Federal Highway
Administration

Public Policy Impacts on Freight Productivity

Final Report with
Annotated Bibliography

October 22, 1999

PUBLIC POLICY IMPACTS ON FREIGHT PRODUCTIVITY

FINAL REPORT WITH ANNOTATED BIBLIOGRAPHY

Prepared By:
HLB DECISION ECONOMICS INC.
1010 Wayne Avenue, Suite 300
Silver Spring, MD 20910

In Association With:
KPMG LLP

October 22, 1999
HLB Reference: 6598
File Name: Paper2n.doc

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1 Purpose of Study

This Working Paper #2 Report is part of the "Public Policy Impacts on Freight Productivity" study for FHWA. The purpose of the study is to synthesize existing research efforts and informing decision-makers of the nature and magnitude of public policy influence on freight productivity. Working Paper #1 developed a framework and typology to allow the results of the study to be presented within a comprehensive functional classification. Working Paper #2 provided an annotated bibliography and a discussion while this final report adds more records the bibliography and provides an analysis of the findings. A computer database on disk and a user's manual accompany this report to allow users an easy access to various studies at the national, regional, sectoral, and industry levels.

1.2 Purpose of this Report

The purpose of this report is to provide an annotated bibliography of the literature profile synthesizing existing research efforts that investigate public policy impacts on productivity. The annotated bibliography serves as a basis for the computer database. Each citation in the database is classified in relation to the functional classification developed in Working Paper #1.

1.3 Plan of the Report

This report is presented in three chapters. Following this introductory chapter, Chapter 2 provides answers, emerging from the literature review, to questions about public policy impacts on productivity. Chapter 2 also introduces the format of the annotated bibliography and Chapter 3 concludes this report by providing a summary of findings.

2. ANSWERS EMERGING FROM THE LITERATURE REVIEW

2.1 Introduction

The freight industry affects the functioning and growth of an economy both directly and indirectly. The freight industry's direct contribution to the competitiveness and economic development of an economy is derived from improvements in the productivity of the freight industry itself. Freight transportation improvements, resulting in lower transportation cost for users, indirectly contribute to higher industry productivity. Moreover, additional productivity gains for firms accrue from the newly opened opportunities through substitution between the basic logistical inputs -- transportation, inventories and facilities.

Transportation infrastructure improvements affect freight transportation characteristics that lead to improvements in the level of service for particular shipments. That is, expected travel time and travel time variance for these shipments are reduced. Greater reliance on improved transportation services allows firms to adjust warehouse and inventory requirements, and reduce their costs, which leads to productivity gains. Moreover, the net amount by which firms are able to reduce their logistical costs constitutes additional benefits. These benefits are above and beyond the conventional benefit of having an infrastructure improvement.

2.1.1 Criteria for Literature Selection

The criteria for selecting pertinent literature was based on the functional classification of the public policy impacts on freight and industry productivity developed in Working Paper #1. This functional classification mainly reflects the causality between various public policies and their impacts on productivity.

A public policy may affect productivity directly or indirectly. A direct effect exists when public policy can lead to productivity gains by changing the institutional environment, competitive conditions, tax system, trade regulations, standards, administrative and informational services provided by governmental institutions and other. Public policy may also affect the attributes of the transportation system that influence most productivity -- infrastructure changes and technology improvements. Thus, such a public policy leads indirectly to productivity gains. In addition, public policy effects on productivity are considered in a broader context -- economy-wide effects, direct effects on freight and other industries, and indirect (logistics restructuring, network, externalities) effects. Moreover, public policy impacts on productivity should be considered at different levels of aggregation nationally and internationally -- aggregate economy, industry and sector level, and firm level.

In summary, the literature included in this project's database is chosen according to the criteria and principles described below.

1. Type of public policy affecting productivity

- *Investment and financing policies* (Federal and State funding for highway programs, transit projects, R&D, safety, Intelligent Transportation Systems, etc.)
- *Regulation/deregulation and institutional cha*nges affecting intramodal and intermodal transportation services, industry structure and competitiveness, trade patterns.
- *Assistance at national and international level;* administrative and informational services, facilitation, standardization and compatibility.

2. Type of effect on productivity

- Economy wide and macroeconomic effects.
- Directs effects on freight industry and other industries.
- Indirect (logistics restructuring, network, and externality) effects.

3. Level of aggregation of the study

- National or international.
- Aggregate economy, industry and sector level, and firm level.

2.1.2 Definitions

A set of definitions is provided below to provide a specific meaning to some terms that are used throughout this paper.

2.1.2.1 Highway Investment

The term "highway investment" is defined broadly to include a range of investments leading to capacity expansion, research and development expenditure, and introduction of communication and information technologies, such as ITS.

2.1.2.2 Industry Productivity

Industry productivity is defined as the ratio of outputs to inputs measured in dollar terms. Increased productivity means either that (1) with the same quantity of inputs, larger quantities of outputs can be produced, or (2) that a given level of outputs can be achieved using less inputs.

Improvements in the transportation system – either through transportation infrastructure improvements, policy changes or technological advances – enable industrial firms to realize short-term productivity gains due to lower operating costs. Moreover, changes in the transportation system make beneficial substitution between the basic logistical inputs: transportation services, inventories and facilities. These substitutions can result in more efficient configurations of inputs, hence productivity gains.

2.1.2.3 Freight Productivity

Freight productivity is defined as the ratio of freight outputs (freight carriage services) to inputs measured in dollar terms. Increased productivity leads to a lower unit costs of carrying freight.

2.1.2.4 Intermodal Freight

The term "intermodal freight" is defined to mean the coordinated and sequential use of two or more modes of transport where a single party assumes the responsibility for the completion of the transportation service.

