Impact of State Highway Investment on Employment Along Major Highway Corridors

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Prioritization and selection of highway projects may be based, in part, on the expected impact of a proposed investment on the regional economy. Previous studies have shown that the magnitude and significance of the impact of highway investment on a regional economy may be affected by the nature of the economy and the spatial distribution of socioeconomic activity. The question of how highway proximity influences the impact of highway investment on the economic activity of 87 Minnesota counties was examined. The analysis is based on highway construction expenditures and county employment data in conjunction with vector autoregression structural plots and causality tests. The results suggest that, in response to highway expenditures above the trend, counties containing major highway corridors experience a small, statistically significant, increase of their total and manufacturing employment. In contrast, counties not containing major highways experience a small, statistically significant reduction of their total employment.

Urban, transportation, and economic planners often face decisions on the prioritization and programming of highway investments. Decision-making criteria in the evaluation process of state highway construction projects are based, substantially, on benefit-cost analysis. Incremental roadway user savings, measured in terms of vehicle operating cost and travel time, are the project benefits and are compared against the investment cost of highway projects. Although all project benefits are included in the roadway user savings, highway investments have a broader regional economic impact. For quantifying the latter hypothesis, an appropriate criterion is the expected impact of a proposed investment on the economic well-being of the region in which the project is located.

Linkages between economic development and transportation network expenditures have been established in a number of studies (*1-4*). These studies have demonstrated that highway infrastructure investments can affect the level of economic activity of a region by inducing changes in residential location (*1*), work place (*2*), and enterprise location (*3,4*). Furthermore, the relationship between proximity to interstate highway corridors and population and employment growth have been studied in England (*5*) and in the United States (*6,7*).

The objective of this paper is to empirically examine the effect of highway construction expenditures on the employment level of various sectors of the economy in the state of Minnesota. In particular, we seek to determine whether there are differential effects of highway construction expenditures on the employment of a region as a result of proximity of that region to major highway transportation corridors.

The rest of this paper is organized as follows. The second section of the paper presents an overview of previous related work. The third section describes the proposed methodological framework for determining the relationship between highway construction expenditures and employment. In addition, this section summarizes the input data of a case study used to illustrate the proposed methodology. The results of the case study are then discussed and are followed by concluding remarks.

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PREVIOUS RELATED WORK

Traditionally, the prioritization of highway construction expenditures has been based, to a large extent, on the consideration of roadway user benefit-cost analysis. A limitation of this approach is that it does not explicitly consider potential effects of highway expenditures on the overall economic well-being of the geographic region in which the investment takes place. Nevertheless, in the United States, 36 departments of transportation consider the economic impact of highway construction expenditures in their project prioritization and selection process (*8*). Further, work in the area of prioritization of highway investments for low-volume rural roadway networks has suggested that low-volume roadway investments should be viewed in the context of regional economic integration and development (*9-14*).

Koch et al. (*9*) proposed a multicriteria framework for the socioeconomic evaluation of rural road projects. The study used the following five criteria for the appraisal of rural road projects: (a) economic benefits, (b) economic costs, (c) distribution, (d) accessibility to social services, and (e) employment. Leinbach and Cromley (*10*) introduced a goal programming formulation for the evaluation of rural roads in Indonesia. Among the considered criteria are total population served by the projects, area of the agricultural land served, connectivity to major corridors, daily market distance, and nature of facilities served. A study of rural road accessibility and development of agriculture and social infrastructure in Ghana (*11*) concluded that improved accessibility resulted in increased social development of rural communities. Analysis of the relationship between the structure of the rural roadway network and accessibility of public facilities (*12*) revealed that

improvements in the travel times of crucial roadway segments can reduce the number of health care facilities required to effectively serve a given geographic region. However, improved accessibility can also increase the extent of disparities in the local economy (*14*).

The relationship between transportation network investments and level of economic activity has been the subject of a number of empirical studies. However, the results of these studies are inconclusive and often are not in agreement with the hypothesis that the improvement of the transportation infrastructure is a prerequisite to economic development in a region (*13*). For instance, a study of the Ozark region in Arkansas found little correlation between highway investments and economic development (*15*). Further, a study conducted in the Atlantic region of Canada found that investments in the area's transportation infrastructure would attract few industries (*16*).

