THE CENTER FOR
APPLIED ECONOMICS

Supporting Regional Economic Development through Analysis and Education

If You Build It, Will They Come?

An Examination of Public Highway Investments and Economic Growth

Eric Thompson, Ph.D.
Director
Bureau of Business Research
College of Business Administration
University of Nebraska– Lincoln

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About the Author

Eric C. Thompson, Ph.D., is the Director of the Bureau of Business Research and an Associate Professor of Economics at the University of Nebraska-Lincoln. His research on the Nebraska and national economy examines competitive factors affecting state economic growth, the impact of infrastructure on the economy, and rural economic development. Thompson has written widely on the contribution of interstate highways and bypass roads to local and regional economic development. His research has appeared in *Regional Science and Urban Economics*, the *Journal of Regional Science*, *Regional Studies*, and the *Journal of Cultural Economics.* Thompson also served as the Co-Editor of the Journal *Growth and Change* in 2003 and 2004.

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If You Build It, Will They Come? An Examination of Public Highway Investments and Economic Growth

I. Summary

Economic research studies in general have not found that more highways lead to a larger economy in states and regions. Over the last three decades, the presence of more highway capital in a state has not been found to attract more private capital to the economy. Most studies have not found that highways, and new investment in highways, increase the level of employment or labor earnings in the economy overall. Finally, most studies have found that the presence of more highways in a state has done little over the last three decades to make state economies more productive.

To be sure, studies find localized effects. All but the most remote rural counties grew after receiving major investments in interstate and state highways, particularly in key sectors such as manufacturing. This localized growth tended to be part of a reorganization of industry within the larger economy, however, rather than net growth. Counties receiving a highway investment grew, but neighboring counties declined as business activity was drawn toward the highway. No overall growth was observed for states or regions.

What explains these findings? The problem may be a tendency to over-invest in the highway system—in other words, the problem has been a failure to ration investment to only the most critical projects. Public roads and highways can contribute to the efficient functioning of the economy, and recent capital investments have undoubtedly included many worthy projects, including investments to maintain and rebuild the existing highway system as it depreciates over time. But there also may have been too many unnecessary investments in new and expanded highways. The net result is that additions to highway capital stock during the last three decades (over and above maintenance and upkeep) on the whole have not contributed to greater economic activity.

Public highway investments must be limited to high value investments because these investments are funded with tax dollars. Public highway investments can only grow the economy if investments are worth their cost in terms of taxation. The bottom line is that highways must encourage economic activity at least as much as taxation discourages it. If public highway investments cannot be effectively rationed, over-investment will discourage private sector activity. But if government and government agencies can limit highway capital investments to needed maintenance and rehabilitation projects and critical new investments that are worth their cost in terms of taxation, public highways can make a clear contribution to productivity in state and regional economies.

The performance of states in allocating highway funds is critical. Highways have accounted for between one-quarter and one-third of state and local government capital outlays over the last two decades (United States Department of Commerce, 2001; 2004). State highway capital investments alone accounted for half of the $100 billion that states spend on the road and highway system (U.S. Department of Transportation, 2004). States and regions must focus on rationing highway investments to only high value projects where the benefits of the projects exceed their costs.

II. CONCEPTUAL ISSUES

States invest tens of billions of dollars on new or improved highways during a typical year. This highway spending accounts for one-quarter to one-third of all public capital outlays by state and local governments. Such a large amount of spending could have a substantial impact on the economy. In particular, …

- **Public highway investments could impact both the productivity and level of activity of a state's private sector.**
- **Public highway investments could affect the allocation of economic activity by drawing economic activity toward new or expanded highways and by encouraging the expansion of particular industries.**

The conceptual reasons for each of these impacts are discussed below.

A. Public Highway Capital and Total Economic Activity

Productivity

Highway investments are made in part with the expectation that the investments can increase the productivity of the private economy. By reducing congestion or by providing more direct travel routes, highway investments are expected to:

1. Allow businesses to receive or ship goods more quickly and at a lower cost;
2. Allow consumers to travel more quickly to retail or services outlets;
3. Allow workers to travel more quickly and cheaply to work; and
4. Improve the safety of travel.

Highway investments that achieve these goals enable businesses to deliver more goods to market with the same number of drivers and enable workers to devote more time to work and less time to commuting. Such highway investment enables a business with a given amount of equipment and employees to produce more.

There is no guarantee, however, that highway investment will increase the productivity of the private sector. The right investments need to be made. The public sector needs to restrict investments to projects that substantially improve the flow and safety of travel and avoid projects with few pay-offs for productivity such as:

1. Upgrades of roadways where there are few problems with congestion or safety; or
2. New highways that connect two areas with little employment and population (and limited potential for growth).

If investment is restricted to only high value projects in terms of the flow and safety of travel, then public highway investments *as a group* will contribute significantly to the productivity of the economy. Highway investments as a group, however, will contribute little to productivity if too many low value projects are undertaken.

Private Sector Activity

In addition to influencing the productivity of the private sector, public highway investments affect the amount of private investment and labor effort in the economy. This is because public highway investments must be funded by taxes, in large part taxes on private capital and labor.[1] While the new highway infrastructure (if it contributes to productivity in the economy) may attract more private investment and labor effort,[2] the taxation required to pay for the highways will discourage capital investment and work. The net effect will be negative for private sector activity if the additional highway infrastructure is not sufficiently important to balance the negative influence of taxation. The issue is fundamentally a question of relative benefits and costs. The most crucial highway investments that yield benefits in excess of costs can raise the level of private capital and labor. Should government over-invest in

highways by making too many unnecessary investments, however, it could retard the amount of labor, private capital, and value added in the economy.

Poor investment by the public sector is a risk. In private sector investments, businesspeople face the discipline of the marketplace when making decisions. While businesspeople will make mistakes, market forces ultimately require that capital is invested efficiently. These conditions do not exist in the public sector. Investments in public infrastructure, which primarily are funded by taxes, are not made by decision-makers facing the rigors of the marketplace. Public officials and government specialists making investment decisions, despite honorable intentions, may consistently make investments that are not worth their costs in terms of the tax burden placed upon the public.