2.1.3 Four Main Questions Arising from the Literature Review

Four main questions arise from the literature review regarding the qualitative nature and quantitative magnitude of the relationship between the highway investments, or more broadly investments in public capital, freight, and industrial productivity:

A. Has the relationship between highway investment and freight productivity been discerned at macro and micro-level?

B. Has the relationship between highway investment and industrial productivity been discerned at macro and micro-level?

C. In what sectors has this productivity effect been most pronounced?

D. What is the nature of productivity effect: direct effect (time savings, etc.), logistics restructuring, network effect, externalities effect?

The next sections will attempt to answer these questions, individually, based on existing research findings.

2.2 Has the Relationship between Highway Investment and Freight Productivity Been Discerned at Macro and Micro-level?

2.2.1 Classification of Literature Findings

A summary classification of literature findings related to Question A on highway investment and freight productivity is presented in Table 1. It should be noted that the other types of public policy related to productivity are not discussed in this paper in order to make the exposition more focused.

Table 1: Classification of Literature Findings Related to Question *A: "Has The Relationship between Highway Investment and Freight Productivity Been Discerned at Macro and Micro-level?"*

	Direct Investigations	Indirect Investigations
Number of Citations	* 2 [59], [93]	4 [7], [27], [44], [94]
Percent of Total Citations	2	4
Range of Quantitative Findings	➢ Benefits of highway investments in truck cost savings alone can justify between one-third and one half of the Federal-aid highway system between 1950 and 1973. ➢ Terminal inefficiencies that can be readily absorbed in long-haul freight moves – 900 to 1200 miles – cannot be absorb in short haul markets.	➢ The aggregate transportation services sector contributed in average 8.3 percent to national productivity gains. ➢ The largest portion of productivity growth, however, comes from increased labor productivity. ➢ Intermodal freight operations produce only about one fifth of the VMT that would be generated by trucking industry.
Nature of Qualitative Findings	➢ Growth of highway investment between 1950 and 1973 had a strong positive effect on productivity in trucking. ➢ After 1970 the benefits of additional highway investments were close to normal. ➢ Terminal congestion is found to be a factor in short-haul markets, in which lengthy delays can eliminate the cost benefits of intermodal movements of freight.	➢ Effective transportation network delivers benefits beyond the immediate benefits of improved transportation services. ➢ Nontraditional strategies, such as providing reserved capacity for trucks, may have significant productivity impacts. ➢ The current and potential benefits from intermodal freight operations have significant implications for the overall efficiency of the transportation system.

* Numbers is square brackets give citation number in Appendix 1.

2.2.2 Review of Literature Findings

Several studies address the issue of measuring the direct efficiency gains experienced by freight industry as a result of highway investments. The DRI/McGraw-Hill (1994) study addresses the issue of measuring comparative efficiency gains experienced by individual transportation modes as a result of highway investment. This study finds that both railroad and motor freight posted among the highest direct productivity gains of any sector in the economy from 1963 to 1991. While motor freight experienced the largest portion of growth from increased labor productivity, the contribution of highway investment to productivity growth was still significant. Furthermore, the statistical results obtained by Keeler and Ying (1988) point out that the benefits of highway investments are large enough to justify between 33 percent and 50 percent of the cost of the Federal-aid highway system. The study considered the period from 1950 to 1973 and estimated the benefits on the basis of the direct cost savings to trucking alone. It appears, however, that the marginal benefits to the freight industry of additional highway investments after 1970 were close to normal.

Trowbridge and al. (1996) offer an interesting micro-level perspective to the trucking industry. This study considers the productivity impacts that would result from providing "reserved capacity" for trucks rather than restricting them. Such a strategy for trucks would lead to substantial travel time savings for both the trucking industry and passenger vehicles. However, surveys of the general public showed considerable resistance to reserved-capacity strategies for trucks.

2.3 Has the Relationship between Highway Investment and Industrial Productivity been Discerned at Macro and Micro-level?

2.3.1 Classification of Literature Findings

A summary classification of literature findings related to highway investment and industry productivity is presented in Table 2.

2.3.2 Review of Literature Findings

2.3.2.1 Relationship between Highway Investment and Industrial Productivity

The relationship between highway investment and industrial productivity attracted the attention of many researchers. Research by Aschauer (1991) uncovered a positive relationship between general transportation spending and long-run economic performance. The study finds that an increase in transportation spending of $10 billion for ten years would raise labor productivity by nearly four percent over the level which would occur in the absence of higher transportation funding. The econometric study performed by Pinnoi (1993) suggests that highway and street capital provides positive marginal benefits to firms in the manufacturing industry. In addition, the study concludes that the productivity slowdown of 1980's may be partially explained by utilizing suboptimal levels of public and private capital.

Some recent studies also confirm the positive nature of the relationship between the highway investment and private sector productivity at macro-level. The econometric study by Nadiri and Mamuneas (1996), an analysis of 35-industry, documents the highway network's contribution to industry productivity growth, national economic performance, and international competitiveness. The study finds that the net social rate of return on investment in the non-local highway system during the 1980's was 16 percent, and the rate of return for the entire road network was 10 percent. This high return to highway capital is due to its network feature (i.e., its benefits are shared by all industries).

Table 2: Classification of Literature Findings Related to Question B: "Has the Relationship between Highway Investment and Industrial Productivity Been Discerned at Macro and Micro-level?"