Sheppard (*14*) and Stephanedes (*17*) suggest that the inconclusive and occasionally contradictory conclusions on the relationship between transportation and economic development are the result of three major factors: (a) variability in the geographical scale across studies, (b) use of methods that are not appropriate to determining the direction of the relationship between the two variables (i.e., the level of economic activity and highway construction expenditures), and (c) failure to consider the hysteresis involved in transportation-economy interactions.

Therefore, in evaluating the impact of highway investments on economic development, it is necessary to use analytical methods that can determine directional effects between the involved variables and account for the time lag between the highway investments and the level of economic activity. Stephanedes (*13*) proposed vector autoregression, causality tests, and structural plots as the most appropriate analytical methods, and these are also adapted in this study.

METHODOLOGY AND DATA SOURCE

The vector autoregression (VAR) formulation for this analysis consists of two equations—one explaining highway expenditures and one explaining employment. Equations 1 and 2 represent mathematically the VAR.

$$H_{i,t} = \gamma_1 + a_{11} H_{i,t-1} + a_{12} H_{i,t-2} + \ldots + a_{1q} H_{i,t-q} + b_{11} E_{i,t-1} + b_{12} E_{i,t-2} + \ldots + b_{1q} E_{i,t-q} + \varepsilon_{i,t} \quad (1)$$

$$E_{i,t} = \gamma_1 + a_{21} H_{i,t-1} + a_{22} H_{i,t-2} + \ldots + a_{2q} H_{i,t-q} + b_{21} E_{i,t-1} + b_{22} E_{i,t-2} + \ldots + b_{2q} E_{i,t-q} + \eta_{i,t} \quad (2)$$

where

$H_{i,t}$ = highway construction expenditures in county i during year t,
$E_{i,t}$ = employment in county i during year t,
a, b, and γ = coefficients, and
ε and η = error terms.

Two sets of data are necessary for the implementation of the VAR method. The first set represents the distribution of highway construction expenditures over time, whereas the second represents the time evolution of employment level.

For this application, state trunk highway expenditure data on the 87 Minnesota counties were obtained from the Minnesota Department of Transportation for the period 1957–1982. Because the objective was to determine whether there is a differential effect of highway proximity on the relationship between highway investment and economic development, the 87 Minnesota counties were divided into two groups. The first group includes the Minnesota counties that contain a major highway transportation corridor; all other counties are placed in the second group. For the purposes of this study, a major corridor was defined by an interstate or one of the most heavily traveled state trunk highways.

Employment data were obtained from the County Business Patterns, spanning the period 1964–1982 for the same 87 Minnesota counties. A study of the distributional effects of state highway investment on local and regional development has shown that, in diversified economies, highway investments affect to a different extent the employment level of various economic sectors (*17*). For instance, the employment impact of highway investments may appear first in the manufacturing sector, and the impact on other sectors (e.g., retail and wholesale) follows. Therefore, it was deemed necessary

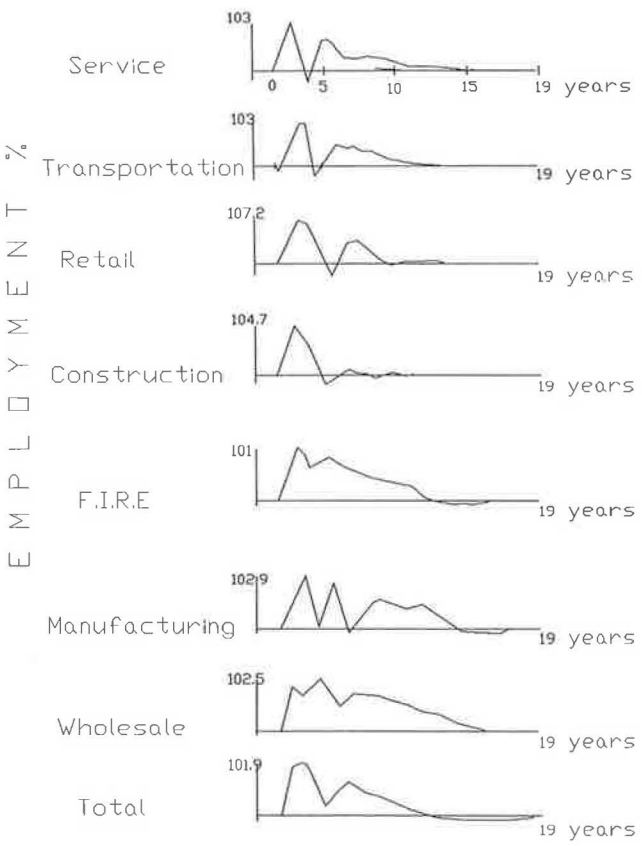

FIGURE 1 Effect of highway expenditures on employment: counties with major highways.