Methods such as project benefit and cost analysis have been developed to aid public officials in making investment decisions. Benefit cost analysis requires policymakers to compare the benefits of the project in the future with the current cost of the project subject to a minimum rate of return. In the case of transportation investments, this has been a matter of comparing project benefits (such as time savings or a reduction in accidents) with the opportunity cost of the public funds that must be raised through taxation to pay for these projects.

Most researchers agree that benefit cost analysis on a project by project basis is the most effective way to assess public highway investments (Holtz-Eakin, 1993; Munnell, 1992). Such economic feasibility analysis, however, is frequently not used effectively to ration transportation investments. Many highway investments are not subject to these benefit cost tests. Even when benefit cost tests are required, the studies may be subject to error (including potential errors in setting a sufficiently high rate of return that should be demanded from public sector investments). U.S. Department of Transportation guidelines require use of a 7% rate of return, but a higher rate of return of around 15% may be more appropriate (Lyon, 1990; Quirk and Terasawa, 1991).

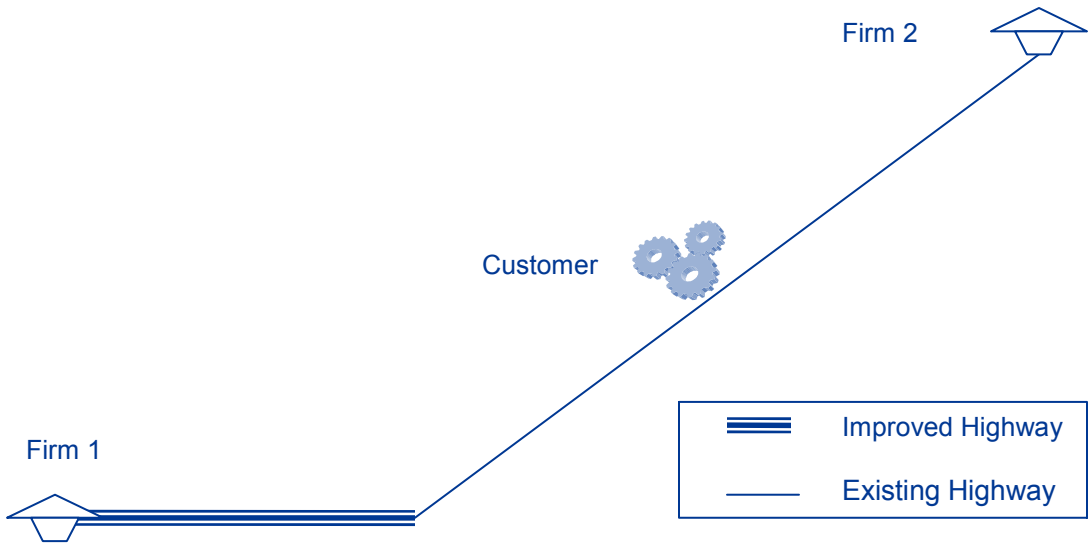
B. Industrial Location – Public Highway Capital and the Reallocation of Economic Activity

Public highway investments, in addition to their effect on aggregate economic activity, may reallocate economic activity. Take the case of a major improvement to an existing highway. Economic activity could be drawn to the area adjacent to the highway and away from other areas because the highway improvement would encourage some industries to expand. Not all industries would benefit, however. Figures 1 and 2 illustrate how an improved highway (or a new highway) would encourage reallocation of economic activity for nationally- and locally-oriented firms.

Figure 2 illustrates that a new highway investment would increase competition among locally-oriented businesses. Improved transportation would lower the cost of travel. The result would be that locally-oriented businesses such as restaurants or health care providers would compete more based on the quality and cost of their services and less based on proximity to customers. This would benefit local consumers, but would not lead to an expansion of locally-oriented industries. Regional residents may notice a tendency for retail and service businesses to locate along the improved highway (to maximize access and visibility). This would not represent a net expansion, however, but would instead represent the reallocation of businesses toward the highway and away from outlying areas.

Figure 1 shows why there might be net expansion of nationally-oriented industries. The costs of reaching customers and receiving supplies would fall for nationally-oriented businesses in the vicinity of a new or improved highway, but would remain unchanged for competitors in other areas. The manufacturer would gain an

Figure 1:
Firms that Compete for Customers Nationally



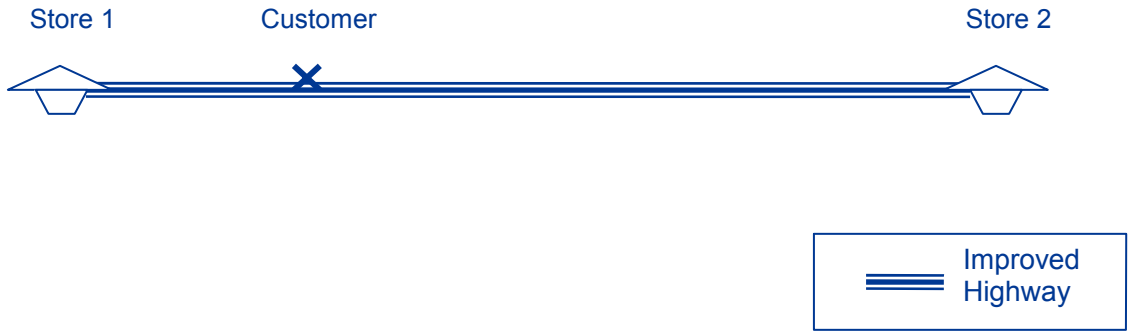
Description

Figure 1 presents the case of nationally-oriented firms or firms that compete in a larger, multi-state market (Chandra and Thompson, 2000). In the example, Firms 1 and 2 both make steel and compete for customers in the auto industry. Firm 1 is located in an area of a state where there was a major highway improvement, while Firm 2 is located in another part of the state or in a nearby state where there was no improvement. Firm 1 could deliver its steel to the customer cheaper because it has lower transportation costs, while the delivered cost for Firm 2 has not changed.

