impacts. The case studies also help to establish the extent of causal connection between highway-related improvements and resulting economic impacts, though they cannot yet relate the observed economic impacts to pre/post change in transportation conditions.

The most obvious application of the current case study database and TPICS web tool is to provide transportation planners with a way to search for relevant types of projects in specific types of setting (region location, urban/rural population density, etc.). It also allows users an option to specify a given type of proposed project, and then see the range of impacts that have been actually observed in case studies to date. This can have three important uses. First, it can have value for early stage policy or strategy development, in which may be useful to initially identify the magnitude and types of impact tradeoffs to be considered. Second, it can be useful for “sketch planning” processes, in which it may be useful to identify the types of local non-transportation factors that may need to be addressed in later, more detailed planning steps. And third, the case study findings can be useful in public hearings, as they provide a way of responding to the sometimes unrealistic hopes of proponents or fears of opponents, with information on the range of impacts that have actually occurred in the real world.

The case study results can also be used as a rich set of data to obtain provide empirical evidence to help validate the reasonableness of predictions made by economic impact forecasting models for proposed future projects. Until now, there has been a paucity of such data available for validating predictive models. However, it should also be clear that the case study database and web tool alone cannot serve as a substitute for the detailed analysis incorporated into predictive economic impact models. For while predictive economic impact models forecast shifts in economic growth resulting from complex interaction of changes in transportation conditions and changes in the underlying economy, the case studies lacked both the transportation change data and the statistical controls incorporated into such models. Consequently, it is most useful to consider the case study database to be most useful as a sketch planning tool for initial planning, policy or strategy development, while economic impact models are designed for to be most useful in later stages of planning and prioritization, where more details are available on the nature of proposed projects and their expected transportation system impacts.

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