	Direct Investigations	Indirect Investigations
Number of Citations	* 23 [9], [23], [29], [38], [45], [49], [51], [53], [56], [61], [62], [63], [66], [67], [68], [69], [70], [80], [84], [95], [96], [99], [102]	7 [7], [28], [52], [54], [71], [82], [100]
Percent of Total Citations	23	7
Range of Quantitative Findings	➢ The marginal industry benefits of highway capital are in the range 0.2 to 0.6 cents per year per $1 increase in highway capital. Somewhat lower results are obtained for Germany and Sweden. ➢ A study replicating the analysis of Aschauer regarding the impacts of public investment on private productivity obtains insignificant results for the State of Texas. The same methodology applied to data from several OECD countries and USA finds similar negative results. ➢ Cross-section analysis of data from 98 countries showed significant associations between per capita national product and per capita length of paved road network.	➢ The positive shadow prices for public capital indicate that infrastructure has a significant role in determining productivity growth. ➢ Net return on investment in public infrastructure accruing specifically to the manufacturing sector could be close to zero. ➢ Highway projects that appear to generate large amounts of growth may not actually cause that growth or may cause it in part by shifting economic activity from other areas.
Nature of Qualitative Findings	➢ An increase in highway capital reduces cost for a given level of output for all industries. ➢ The decline in public infrastructure investment has contributed to the slowdown in productivity. ➢ Changes in road growth lead to larger changes in productivity growth in vehicle intensive. Industries. ➢ The econometric evidence suggests that congestion reduction is productive. The effects of expanding the street and highway stock is more dubious.	➢ Several case studies illustrate how an effective highway network plays an important role in private economic activity. ➢ Economic rate of return, not number of "jobs created" should be the criterion for infrastructure project selection. ➢ The link between transportation investment and private economic performance varies by transportation mode, industry and state.

* Numbers in square brackets give citation number in Appendix 1.

Fernald (1999) obtains similar results. He investigates econometrically how changes in roads affect the relative productivity performance of U.S. industries between 1953 and 1989. The study finds that changes in road growth are associated with larger changes in productivity growth in industries that are more vehicle intensive. The results indicate that the highway construction investment between the late 1950's and 1973 substantially boosted productivity. In particular, the estimates imply that public investment had above-average rates of return, and contributed to an additional one percentage point to total productivity growth. The study concludes that roads were exceptionally productive before 1973 and normally productive thereafter.

Queiroz and Gautam (1992) investigate empirically the relationship between per capita income and the magnitude and quality of road infrastructure. Cross-section analysis of data from 98 countries, and time series analysis of U.S. data since 1950 shows consistent and significant relationship between economic development, in terms of per capita national product, and road infrastructure, in terms of per capita length of paved road network. The data indicate that per capita stock of road infrastructure in high-income economies is dramatically greater in middle and high-income economies. For example, the average density of paved roads (km/million inhabitants) varies from 170 in low-income economies to 1,660 in middle and 10,110 in high-income economies. Road condition also seems to be associated with economic development: the average density of paved roads in good condition (km/million inhabitant) varies from 40 in low –income economies to 470 in middle and 8,550 in high-income countries.

Another line of research finds no significant relationship between highway investment and productivity. Roeseler and Smithson (1980) address the impact of technological change in rail and highway network on the regional productivity and development. The study investigates the Houston-Beaumont region in Texas. The main finding of this study is that technological changes in transportation systems have very little measurable impact on the overall economy of the region. Husak and Glenn (1998) reached a similar conclusion. Their study attempts to replicate the analyses of Aschauer and others regarding the impacts of public infrastructure investment on private factor productivity for the State of Texas. The generated relationships are, however, statistically insignificant.

2.3.2.2 Relationship Between Infrastructure Investment and Industrial Productivity

Some studies investigate the broader relationship between public capital (highway, water, sewer, etc.) and industrial productivity. Studies by Aschauer (1990b, 1991) and Munnel (1990) show that public capital has a significant, positive impact on the output and productivity at the state and macroeconomic level. The regression coefficients imply that the marginal productivity of public capital is comparable and even higher in some cases than the marginal productivity of private capital. Other research, such as, Morrison and Schwartz (1996) and Nadiri and Mamuneas (1994) have obtained similar findings. They conclude that publicly-financed infrastructure has a significant role in determining productivity growth. The magnitude of these effects is, however, smaller than has been previously reported in the literature.

At micro-level, the positive relationship between highway investment, freight transportation and industry productivity is illustrated by several case studies. Apogee Research (1990) and Hickling (1995) demonstrated the positive impact of highway investment on firm productivity. These studies find that companies such as Koley's Medical Supply, James River Corporation, and Dole Fresh Fruit achieved productivity improvements through stockless purchasing and good transportation access. In addition, the studies find that effective highway network helped other companies, like Alladin Mills and Hewlett Packard to become more competitive by facilitating labor access from adjacent communities. Firms such as Digital Equipment Corporation and Bank of Boston benefited from improved highway network, which allowed for cost-effective expansion into new geographical areas.

In the international arena, Berndt and Hansson (1992) and Conrad and Seitz (1994) investigate statistically the relationship between public investment and industry productivity for Sweden and Germany, respectively. These studies show that public infrastructure contributes to industry productivity and that public investments are a complement to private investments. This line of research is not, however, without, antagonists. Chrihfield and Panggabean (1995) study the productivity of public investment within the context of a neoclassical growth model. The model's estimations indicate that public infrastructure has at most a modest effect on factor markets, and an even smaller impact on growth of per-capita income. Moreover, most infrastructure coefficients in the growth models were found to be statistically insignificant. Neither state nor local investments were found to lead to growth of per-capita income. The study concludes that there are no substantial unexploited gains from public investments.