Key points:

- Manufacturing businesses (such as Firm 1) in an area with a major highway improvement should gain an advantage over competitor firms located elsewhere.
- This advantage will arise because the manufacturing firms will have lower costs for delivering finished manufactured goods to customers. The competitor's delivered prices will not be affected.
- Manufacturing would not be the only industry that could gain. Any industry that competes in a multi-state, national, or international market and uses highway transportation should gain. Other potential gaining industries include:
  > Mining; and
  > Destination tourism.

Figure 2:
Firms (Stores) that Compete for Customers Locally



Description

Figure 2 presents the case of locally-oriented firms (Chandra and Thompson, 2000). Stores 1 and 2 each sell furniture to the public and compete for household customers. With the highway improvement, the customer would see a modest decline in the cost of traveling to either Store 1 or Store 2. Given that travel costs are now lower, the customer may be more inclined to travel to Store 2 than before, particularly if Store 2 has advantages in terms of cost or quality. The highway improvement will encourage local customers to patronize those locally oriented businesses that are superior in terms of cost or quality.

Key points:

- For locally-oriented businesses (such as Store 1 and Store 2), a highway improvement in a region will lower customer travel costs to multiple competitors.
- With lower travel costs, stores will compete more based on cost and quality and less based on proximity. Higher quality and lower cost businesses will gain at the expense of less appealing competitors.
- While the highway improvement would allow customers to patronize lower cost and higher quality businesses, there would not be a net gain in sales. Retail and service businesses may tend to locate along the improved (or new) highway, but this would result in a loss in retail and services in areas off the highway rather than in a net expansion.
- Retail is not the only locally-oriented industry. Other important locally-oriented industries include:
  - > Restaurants and entertainment;
  - > Personal services; and
  - > Health and other professional services.

advantage in terms of cost and delivery time to customers that could allow the industry to expand near the highway.

Taken together, these findings suggest a reallocation of economic activity in response to new highway investments. Business activity would be drawn toward the highway, and a net expansion would be anticipated for nationally-oriented industries such as manufacturers but not necessarily for locally-oriented industries such as services businesses.

These findings regarding manufacturing businesses also are consistent with industrial location theory. Industrial location theory (Greenhut, 1956) argues that highway investments can impact the location of businesses within a regional market. Under the theory, market access is the governing force in firm decisions about locating factories in particular regions of the country. Location in a multi-state region may be crucial if:

1. A market offers higher profits (perhaps a rapidly growing market, a market with relatively few competitors, or a need for just-in-time delivery to key customers in that market); or if
2. Scale factors make it necessary to place a plant in all markets.

These market forces determine if a factory will be located in a particular multi-state market. The selection of a location within a multi-state market area, however, is governed by secondary factors such as labor costs and availability, transportation costs, or taxation. Figure 1 shows that a significant highway investment could draw a new plant to a site near the improved highway and away from other areas in the multi-state market. In summary, …

> **Nationally-oriented industries such as manufacturing would be more likely to gain from a highway investment than would locally-oriented industries such as retail (unless that retail is primarily supported by tourists).**

While the proceeding analysis does predict that certain industries are more likely than others to gain an advantage from highway investments, it does not imply that nationally-oriented businesses or the economy overall will grow. The general conceptual ideas discussed earlier about the influence of highway investments on the productivity and level of private sector activity still apply. All types of industries will be influenced by the appropriateness of public sector investment. A poor investment that is expensive and does little to boost productivity will discourage retail and services businesses. A sufficiently poor investment could even cause manufacturing businesses to decline if the investment raises taxes but has little effect on transportation costs.

III. EMPIRICAL ISSUES

Conceptual analysis illustrates that public highway investments may or may not lead to a more productive and larger economy. If the public sector is able to restrict investments to projects that substantially improve the flow and safety of travel, then these transportation investments could help the economy grow. If the public sector over-invests by also including projects with few pay-offs relative to project costs, then the transportation investments *as a group* may be unproductive. With over-investment, the aggregate impact of all investments taken together will contribute little to the productivity of the economy.

The question is an empirical one; we can only resolve the issue by looking at real world data. The relationship between highways and productivity needs to be analyzed using data on highway capital, productivity, employment, and output within the U.S. Several dozen studies have been conducted over the last decades that have used state, local, and national data to examine how the number of highways and highway investments influences the economy. This section summarizes the findings

of these previous economic studies. Two questions are considered first:

- Have public highways increased the productivity of the economy?
- Have public highways encouraged or discouraged private capital formation and labor effort?

This section also considers how public highways may reallocate activity within an economy. Conceptual analysis suggests that highway investments will tend to draw private sector activity toward the highway and that gains may be concentrated in nationally and regionally-oriented business rather than in locally-oriented business. This section summarizes the findings of previous economic studies on two additional questions:

- Do public highways draw economic activity toward the highway and away from adjacent communities and counties?
- Which specific industries, if any, gain from highway investments?

When reviewing these empirical results, it is useful to consider the difference between investments in upgrading, widening or building new highways and bridges versus reconstruction, rehabilitation, and restoration. As is true with any kind of capital investment, capital investment in highways includes both investments to overcome the depreciation of existing capital stock (reconstruction and rehabilitation) as well as new investments to upgrade or widen existing highways (or build new highways) to increase the capital stock. Studies that examine capital investment in highways among states may not differentiate between rehabilitation versus expansion. Other studies will simply follow changes in highway capital stock over time. Differentiation also will not be possible in these studies. As a consequence, results from these state and local studies of highway capital stock will tend to show overall effects. These overall affects will not necessarily represent the effect of maintenance and rehabilitation efforts alone. This is particularly true because efforts to expand the highway capital stock through new construction, reconstruction to add capacity, and major highway widening account for roughly 40% of all highway capital investment (U.S. Department of Transportation, 2004).