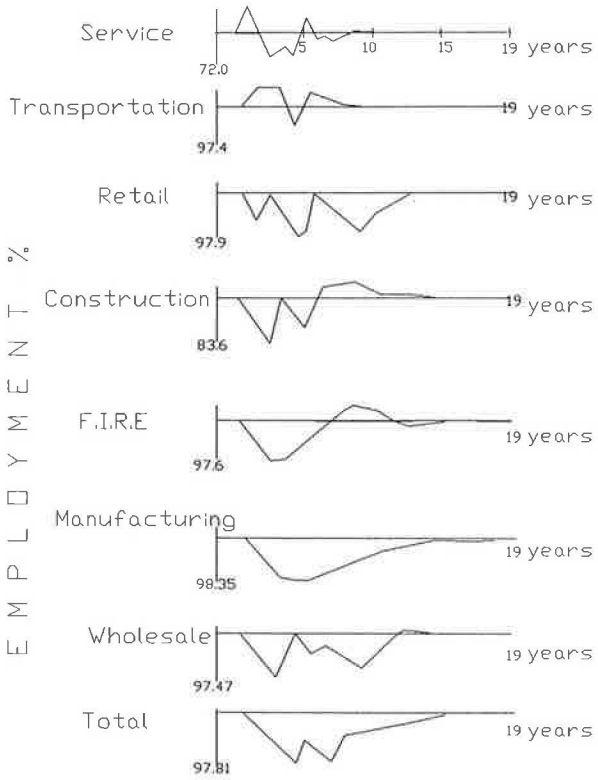

FIGURE 2 Effect of highway expenditures on employment: counties with no major highways.

for this study to examine the effect of highway investments on total employment as well as on sectoral employment levels. For the sectoral employment analysis the following employment categories are used: (a) manufacturing, (b) service, (c) wholesale, (d) transportation, (e) finance insurance and real estate (FIRE), (f) retail, and (g) construction.

Following filtering of panel data (*17*), time series analysis and causality tests were performed for the two groups of counties and the eight employment sectors. Since long-term effects are of primary interest, a 5-year lead was used in the VAR analysis. Furthermore, a 5-year lag was used in VAR to capture the inherent delay in transportation-economy interactions [see work by Stephanedes (*13*) for a detailed description of the method]. The results of the time series analysis are summarized in Figures 1 and 2 in the form of structural plots, and the causality test results are summarized in Table 1.

DISCUSSION OF RESULTS

In this section we discuss the results of the structural plots and the causality tests. First we consider the effect of highway investments on total employment for the two categories of counties; the discussion of the sectoral effects follows. The structural plot of each sector indicates the expected effect of a one-time 10 percent increase in trunk highway expenditures on the employment of that sector.

Total Employment

The employment effect varied between the two county groups. The data demonstrate that, in counties containing major freeway corridors, money spent on improving highways causes an increase in total employment above the normal trend. From Figure 1, a one-time 10 percent increase above the trend in highway expenditures may induce a 1.9 percent short-term increase in total employment. The peak of this increase is observed in the second year. The immediate employment changes that are due to expand business activities during construction last approximately 4 years. This short-term increase is followed by a sharp drop in total employment to its initial level. However, a positive long-term effect of highway investment on the employment of these counties is also indicated over a period of 15 years. From the causality test (Table 1), this impact is statistically significant at the 18.7 level.

For the counties that do not contain major highway corridors, the structural plot of Figure 2 indicates that a 10 percent increase in highway expenditures results in a 2.2 percent decrease in total employment. A long-term reduction in total employment is also manifested over a period of 15 years. In this case, the results of the causality test suggest that the decrease in total employment is significant at the 10.2 percent level.