Ford and Poret (1991) accept the essentials of Aschauer's methodology. They applied the methodology to a broader range of data (several OECD countries and a larger data set for the United States). The results, however, provide little support for Aschauer's hypothesis. The study shows that while infrastructure growth slowed in the 1970s in all twelve of the countries examined, it was accompanied by a deceleration of private-sector total factor productivity in only half of them. Examination of a century of data for the United States implies that there is no relationship between productivity and infrastructure capital in the United States except for the post-war period examined by Aschauer. The authors conclude that overall the regression results cannot support a policy recommendation of a sharp acceleration of infrastructure investment.

In summary, most of the literature findings suggest that a positive relationship exists between public infrastructure investments and freight and industry productivity, though the strength of this relationship has weakened since 1973. There are, however, a number of valid theoretical, econometric and other reasons for exercising caution in the use of these results for policy making.

2.4 In What Sectors Has This Productivity Effect Been Most Pronounced?

2.4.1 Classification of Literature Findings

A summary classification of literature findings related to public infrastructure impacts on productivity is presented in Table 3.

Table 3 Classification of Literature Findings Related to Question C; *" In What Sectors Has This Productivity Effect Been Most Pronounced?"*

	Direct Investigations	Indirect Investigations
Numbers of Citations	* 6 [9], [23], [27], [38], [51], [56]	3 [31], [43], [52]
Percent of Total Citations	6	3
Range of Quantitative Findings	➢ Potential logistics restructuring benefits for several surveyed industries are between 14 and 64 percent of the direct conventional benefits resulting from infrastructure improvements. ➢ The average elasticity of cost with respect to highway capital is about -0.04 to -0.06. ➢ The output elasticity in different industries in respect to highway capital ranges from 0.12 to 0.02.	➢ A study about the Kansas Comprehensive Highway program measures the economic impacts of the $2.86 billion spent on state highway system over eight years. It is argued that the economic impact of this program as measured by output is $7.4 billion., as measured by income is $1.4 billion, and, as measured by employment is 117,820 full time jobs.
Nature of Qualitative Findings	➢ The greatest benefit from highway improvements accrue to the industries that are most intensive users of highways: Trade, Finance, Insurance, Real Estate, Transportation Equipment and Motor Vehicle, and Construction ➢ Given a level of output, an increase in highway capital leads to a reduction in demand for labor and materials and an increase in demand for private capital. ➢ Roads were exceptionally productive before 1973 but are not so productive at the margin thereafter.	➢ A series of case studies have shown how individual firms or specific industries have used transportation as catalyst to improve their productivity. ➢ Methodologies, available to analyze the relationship between transportation investment and productivity, are identified, critically evaluated, and applied to a sample of case studies.

* Numbers in square brackets give citation number in Appendix 1.

2.4.2 Review of Literature Findings

The contribution of transportation to freight productivity is well documented by DRI/McGraw research (1994). An interesting finding is that railroad and motor freight, from 1963 to 1991, were top productivity performers, surrounded by "high technology" sectors. The aggregate transportation services sector contributed 8.3 percent to national productivity gains for the same period. Fernald (1999) explores the relationship between public capital, focusing on roads as its largest element, and macroeconomic productivity.

His study strongly supports the notion that industries with a lot of vehicles benefit disproportionately from road building.

An innovative line of research focuses on measuring the effects of infrastructure improvements on freight transport characteristics (travel time, travel time reliability, travel cost), and through them, on industry productivity. It was conventionally assumed that the value of user and system benefits include the total value of productivity and output gains that occur due to a transportation infrastructure investment. However, if an improvement in the transportation system is large enough, some firms will choose to restructure their logistics practices in order to take advantage of improved transportation. This will be a source of an additional logistic restructuring benefits not captured by the traditional approach. An industry survey performed by Hickling (1995) found that the industries, which had the biggest traditional and logistics related benefits from infrastructure improvements, are medical and surgical instruments, automotive parts, telecommunication equipment and retail food. Moreover, it was found that the potential benefits from industrial restructuring are within the range of 14 to 64 percent, for the surveyed industries, relative to conventional benefits.

Nadiri and Mamuneas (1998) estimate the average elasticity of cost with respect to highway capital for 35 industries. They find that an increase in highway capital does reduce costs in all but three industries. The elasticities are relatively large in sectors such as Services, Trade, Finance, Insurance, Real Estate, Agriculture, Transportation Equipment and Motor Vehicle Manufacturing. These industries are the most intensive users of the highway network. For most of the manufacturing industries, the elasticities are about - 0.04 to -0.06.

The cost reduction due to an increase in highway capital may lead to a reduction in output price. As a result demand for output will increase. The output elasticity in different industries, found by Nadiri and Mamuneas (1998), ranges from 0.121 for Trade to 0.017 for Instruments. The industries with the largest output elasticity with respect to highway capital are some of the service industries, transportation industries, the construction sector, and some manufacturing industries.

The magnitudes of the elasticities of employment, private capital and materials with respect to highway capital vary across industries. The empirical findings suggest that in most industries highway capital and private capital are complements. This complementary effect is relatively large in industries such as Crude Petroleum and natural Gas, Utilities, Trade, Finance & Real Estate, and Other Services.

Marginal benefit of highway capital, defined in terms of industry cost reduction with respect to highway capital, indicates the "willingness to pay" for an additional unit of highway capital services by each industry. These benefits are measures of the highway system's externality benefits to various industries. The largest benefits occur in service industries – Trade, Finance, Insurance and Real Estate, Other Services, Construction, Kindred Products, Machinery except Electric and Motor Vehicles.

2.5 Nature of Productivity Effects

2.5.1 Classification of Literature Findings

A summary classification of literature findings related to the nature of productivity effects is given in Table 4.