In general, these concerns pertained primarily to the first two questions. The studies into state and national productivity, labor effort, and private capital formation tended to follow changes in highway capital stock, which again could be either due to maintenance and rehabilitation or due to expanding the highway system. By contrast, studies into localized effects or the effects on specific industries were more likely to focus on the affects of building new highways on the economy (or on the presence or absence of highways in a county).

A. Question 1: Have public highways increased the productivity of the economy?

Table 1 lists numerous research studies over the last 15 years that have examined the issue of whether public highways contribute to the productivity of the national economy or state economies. The table lists the types of industries studied. Most of the research examined the impact of highways on productivity in all industries, but some studies focused on manufacturing. The table lists whether each research study used national data (totals for U.S. economy) or state data (totals for each individual state) and also indicates the time period that was studied. The time period studied is a key issue because the impact of highways on productivity over the last three decades appears to be substantially less than the impact during the 1950s and 1960s (when much of the interstate highway system was built). The table reports and interprets the main findings of each study.

Table 1:
Economic Research on Public Highways and Productivity of the Economy

Citation	Industries Studied and Market Studied	Geographic Scope and Time Frame	Did the Statistical Technique Address the Causality Issue?	Finding	Interpretation
Munnell (1990)	All Industries	National Data 1948-1987	No	• Public capital (including highways) increased productivity—a 1% increase in public capital led to a 0.3% to 0.4% increase in national output.	• Implications unclear. Causality issue not addressed.
da Silva *et al.* *(1987)*	All Industries	State Data 1972	No	• Public capital (including highways) increased productivity—a 1% increase in public capital led to a 0.2% increase in state output.	• Implications unclear. Causality issue not addressed.
Garcia-Mila and McGuire (1992)	All Industries	National Data 1969-1983	No	• Highway capital increased productivity—a 1% increase in highway capital led to a 0.04% increase in national output.	• Implications unclear. Causality issue not addressed.
Eberts (1997)	Manufacturing	State Data 1988-1992	No	• Highway capital increased productivity—a 1% increase in highway capital led to a 0.15% increase in manufacturing output.	• Implications unclear. Causality issue not addressed.
Holtz-Eakin (1994)	All Industries	State Data 1969-1986	Yes	• Once causality is addressed, there was no relationship between public capital and state output. • If causality is not addressed, findings are similar to Munnell (1990).	• After addressing the causality issue, public infrastructure (including highways) is not found to increase productivity.

Table 1: (Continued)
Economic Research on Public Highways and Productivity of the Economy

Citation	Industries Studied and Market Studied	Geographic Scope and Time Frame	Did the Statistical Technique Address the Causality Issue?	Finding	Interpretation
Holtz-Eakin and Schwartz (1995)	All Industries	State Data 1969-1986	Yes	• Once causality is addressed, there was no relationship between highway capital and state output. • There also was no relationship between highway capital in a state and output in neighboring states.	• Highways were not found to increase productivity of the economy in own state or neighboring states.
Brown *et al.* *(2003)*	All Industries	State Data 1977-1997	Yes	• Holding employment and private investment fixed, there was no relationship between highway capital and output (i.e., no productivity effect).	• Highways were not found to increase productivity.
Fernald (1999)	All Industries	National Data 1953-1989	Yes	• Prior to 1973, highway investments had a higher rate of return than did private investments. • After 1973, rate of return was not statistically different than zero.	• Construction of interstate system in the 1950s, 1960s, and early 1970s added to productivity, but highway investment since then may not have contributed to productivity.
Aschauer (1989)	All Industries, Trucking	National Data 1949-1985	Yes	• Highway capital had a large influence on productivity in the trucking industry.	• Further evidence that highways enhanced productivity in 1950s, 1960s, and early 1970s, but no analysis of post-1973 period.
Carlino and Voith (1992)	All Industries	State Data 1963-1986	Yes	• Highway capital, as measured by highway miles per square mile of land area, increased state productivity.	• Highways were found to increase the productivity of state economies.

The middle column in Table 1 evaluates the statistical technique used in each study. This column is included because statistical technique plays a large role in research on the productivity question. Some studies used a technique that could identify whether highway investments caused greater productivity. A "Yes" response appears in the column for these studies. Other studies used techniques that could only determine whether highways or productivity were correlated. These studies could not determine whether:

1. More highways lead to greater productivity, or
2. Greater productivity leads to more spending on highways.

A "No" appears in the column for these studies.

Why would the direction of causality be unclear? It is easy to see how more highways might make the economy more productive. But how could the relationship work in the other direction? The answer is that some third factor (such as strong entrepreneurship in a state) could make an economy more productive and wealthy, and a wealthier economy would have more resources to invest in highways. In the latter case, highways and productivity would be correlated, because more productive economies demand more highways. There was no productivity impact from highways per se.

Numerous authors have identified this issue about the direction of causality between highway infrastructure and productivity as critical (Holtz-Eakin, 1993; Holtz-Eakin, 1994; Holtz-Eakin and Schwartz, 1995; Duffy-Deno and Eberts, 1991, Stephanades, 1990; Stephanades and Eagle, 1986; Thompson *et al*., 1990). A number of other factors also may affect productivity beside highways. For example, some states may have always had, or may develop, a concentration of the most productive industries or greater levels of entrepreneurship. These state economies would be more productive even with scant highway investment. When we consider the national economy, we see that there were multiple shocks hitting the economy simultaneously during the period in the 1970s when highway investment was slowing (due to the near completion of the interstate highway system): the energy crisis, economic restructuring, and the introduction of new environment regulations. This makes it difficult to differentiate the influence of slowing highway investments on national productivity from the influence of these other factors.

With both state and national data, however, some researchers were able to develop and use statistical techniques that allowed them to determine whether more highways yielded greater productivity. Table 1 shows that there is a difference in the findings between economic research studies with a "Yes" compared to studies with a "No." Studies with a "No" did identify a correlation between highway capital and productivity in the state or national economy and concluded that highways contributed significantly to enhancing productivity. Munnell (1990) modeled national labor productivity as a function of both private and public capital stock and found that the contribution of public capital stock contributed substantially to output. Munnell says public capital stock contributed more than did private capital. da Silva *et al.* (1987), Eberts (1997), and Garcia-Mila and McGuire (1992) used a similar approach for a cross-section of states and found that highway capital had a positive impact on productivity. These studies concluded that a 1% increase in public capital of all kinds would increase output 0.30% to 0.40%, while a 1% increase in highway capital only would increase output between 0.04% and 0.15%.