The total employment results are in agreement with those of other empirical studies (*6,7*), which found that highway

TABLE 1 Effect of Highway Expenditures on Employment

Employment Sectors	Counties with Major Highways	Counties without Major Highways
	F-Test Significance Level (%)	F-Test Significance Level (%)
Service	16.1	>30
Transportation	>30	>30
Retail	>30	>30
Construction	>30	>30
F.I.R.E.*	>30	6.7
Manufacturing	0.7	>30
Wholesale	>30	>30
Total	18.7	10.2

*F.I.R.E. = Finance Insurance Retail Employment

infrastructure investments have a positive effect only on the localities in the vicinity of major corridors. The results also indicate that most of these gains are balanced by employment losses in the counties that are further away. Since regional centers tend to be situated along major corridors, this finding is also in agreement with those in earlier studies (*13,17*) that showed that highway investments benefit such centers over other counties.

Manufacturing Employment

The manufacturing employment structural plot (Figure 1) suggests that an increase in highway expenditures causes a 2.9 percent short-term increase in employment in the counties containing a major highway corridor. The peak of manufacturing employment is observed in the third year. The long-term gains in manufacturing employment are substantial. This pattern is common to the manufacturing, wholesale, and FIRE sectors, as well as to the total employment of the state. From the causality test, the effect of highway investment on manufacturing employment of counties containing major highway corridors is highly statistically significant at the 0.7 percent level.

In contrast, the structural plot of manufacturing employment for the counties that do not contain major highway corridors indicates a decrease in employment. The short-term decrease is 2.7 percent and the impact extends over a period of 15 years.

Construction Employment

A 4.7 percent increase in construction employment is indicated by the corresponding structural plot of Figure 1. This increase lasts for 3 years after the highway expenditures. This result suggests that the construction of the highway creates short-term employment opportunities in the counties located in the vicinity of the highway corridor. This positive effect diminishes after the completion of highway construction, as expected. Further, the results of the causality tests indicate that the overall effect on construction employment is not statistically significant.

Other Sectoral Employment Effects

The structural plots for the service, wholesale, retail, and FIRE employment sectors suggest that highway expenditures have a positive effect on the employment level of these sectors in the counties containing major highway corridors. The mirror image of this general pattern (i.e., decrease in employment) is indicated for the counties that do not contain major highway corridors. For the counties without major highway corridors, a FIRE employment short-term decrease of 2.4 percent is statistically significant at the 6.7 percent level, indicating the lack of opportunities in this sector when major corridors do not facilitate interactions with major urban areas.

CONCLUDING REMARKS

In this paper we have examined the time-dependent effect of highway funding on county economic development with an application to the counties in the state of Minnesota. For determining this effect, VAR analysis, structural plots, and causality tests were used with data from trunk highway expenditures and total and sectoral employment. The hypothesis tested is that, in terms of employment gains, counties containing major highway corridors are the primary beneficiaries of highway investment.

When total aggregate employment data were used, it was found that there is a small, positive, long-term effect of highway expenditures on the total employment of counties containing major highway corridors. On the other hand, counties without major highway corridors experienced a small, long-term, statistically significant reduction in their total employment despite the increase of highway expenditures.

When the data were disaggregated to reflect employment for eight sectors of the economy, it was found that sectoral employment increased for all employment categories in the counties containing highway corridors. Further, the increase in the manufacturing sector proved to be highly statistically significant. For the counties not containing highway corridors, highway investment had a small, negative, not statistically significant impact on the employment level of all sectors. The negative effect was significant in the FIRE sector. Although there was a lack of significance, the pattern of long-term employment losses was similar across most economic sectors.

The finding that improved highways tend to help the economy of counties in which the major highways are located but may hurt other counties should not be surprising. In particular, counties that act as regional economic centers tend to be located on major highways, and it has already been suggested in the literature (*17*) that those counties stand to benefit the most from highway expenditures. Counties that are located far from major highways tend to depend on employment opportunities provided by regional centers; better highways allow the residents of these counties to conduct more of their economic activities in nearby centers. These counties can improve their economy if local firms can take advantage of better transportation to expand their activities and improve their competitiveness in the marketplace.

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