Table 4 Classification of Literature Findings Related to Question D: *"What is the Nature of Productivity Effects?"*

	Direct Investigations	Indirect Investigations
Number of Citations	* 3 [9], [44], [81]	6 [4], [7], [10], [33], [43], [79]
Percent of Total Citations	3	6
Range of Quantitative Findings and Nature of Quantitative Findings	*Direct Gains* ➢ Reserved-capacity strategies for trucks for a particular highway stretch would offer a saving of about 2.5 minutes per truck trip. This translates into nearly $10 million in annual travel time savings for the trucking industry. *Logistics Restructuring* ➢ It is estimated that the benefits from logistics restructuring are 26.5, 3.57 and 1.34 million for Medical Instruments, Telecommunication Equipment and Automotive parts, respectively, for 1994. *Spillover Effects* ➢ Using data for California counties from 1969 through 1988, Boarnet (1988) shows that when input factors are mobile, public infrastructure investment in one location can draw production away from other locations, i.e., negative spillover effect exists.	*Direct Gains* ➢ Some case studies illustrate the nature of the direct productivity gains from infrastructure improvements: stockless purchasing, facilitating labor access, etc. *Logistics Restructuring* ➢ A study of I-5 Interstate corridor estimated that with a 20 percent improvements in travel time and travel time reliability at least six percent of the firms would restructure their logistics and distribution process. The logistics restructuring benefits from such a highway improvements for the region along the I-5 corridor are estimated to be between $585 million and $1,046 million in 1997 prices over the next 30 years. *Network Effects* ➢ Protagonists view: firms exploit external network economies in achieving productivity growth. ➢ Antagonists view: effects counted as positive network externalities are normal consumer's or producer's surplus.

* Numbers in square brackets give citation number in Appendix 1.

2.5.2 Review of Literature Findings

2.5.2.1 Direct Savings

Changes in transportation system may affect the system attributes of travel time and travel time reliability. This would enable freight and other private firms to realize short-term cost savings due to lower operating costs. For example, it is estimated[1] that reserved-

[1] Trowbridge at al. (1996)

capacity strategies for trucks, on a particular road stretch, would offer a saving of about 2.5 minutes per average truck trip. This leads to nearly $10 million in annual travel time savings for the trucking industry and almost $30 million in annual time savings for single occupancy vehicles. Transportation system improvements could, by some estimates[2], generate savings of up to fifty percent in distribution cost for some industries. Several case studies[3] demonstrated the nature and extent of the direct productivity improvements stemming from infrastructure investment.

2.5.2.2 Logistics Restructuring Productivity Gains

An improved transportation system will reduce the travel time and increase travel time reliability. This may induce some firms to restructure their logistics operations (transportation, warehousing, and inventories) when they identify an opportunity to reduce the cost of operations, or to facilitate the expansion of business activities. It is estimated[4], for example, that the benefits from industry restructuring alone for 1994 were $26.5, $3.47 and $1.34 million for Medical and Surgical Instruments, Telecommunication Equipment, and Automotive Parts, respectively. Though these numbers seem small, the logistic restructuring benefits are (1) additive to and (2) of great significance relative to the direct conventional benefits.

2.5.2.3 Network Effects

At micro-level, some studies[5] measure how firms exploit economies of density and scope in achieving productivity growth and maximizing profit. These studies investigate potential significance of external network economies and their policy implications for pricing policies that seek to internalize negative congestion, environmental and other externalities. There are opponents, however, such as Rotengatten (1994) who argues that most of the effects counted as positive externalities--such as improvements in economic efficiency or development of new consumption/production structures--are not external benefits but are part of the normal consumer's or producer's surplus

2.6 Annotated Bibliography

One of the objectives of this study is to provide annotated bibliography of the pertinent research efforts informing decision makers of the nature and magnitude of public policy influence on freight productivity. An annotated bibliography format is developed for this purpose. This format is shown in Figure 1. It is designed to provide all the necessary bibliographical information, to present the public policies, investigated in a specific study, and the resulting productivity gains. Key words are also provided to allow a computer database to be developed at the last stage of this study.

2.6.1 Aims of the Annotated Bibliography Format

- To provide necessary bibliographical information;

[2] Hickling (1995)
[3] Apogee Research (1990), Hickling (1995)
[4] Hickling (1995)
[5] Button at al. (1998), Hickling (1995)

- To present examined public policies;
- To summarize the key findings related to productivity;
- To provide the key words needed for development of a computer database .

2.6.2 Description of the Annotated Bibliography Format

- The top line provides the title of the study and the year of its publication.
- Line 1 gives the name of the author(s).
- Line 2 provides the title of the study if it is a chapter in a book or a journal article.
- Line 3 may give either (1) the title of the study itself, or (2) the title of the book/journal if the study is a book chapter/journal article.
- The type of the study (book, book chapter, journal article, report, discussion paper, etc.) is given in line 4.
- The publisher and the date of publication are provided in lines 5 and 6, respectively.
- The status of the study (published and refereed; published, not refereed; unpublished) can be obtained from line 7.
- The key words, related to different aspect of the functional classification, are summarized in line 8.
- Line 9 gives the main public policies, affecting productivity, examined in the respective study. They can be related to the summary of results and key findings presented in line 10.

Figure 1: Annotated Bibliography Format

TITLE (YEAR)

1	Author(s)	
2	Title	
3	Book/Journal Title	
4	Type	
5	Publisher	
6	Date of Publication	
7	Status of Study	
8	Key Words	
9	Policy Examined	
10	Summary of Results (Key Findings)	

3. CONCLUSION

This paper provides an annotated bibliography and an analysis of the pertinent research findings investigating public policy impacts on productivity. The prevailing view, emerging from the surveyed literature, is that public capital has a weak positive effect on freight and private economic productivity and output.