Studies with a "Yes" used statistical models that allowed the researchers to test whether more highways *caused* greater productivity. These studies typically reached different conclusions. Holtz-Eakin (1994) presented a series of models of how public capital stock (highways as well

as other public infrastructure) affected private sector productivity in states. His first model did not account for causality and found results similar to Munnell (1990). Subsequent models accounted for causality, used the same data, and found that the public sector capital did not contribute to productivity. Another study by Holtz-Eakin and Schwartz (1995) specifically addressed highway capital. That study did not find that highway capital contributed to the productivity of state economies. Further, no spillover effect was found. State economies were not found to benefit from highways in adjacent states. Brown *et al.* (2003) found that public infrastructure capital in general, and highway capital in particular, does not increase private sector value added (for a given level of labor and private sector capital). In summary, most of the studies that used appropriate statistical approaches did not find that the level of highway capital in states, or nationally, influenced the productivity of the economy.

There were some studies that did test for causality and found an impact on productivity, however, at least during the 1950s and 1960s. Fernald (1999) examined growth in national productivity across industries and time. Prior to 1973, Fernald found highway investment caused more rapid productivity growth in industries that use highways more (such as the trucking industry). He did not find that public highway investments raised productivity in the post-1973 period.[3] Aschauer (1989) similarly found that highway investment nationally caused productivity growth in the trucking industry for the 1949 to 1985 period overall, but Aschauer did not examine results separately for the post-1973 period.

The Fernald (1999) and Aschauer (1989) studies used national data. There also was a state study that found that highway capital increased productivity. Carlino and Voith (1992) used the concentration of highways in states as one of a set of variables explaining differences in private sector productivity. Carlino and Voith found that states with a higher concentration of highways had greater productivity.

The overall finding from economic research, including those of Carlino and Voith (1992), was that there is only limited evidence that highway capital enhanced productivity in state economies or the national economy over the last three decades. This leads to the conclusion that…

> **Empirical research indicates that public highway investments have contributed little to increase the productivity of the economy over the last three decades.**

B. Question 2: Have public highways encouraged or discouraged private capital formation and labor effort?

Table 2 lists those research studies that have examined the issue of how public highways influence private capital and labor effort in state and regional economies. The table lists the citation, the geographic scope, the time frame studied, information on the statistical technique, and research findings and interpretation. Table 2 shows that these studies are much more consistent in terms of geographic scope. All studies look at either state data or substate economies. The studies examine data from the last three decades. All studies used statistical techniques that isolate whether highway investments cause greater capital formation or labor effort.

Brown *et al.* (2003) examined the influence of highway capital on both private capital and labor. Brown *et al.* found that the net effect of financing highway investments with miscellaneous taxation and borrowing was to reduce private capital and labor in states. Similarly, Chandra and Thompson (2000) examined the impact of new highway investments on earnings growth in non-metropolitan regions. These major investments in rural regions were likely not financed by local taxes (though largely financed by state taxes), so this study did not consider whether taxes to pay for the highway reduced employment. But the study found no net increase in em-

Table 2: Economic Research on Public Highways and Capital and Labor Effort

Citation	Industries Studied and Market Studied	Geographic Scope and Time Frame	Did the Statistical Technique Address the Causality Issue?	Finding	Interpretation
Brown *et al.* *(2003)*	All Industries, Employment, Private Capital, and Output	State Data 1977-1997	Yes	• Highway capital financed by taxation and borrowing decreased private capital, labor effort, and output in states.	• Private capital and employment in states has declined with highway financed by taxation. • Total state output also declined—highways didn't merely reduce the need for private capital and labor in producing output; highways discouraged output.
Chandra and Thompson (2000)	All Industries Worker Earnings	Sub-state Non-metropolitan Regions 1969-1993	Yes	• A major highway investment had no effect on aggregate earnings in non-metropolitan regions. • This occurred even though local taxes were not the main source of funding.	• A major highway investment financed by non-local taxes did not increase worker earnings. This finding suggests that the joint effect of a highway investment and the taxes to pay for it may reduce worker earnings.
Dahlenberg *et al.* *(1988)*	All Industries Employment	State Data 1972-1991	Yes	• Highway capital increased state employment. • Taxation to pay for more government spending reduced state employment. • Highway capital increased employment more than taxation decreased employment.	• State employment rose with highway capital financed by taxation.

ployment due to highway investments, even in the absence of the negative impact of taxes.[4] Only a study by Dahlenberg *et al.* (1998) found that employment grew in response to more highway infrastructure. That study found a modest contribution to employment growth, even when taxation was used to pay for the highways.

Except the findings of Dahlenberg *et al*., this research on balance found that highways have not contributed to private capital and employment growth and may have led to a decline in the factors.[5] Taken together, these studies indicate that …

> **The combination of public highway investments and the taxes required to fund them likely has not encouraged private capital investment and labor effort and may have had a negative effect.**

One might argue that this result does not imply that highways discourage regional economic activity, but that highways simply substitute instead for private capital and labor (so that the same amount of output can be produced with less private capital and labor). For example, a new highway might improve the flow of traffic and allow a company to deliver its goods to its customers using fewer drivers and fewer vehicles. If this were the case, however, output would be unaffected by highway capital even as employment and private investment decline. But Brown *et al.* found that output also declined, by roughly the sum of the decline in private capital and labor. This suggests declining regional activity rather than the substitution of public capital for private activity.

C. Question 3: Do public high ways draw overall economic activity toward the highway and away from adjacent communities and counties?