Below are the main findings from the pertinent literature exploring the nature and magnitude of public policy influence on productivity:

- Highway investments between 1950 and 1973 had a significant positive impact on trucking and economy-wide productivity.
- After 1970 the benefits of additional highway investment declined and were close to normal.
- The decline in both public and private investment has contributed to the slowdown in productivity.
- Changes in highway network investment lead to larger changes in productivity growth in vehicle intensive industries.
- An increase in highway capital leads to a reduction in demand for labor and materials and an increase in demand for private capital.
- Effective transportation network delivers benefits beyond and above the direct benefits from improved transportation. These indirect benefits stem from logistics restructuring or external network economies.

The exact nature of the linkage between public policy and productivity is, however, beginning to be understood. This is especially true for the nature of the specific relationship between highway investments and freight productivity. It is instructive that only 6 out of 102 studies, included in the annotated bibliography, directly investigate this relationship, while another 49 studies examine the public infrastructure contribution to industry productivity. The rest of the annotated studies explore impacts of various public policies on productivity.

Many questions concerning public policy impacts on productivity, competitiveness and economic vitality remain to be clarified methodologically and answered quantitatively. Industry logistics restructuring and network effects are the subjects the least investigated.

It can be concluded that our knowledge of the relationship between public capital and productivity is not sufficient to state the exact impact of public-sector investments on freight productivity. This makes further study of the relationship between public investment and productivity even more needed to develop public policies that will make the most contribution to freight and industry productivity and economic growth.

APPENDIX 1: ANNOTATED BIBLIOGRAPHY

1. ECMT (1998a)

1	Author(s)	European Conference of Ministers of Transport (ECMT)
2	Title	
3	Book/Journal Title	*Efficient Transport for Europe: Policies for Internalization of External Costs*
4	Type	Report
5	Publisher	OECD Publishing Service
6	Date of Publication	1998
7	Status of Study	Published, not refereed
8	Key Words	International, aggregate economy, macroeconomic, investment , financing, regulation, assistance, cross-section, economic incentive, Europe, internalization, external costs, environment, marginal
9	Policy Examined	Regulation: ➢ Internalization policies to internalize transportation externalities; ➢ Taxes and congestion charges; ➢ Financing arrangements and subsidies; ➢ Road safety.
10	Summary of Results (Key Findings)	➢ Significant welfare gains could be realized through policies aimed at internalizing the external costs of transport. ➢ Four major categories of external costs are identified: accident externalities, environmental damage, uncovered infrastructure costs, and congestion. ➢ Internalization policies can be implemented through economic instruments, and/or regulations, designed to reduce externalities to the optimal level. ➢ Internalization has implication for both the structure and the level of prices. However, internalization will primarily involve structuring prices more efficiently, rather than increasing the overall price level. ➢ Internalization raises some adjustment problems through its impact on different categories of transport users. ➢ Internalization is expected to have little impact on GDP growth or on competitiveness of transportation industry as a whole. The effects of increased costs will be offset by increases in efficiency and opportunities for reducing general taxes.

2. ECMT (1998b)

1	Author(s)	European Conference of Ministers of Transport (ECMT)
2	Title	
3	Book/Journal Title	*Report on the Current State of Combined Transport in Europe*
4	Type	Report
5	Publisher	OECD publishing service
6	Date of Publication	1998
7	Status of Study	Published, not refereed
8	Key Words	International, aggregate economy, macroeconomic, investment , financing, regulation, assistance, case study, industry structure, intermodal, combined transport, Europe
9	Policy Examined	Investment and Financing Policies: ➢ Infrastructure funding; ➢ Communication technologies Regulation: ➢ Intramodal transport; ➢ Industry structure and competitiveness; National and International Assistance: ➢ Facilitation; ➢ Standards.
10	Summary of Results (Key Findings)	➢ At the European level, combined transport has to be understood as the organization of door-to-door transport by transferring goods from one mode to another without changing the loading unit. ➢ European countries have been working for many years on joint policies to improve the conditions for combined transport. ➢ The report presents an overview of combined transport in 30 European countries and a summary of EU activities in the area of combined transport. ➢ The general analysis considers the main European routes in combined transport and factors, which determine their competitiveness – related infrastructure, transit time and reliability, border crossings. ➢ Price competition between road and combined transport is illustrated by several case studies. ➢ The book concludes with a summary of findings and comparison with the conclusions of the 1992 report.

3. ECMT (1995a)

1	Author(s)	European Conference of Ministers of Transport (ECMT)
2	Title	
3	Book/Journal Title	*Transport Infrastructure in Central and Eastern European Countries*
4	Type	Report
5	Publisher	ECMT
6	Date of Publication	1995
7	Status of Study	Published, not refereed
8	Key Words	International, aggregate economy, macroeconomic, investment, financing, funding, regulation, assistance, case study, economic analysis, return
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; ➢ State funding; Regulation and Institutional Environment: ➢ Intramodal transport; National and International Assistance: ➢ Facilitation ➢ Standards and compatibility.
10	Summary of Results (Key Findings)	➢ Transport infrastructure in Central and Eastern European countries needs considerable investment. A truly integrated pan-European network requires that pertinent criteria be established for funding and building these infrastructures. ➢ This publication lays out the criteria for determining priority links: service quality, network coherence and institutional constraints, return on investment ➢ These criteria are chosen from multimodal standpoint and take account for the alternatives that might be offered by other transport techniques, or routes. ➢ It also inventories financing possibilities for infrastructures and transport systems in this region by analyzing needs, sources, and mechanisms, as well as the insufficiencies and possibilities for improving current financing systems.

4. BUTTON AND AL (1998)

1	Author(s)	Button, K., P. Nijkamp and H. Priemus (eds.)
2	Title	
3	Book/Journal Title	*Transport Networks in Europe: Concepts, Analysis and Policies*
4	Type	Book
5	Publisher	Edward Elgar
6	Date of Publication	1998
7	Status of Study	Published and refereed
8	Key Words	International, aggregate economy, macroeconomic, investment, financing, regulation, assistance, environment, network, synergy, subsidy, case study, Europe.
9	Policy Examined	Investment and Financing Policies: ➢ State funding; ➢ Communication and information technologies. **NATIONAL AND INTERNATIONAL ASSISTANCE** ➢ Facilitation; ➢ Logistics management.
10	Summary of Results (Key Findings)	➢ A framework is developed for evaluating European transport networks. ➢ Government policy, it is argued, needs to be carefully designed to ensure that it is not counterproductive in wasting positive synergy effects. ➢ Making better use of existing transportation systems and networks rather than constructing large new ones can attain highly cost-effective solutions. ➢ There is a role for a proactive policy with regard to the fostering of advanced information technologies. ➢ Some means by which transport infrastructure can be financed through new appropriate allocation of responsibilities between the private and public sectors are examined. ➢ A conclusion is made that formation of networks at an urban and regional level can make an important contribution to the efficiency of urban public transport. ➢ The main goals of public intervention, it is argued, should be removal of network barriers by providing information and favoring process that enables actors to initiate and augment linkages.

5. GARLAND (1995)

1	Author(s)	Garland, C.
2	Title	"North American Trucking Policy"
3	Book/Journal Title	*Transport Economics: Selected Readings*
4	Type	Book chapter
5	Publisher	Korea Research Foundation
6	Date of Publication	1995
7	Status of Study	Published and refereed
8	Key Words	International, national, industry, sector, trucking, policy, regulation, deregulation, NAFTA, trade, Canada, Mexico
9	Policy Examined	Regulation and Institutional Environment ➢ Industry Structure and competitiveness; ➢ Trade regulation and facilitation. National and International Assistance ➢ Administrative services and facilitation
10	Summary of Results (Key Findings)	➢ Transportation is a key component of free trade infrastructure in North America initiated by NAFTA. ➢ Government transport policy has an important impact on the ability of the trucking industry to meet the needs of the economy in this new environment. ➢ The economic characteristics of trucking in United States, Canada and Mexico are compared and contrasted. ➢ The deregulation of trucking in all three countries went at different speeds. One consequence is that this created invisible barriers between them, which need to be removed. ➢ A conclusion is made that if the market is left to govern conduct in the trucking industry, North American carriers will become more efficient and the other industries will benefit as a result of this. ➢ As economic regulation disappears in most trucking markets, public policy will refocus on safety and technical regulations. ➢ The lesson from North America is that inconsistent regulatory policies between countries, states and provinces create economic inefficiency.

6. ROBERT AND FAUTH (1988)

1	Author(s)	Robert, P.O. and G. Fauth
2	Title	The Outlook for Commercial Freight
3	Book/Journal Title	*Special Report 220: A Look Ahead - Year 2020*
4	Type	Report chapter
5	Publisher	Transportation Research Board
6	Date of Publication	1988
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, freight, regulation, truck
9	Policy Examined	Regulation and Institutional Environment: ➢ Industry structure and competitiveness. National and International Assistance: ➢ Facilitation; ➢ Standards and compatibility.
10	Summary of Results (Key Findings)	➢ Highlights the key trends in the 1980's and summarizes the resultant position of railroad and motor carriers in today's freight markets. ➢ An assessment is made of where railroads and motor carriers might be in the distant future. It is assumed that the seeds of the technologies and strategies that will be familiar in the year 2020 have already sprouted and are growing quietly. ➢ The study tries to project major trends in commercial freight. However, the results are qualitative and do not suggest specific policies aimed at improving efficiency of freight industry.

7. APOGEE RESEARCH (1990)

1	Author(s)	Apogee Research, Inc.
2	Title	
3	Book/Journal Title	*Transportation: Key to a Better Future. The Relationship of Transportation Investments to Economic Growth: A Special Committee Report*
4	Type	Report
5	Publisher	American Association of State Highway and Transportation Officials
6	Date of Publication	1990
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, investment, financing,, regulation, case study, logistics
9	Policy Examined	**INVESTMENT AND FINANCING POLICIES:** ➢ Economic analysis; ➢ Federal and State funding. National and International Assistance: ➢ Logistics management.
10	Summary of Results (Key Findings)	➢ The link between transportation and economic productivity is examined. ➢ Policy implications: first, it shows the potential gains that can be obtained by investment in the nation's highways and bridges; second, it shows that an effective transportation network delivers benefits beyond the immediate benefits of improved transportation services. ➢ The report highlights the need to understand the importance of public capital for the profitability of private firms. ➢ The case studies presented in this study illustrate how an effective highway network plays an important role in private economic activity.