Table 3 lists those research studies that have examined the issue of how public highways influence growth within local areas such as counties. Most of the studies focused on the impact on counties where the highways were located. Only Rephann and Isserman (1994) and Chandra and Thompson (2000) also examine the issue of how highways impact adjacent counties. The studies shed light on whether highway investments by state and federal governments increased total economic activity in those individual counties where the highway were located and whether activity was drawn away from nearby counties.

Table 3 reports findings for aggregate county employment, earnings, and population. Some of the studies listed in Table 3 also examined the impact of highway investments on individual industries. These results are reported in Table 4. The studies only examined impacts on labor market outcomes such as jobs, earnings from work, and population. Labor market data are the focus because data on private investment and value added are not typically available at the county level.

As mentioned earlier, many of these local area studies only reported economic impacts on counties receiving a new highway investment. These local impacts on employment and earnings could be positive, even though no effect was found for larger areas such as states. This would occur if the highway investment tended to reallocate state economic activity by drawing it toward the highway and away from other areas. The studies of county effects found that counties with interstate highways or receiving investments in state or interstate highways tended to have greater growth in total employment, population, and worker earnings. Bohm and Patterson (1972) and Carlino and Mills (1987) found that counties with a higher stock of highways in the initial period had more rapid growth in population and total employment, respectively.[6] Thompson *et al.* (1992) found that state highway investments (but not local highway investments) were associated with more rapid growth

Table 3: Economic Research on Public Highways and Location of Economic Activity

Citation	Industries Studied and Market Studied	Geographic Scope and Time Frame	Did the Statistical Technique Address the Causality Issue?	Finding	Interpretation
Bohm and Patterson (1972)	Population	Counties throughout the U.S. 1960-1970	No	• Population grew faster in both counties with an interstate and in counties adjacent to an interstate.	• Implications unclear—causality issue not addressed.
Carlino and Mills (1987)	All Industries Employment	Counties 1979	*No	• Density of interstate highways in county affected total employment in that county—doubling highway miles would have yielded 6% growth in total jobs.	• Implications unclear—causality issue not addressed.
Thompson *et al.* (1992)	All Industries—Employment and Earnings (wages, benefits and proprietor's income)	Florida Counties 1980-1990	Yes	• Density of highway capital (miles of state highway per square mile of area) had no effect on total employment growth in that county. • Density of highway capital in county led to increase in total worker earnings in that county.	• Limited evidence that highway capital paid for by the state (state highways) increased labor activity in counties. (Earnings grew, but not jobs.)
Briggs (1981)	All Industries Employment	Non-metropolitan Counties 1950-1975	No	• Location of a new interstate highway had no impact on total employment growth in non-metropolitan counties.	• Implications unclear—causality issue not addressed.

*The Carlino and Mills (1987) paper, however, is notable for its careful consideration of the causality issue for population and employment.

Table 3: (Continued)
Economic Research on Public Highways and Location of Economic Activity

Citation	Industries Studies	Geographic Scope and Time Frame	Did the Statistical Technique Address the Causality Issue?	Finding	Interpretation
Stephanades (1990)	All Industries Employment	Minnesota Counties	Yes	• An increase in spending on state highways increased total employment in urban counties, but not in rural counties. A 10% increase in highway spending yielded a 9.2% increase in urban county employment.	• Highway investments paid for by the state (state highways) increased total employment in urban counties but not in rural counties. • No information provided on the impact on adjacent counties.
Rephann and Isserman (1990)	All Industries Earnings and Population	Counties 1959-1984	Yes	• Location of a new interstate highway increased total earnings and population growth in counties with a small city or located near an urban area. • Location of a new interstate highway had no effect on total earnings in counties located in rural areas. • New interstate had no effect on earnings in nearby, adjacent counties.	• Major highway investments (a new interstate) paid for by the state and nation increased total earnings and population in urban counties and counties with a small city but had no effect on rural counties. • New interstate had no impact on adjacent counties.
Chandra and Thompson (2000)	All Industries Earnings	Non-Metropolitan Counties 1969-1993	Yes	• Location of a new interstate highway increased total earning 3% to 10% in non-metropolitan counties. • New interstate led to a 1% to 3% decline in nearby, adjacent counties. • No net impact on regional overall.	• A major highway investment (a new interstate) reallocated regional activity toward the new highway. • Total earnings increased modestly in counties where the highway was located and declined in adjacent counties.

in total earnings (wages, benefits, and proprietor's income) from work in Florida counties, although the study did not find any increase in total employment. Briggs (1981) did not find that the presence of a highway was associated with faster growth in non-metropolitan counties as a group. Stephanades (1990) did find a modest increase in total employment in response to investment in state highways. Stephanades found that a 10% increase in state highway spending in a county would increase total employment growth in that county 0.2%. Rephann and Isserman (1994) found that total earnings growth was greater in most types of counties after these counties received a new interstate highway. Greater cumulative growth was observed for up to twenty years after the interstate was completed. Chandra and Thompson (2000) found similar results when focusing on non-metropolitan counties that received a new interstate highway. Total earnings grew faster in counties that received a new interstate highway.

Chandra and Thompson, similar to Stephanades (1990), found only a modest labor response. Total earnings increased only 3% to 10% in non-metropolitan counties receiving a new interstate highway a full two decades after receiving the investment. All of these findings applied to state and federal rather than to local highway spending. The counties in question were receiving substantial new investments that were not paid for locally, with only modest impacts found. Finally, these impacts were on the counties where the highway investments were made. What about the impact on nearby counties?

The Rephann and Isserman (1994) and Chandra and Thompson (2000) studies both looked at how interstate highway locations impacted adjacent counties. Adjacent counties were defined as counties with no interstate but located next to a county that received a new interstate highway. The two studies traced growth in these adjacent counties over time in the period after the interstate highway investment. The Rephann and Isserman study found that there was no change in total earnings and population in these adjacent counties. Unlike counties receiving a new interstate, adjacent counties did not grow. Chandra and Thompson found that these adjacent counties actually declined, with total earnings declining between 1% and 3%. These findings paint a picture that major highway investments tend to reallocate economic activity within states and sub-state areas, with activity moving toward the highway and potentially declining in outlying areas. Chandra and Thompson found that the overall effect on the region was no net growth. Growth in the highway counties was mitigated by declines in the adjacent counties.[7] In summary, …

Public highways encourage a reallocation of industries toward the highway so that counties with highways grow, but adjacent counties decline.

Impact in Non-Metropolitan Areas

Some research evidence indicates that in rural and remote regions there is little impact even on counties that receive a new highway (i.e., highway counties). Studies that broke counties into groups found a differential impact of highways on smaller counties. Stephanades (1990) found that spending on state highways in Minnesota counties increased total employment in the same county in urban areas but not in rural counties. Rephann and Isserman (1994) found that the location of a new interstate highway increased total employment and population growth in:

1. Counties of all sizes located near a large city or
2. Counties with a city of more than 25,000 residents but not located near a large city.

There was no impact on employment and population in smaller, more remote counties (no city of more than 25,000 population and not located near an urban area). In both studies, the impact of highway investments on remote non-metropolitan counties was unclear.

D. Question 4: Which industries, if any, gain from highway investments?

Figures 1 and 2 show that there are particular industries such as manufacturing and tourism that are more likely to grow in response to improved highway access. Table 4 considers the impact of highways on individual industries such as manufacturing, services, and retail.

In discussing Table 4, more emphasis is placed on studies such as Rephann and Isserman (1994) and Chandra and Thompson (2000) that consider the impact on the entire region (counties receiving a highway plus adjacent counties) than on studies that only consider the impact on counties where a highway is located (Carlino and Mills, 1987; Briggs, 1981, Stephanades, 1990; and Stephanades and Eagle, 1986). Carlino and Mills (1987) found that the presence of a highway encouraged growth in manufacturing in the same county, while Briggs (1981) found it encouraged the tourism industry. These studies, however, were difficult to interpret because of the statistical approached used. But the results were similar in other studies. Stephanades (1990) found that greater highway investment caused retail and services employment to grow in rural Minnesota counties. Looking at both urban and rural Minnesota counties, Stephanades and Eagle (1986) found that greater highway investments lead to job growth in both the retail and manufacturing industries in these counties.

Only the Rephann and Isserman (1994) and Chandra and Thompson (2000) papers examined entire regions including nearby (adjacent) counties as well as counties where highway investment occurred. These studies give the clearest picture of whether highway investments would promote the overall growth of a particular industry in the highway region. The Rephann and Isserman (1994) study found no net regional effect on any particular industry. Retail earnings grew in all classes of counties where the highway was located, but declined in adjacent counties. There was no effect on manufacturing or services in either highway or adjacent counties. Chandra and Thompson (2000) found a net regional effect for the major industries. Manufacturing and services earnings grew in non-metropolitan regions with a new interstate, but retail earnings declined. Manufacturing grew both in highway counties and in adjacent counties for a consistent impact. Services grew in the highway counties, and there was no change in adjacent counties.

Overall, the research examining the effects of highway investments on individual industries suggests that the manufacturing industry may grow in the vicinity of a new highway investment, including both counties receiving a new or improved highway and nearby counties. Services industries, including tourism, also may grow in regions overall (though growth appears to be limited to highway counties and not nearby counties).

The finding for the manufacturing industry is also supported by a review of the industrial location (i.e., plant location) literature, which is presented in Table 5. Consistent with the views of Greenhut (1956), the industrial location literature suggests that cost factors such as highway access influence the specific site where a plant will be created after other factors determine the multi-state region where the plant will be located. Dean (1972) surveyed over 100 firms and found that firms first selected a multi-state region based on access to markets and then selected a particular sub-region based on three factors: transportation access, taxes, and labor relations. Rees (1972) surveyed Cincinnati firms and found that firms selected a region based on market before choosing a more specific location based on cost factors. Johnson (1991), in a survey of plant managers in the rural South, found that truck access and proximity to interstate highways were not important for choosing to locate in the South, but were important

Table 4: Economic Research on Public Highways and Individual Industry Activity

Citation	Industries Studied and Market Studied	Geographic Scope and Time Frame	Did the Statistical Technique Address the Causality Issue?	Finding	Interpretation
Carlino and Mills (1987)	Manufacturing Jobs	Counties 1979	No	• Density of interstate highways in county affected manufacturing employment in that county—doubling highway miles would have yielded 6% growth in manufacturing jobs.	• Implications unclear—causality issue not addressed.
Briggs (1981)	Individual Industry Jobs	Non-metropolitan Counties 1950-1975	No	• Location of a new interstate highway had no impact on manufacturing job growth in non-metropolitan counties, but there was an increase in tourism jobs.	• Implications unclear—causality issue not addressed.
Stephanades (1990)	Retail and Services Employment	Minnesota Counties 1957-1982	Yes	• An increase in spending on state highways increased retail and services employment in rural counties.	• Highway investments paid for by the state (state highways) increased retail and services jobs in rural counties. • No information provided on the impact on adjacent counties.
Stephanades and Eagle (1986)	Manufacturing and Retail Jobs	Minnesota Counties 1957-1982	Yes	• An increase in spending on state highways in counties increased county manufacturing and retail employment. A 10% increase in highway spending yielded a 0.3 % increase in manufacturing and a 0.2 % increase in retail employment.	• Highway investments paid for by the state (state highways) increased total manufacturing and retail employment in counties. • No information provided on the impact on adjacent counties.

Table 4: (Continued)
Economic Research on Public Highways and Individual Industry Activity

Citation	Industries Studied and Market Studied	Geographic Scope and Time Frame	Did the Statistical Technique Address the Causality Issue?	Finding	Interpretation
Rephann and Isserman (1994)	All Industries Earnings (wages, benefits, and proprietor's income) and Population	Counties 1959-1984	Yes	• Location of a new interstate highway increased retail employment in both urban and rural counties but had no effect on either manufacturing or services. • New interstate had a negative effect on retail in adjacent counties but no effect on manufacturing and services.	• Major highway investments (a new interstate) paid for by the state and nation had no clear impact on retail earnings (highway drew retail activity toward highway counties and away from adjacent counties). • No effect found for manufacturing or services earnings.
Chandra and Thompson (2000)	All Industries Earnings	Non-metropolitan Counties 1959-1984	Yes	• Location of a new interstate highway increased total earnings in manufacturing 2% to 10% in non-metropolitan regions (growth in both highway and adjacent counties). • New interstate led to a 3% to 6% decline in retail activity in non-metropolitan regions (loss in adjacent counties greater than gains in highway counties). • New interstate led to a 3% to 5% increase in services industry earning in non-metropolitan regions (due to a gain in highway counties and no change in adjacent counties).	• Non-metropolitan regions receiving a major highway investment (a new interstate) gained in the manufacturing and services industries, but lost retail earnings.

Table 5: Industrial Location Literature and the Link Between Transportation and Manufacturing

Citation	Industries Studied and Market Studied	Geographic Scope and Time Frame	Finding	Interpretation
Dean (1972)	Manufacturing Plants	Survey of Northeast and Midwest 1966-1969 Survey	• Firms selected a multi-state region first based on markets and then a particular sub-region based on transportation access, taxes, and labor relations.	• Highways didn't influence which multi-state region manufacturers chose to locate a plant but did influence the specific site chosen.
Rees (1972)	Manufacturing Plants	Cincinnati 1970 Survey	• Survey finds that firms selected part of the country based on access to customers and markets but a specific location based on cost factors.	• Cost factors such as highway access didn't influence which multi-state region manufacturers chose to locate a plant but did influence the specific site chosen.
Johnson (1990)	Manufacturing Plants	Non-Metropolitan Counties in South 1987 Survey	• Transportation was only the 10th ranked factor (out of 17) influencing the choice to locate somewhere in the South. • Good trucking connections was the 4th ranked factor (out of 26) in the choice of a specific local plant site, proximity to an interstate was ranked 9th.	• Highways didn't influence the region of location, but did influence the specific site chosen.
Walker and Greenstreet (1990)	Manufacturing Plants	Appalachian States 1988 Survey	• Proximity to highways was not a statistically significant variable in equations predicting: 1) the likelihood of new plant location; and 2) the expansion of existing plants.	• Highway access did not encourage the location of manufacturers nearby.

Table 5: (Continued)
Industrial Location Literature and the Link Between Transportation and Manufacturing

Citation	Industries Studied and Market Studied	Geographic Scope and Time Frame	Finding	Interpretation
Goode and Hastings (1989)	Manufacturing Plants	Non-Metropolitan and Small Metropolitan Communities (population 100,000 or less) in Northeast and Virginia 1970-1978	• A non-metropolitan community's distance to an interstate or access to a paved road increased the probability of new plant location in only 5 of 69 manufacturing industries. • A small metropolitan community's distance to an interstate increased the probability of new plant location in 1 of 69 industries.	• Highway access did not encourage the location of manufacturing nearby.
Charney (1993)	Manufacturing Plants	Communities in Detroit Metropolitan Area	• Highways and other transportation facilities were not found to influence the choice of plant location within a metropolitan area.	• Differences in highway access were not key in the choice a specific plant site within a region.

for selecting a particular locality within the region. In summary, …

> **Most previous research studies indicate that the manufacturing industry would grow overall in the vicinity of highway investments. It is not clear, however, that highways bring net manufacturing growth to states and multi-state regions. Highways do not attract new plants to a multi-state region, but only influence where manufacturing plants are sited within the region.**

Further, there were some studies that did not find any link between proximity to highways and manufacturing plant location. Walker and Greenstreet (1996) surveyed manufacturing firms in Appalachia and found that proximity to highways did not influence the likelihood of new plant location or the expansion of existing plants. Goode and Hastings (1989) did not find that proximity to a highway enhanced the likelihood that a non-metropolitan or small metropolitan community would receive a new factory. Charney (1983) did not find that transportation infrastructure influenced where firms moving within the same metropolitan area chose to relocate.

IV. ENDNOTES

1. Even state transportation investments that are primarily funded through fuel and vehicle registration taxes are indirectly a tax on business vehicle fleets, the labor costs of drivers, and the commuting costs of labor. Federal matching funds for state transportation projects come from a pool of funds largely correlated with the federal fuel taxes collected in a state.

2. Public capital in theory could act as a substitute for private capital or even labor, so that more public capital would imply less private capital and labor. For example, a highway that allows companies to lower delivery costs to their customers could mean less private investment in delivery vehicles and less work for vehicle drivers. Such a productive public investment also might attract more investment in the area by new businesses, however, which would spur both private investment and employment.

3. Fernald (1999) explains the difference between his pre-1973 and post-1973 results by arguing that while it was productive to build one national highway system, building additional capacity was not productive.

4. Chandra and Thompson (2000) argued that these regions received new investments because they were between metro areas that were selected for upgraded transportation. The authors tested and verified that these rural regions did not receive these highways because the regions were quickly growing.

5. Research also has found little evidence that infrastructure influences business start-up rates. A study by Bartik (1989) examined small business start-ups and found that highway density did not contribute to the rate of small business start-ups. Goss (1994) found mixed evidence on the role of public infrastructure on business formation. Current infrastructure spending encouraged business formation, but past infrastructure spending discouraged it.

6. These two studies did not explicitly address the potential causality between growth and highways, but their findings were not substantially different from other studies that did so.

7. The estimated growth impact in highway counties was 3% to 10% versus only a 1% to 3% decline in adjacent counties. There are more adjacent

counties than highway counties, however, because each highway county will border at least two adjacent counties. Overall, the combined effects are almost completely offsetting.

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THE CENTER FOR
APPLIED ECONOMICS

School of Business
University of Kansas
Summerfield Hall
1300 Sunnyside Ave.
Lawrence, KS 66045-7585

785-864-5134 (phone)
785-864-5369 (fax)

www.cae.business.ku.edu

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