8. HLB Inc. (1997)

1	Author(s)	Hickling Lewis Brod Inc.
2	Title	
3	Book/Journal Title	*Social Cost Pricing and the External Benefits of Trucking*
4	Type	Report
5	Publisher	American Trucking Association Foundation
6	Date of Publication	December 1997
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, externality, economic, analysis, trucking, freight, logistics, productivity, uncertainty
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; Regulation and Institutional Environment: ➢ Industry structure and competitiveness National and International assistance: ➢ Logistics management
10	Summary of Results (Key Findings)	➢ This report provides a first step in evaluating the impact that fully pricing the nation's highways would have on the trucking industry. Both the positive and negative externalities are considered. ➢ The trucking industry's contribution to economic growth and productivity through logistics-related technologies – in part, positive externalities – is contrasted with the negative externalities of congestion and environmental damage caused by truck transport. ➢ If full social cost pricing is implemented it is likely that the price of truck transportation services will increase, and part of the negative external costs of trucking will be eliminated. ➢ However, if shippers moderately reduce their capital investment in logistics-related technologies and offer fewer logistic related services in response to an increase in truck transport prices, it is highly probable that economy wide productivity losses will outweigh benefits of reduced congestion and improved air quality. ➢ Not only will economically beneficial truck trips be priced off the road, but also the overall productivity growth of US manufacturing will be reduced, resulting in a net loss to society.

9. HICKLING CORP. (1995)

1	Author(s)	Hickling Corp.
2	Title	
3	Book/Journal Title	*Measuring the Relationship Between Freight Transportation Services and Industry Productivity*
4	Type	Report NCHRP 2-17(4)
5	Publisher	National Cooperative Highway Research Program, Transportation Research Board
6	Date of Publication	1994
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, firm, cross-section, investment, financing, freight, efficiency, logistics, restructuring, case study, economic analysis
9	Policy Examined	Investment and Financing: ➢ Economic analysis; ➢ Federal and State funding. Regulation and Institutional Environment: ➢ Industry structure and competitiveness; ➢ Economic incentives.
10	Summary of Results (Key Findings)	➢ This research explores the sources of productivity within firms vis-a-vis the transportation and logistics functions. ➢ Data collected from a survey of six industries are used to estimate elasticities (measures of sensitivity) of benefits to industry from changes in transportation system characteristics. ➢ It is found that the potential benefits from industrial restructuring are of great significance relative to the conventional benefits which industry derives from transportation system improvements. ➢ One of the key findings is that while prospective benefits from industrial restructuring may be significant, the likelihood of realizing these benefits is contingent upon firm and industry characteristics. ➢ It is also found that public agency policies affecting the willingness of firms to undertake investment in physical capital could significantly impact the realization of industrial restructuring benefits. ➢ Six case studies from firms, which underwent a restructuring of their distribution networks, examine the relationship between freight transport and industry productivity.

10. ROTENGATTEN (1994)

1	Author(s)	Rothengatter, Wener
2	Title	Do External Benefits Compensate for External Costs of Transport?
3	Book/Journal Title	*Transportation Research*, Part A, Volume 28A No4, 321-28.
4	Type	Journal article
5	Publisher	
6	Date of Publication	1984
7	Status of Study	Published and refereed
8	Key Words	International, national, regulation, tax, charge, externality, benefits, costs
9	Policy Examined	Investment and Financing: ➢ Economic analysis. Regulation and Institutional Environment: ➢ Economic incentives (taxes, subsidies).
10	Summary of Results (Key Findings)	➢ Positive externalities of transport activities play a growing role in the political discussion. It is argued that the number and the relevance of positive transportation externalities is low. Moreover, most of the effect counted as positive externalities such as improvement of economic efficiency or development of new consumption/production structures are basically not external but normal consumer's or producer's surpluses induced by market interactions. ➢ The author concludes, due to the fact that external benefits are negligible, there is no reason to subtract such benefits from the external costs of transportation. ➢ The conclusions are purely theoretical without statistical or econometric support. Their validity should be further researched.

11. JANSSON (1993)

1	Author(s)	Jansson, Owen Jan
2	Title	Government and Transport Infrastructure – Pricing
3	Book/Journal Title	Polak J. and A. Heertje (eds.), *European Transport Economics*, 188-219.
4	Type	Book chapter
5	Publisher	Blackwell
6	Date of Publication	1993
7	Status of Study	Published and refereed
8	Key Words	International, national, aggregate, industry, sector, macroeconomic, pricing, transportation, infrastructure, external, costs, externality
9	Policy Examined	Regulation and Institutional Environment: ➢ Economic incentives (road pricing)
10	Summary of Results (Key Findings)	➢ The main characteristic of transport systems, described at the outset is that, with the exception of nearly all railways, transport firms do not own the fixed capital used in the production process. ➢ The nature of the user costs and the producer costs are considered in the light of empirical findings. Pronounced small-scale diseconomies in the producer costs are characteristics of all sorts of infrastructure – common facilities as well as departmentalized facilities, such as parking facilities. At the other extreme of density of demand where, in addition, space can be very limited, as in central cities, plant-size economies cease very definitely with dramatic consequences for optimal pricing. ➢ In the case of road infrastructure external costs should be the main item in the determination of optimal pricing, because the cost of accidents and environmental cost are important both in congested and uncongested conditions. ➢ When asking the question whether optimal road pricing will pay for the roads, however, the focus should be on congestion costs.

12. GERONDEAU (1997)

1	Author(s)	Gerondeau, C.
2	Title	The Road Network: Only the Road Can Relieve the Road
3	Book/Journal Title	*Transport in Europe*, 65-93.
4	Type	Book chapter
5	Publisher	Artech House
6	Date of Publication	1997
7	Status of Study	Published and refereed
8	Key Words	International, national, aggregate, macroeconomic, industry, network, road, congestion, investment, financing, standards, freight, Europe
9	Policy Examined	Investment and Financing Policies ➢ Economic analysis; ➢ State funding.
10	Summary of Results (Key Findings)	➢ An objective examination of the facts and figures, as the author argues, leads to a surprising conclusion. For both people and freight, it is impossible to alleviate road traffic in anything but a marginal way by developing other modes of transport. ➢ Things would be different if it were possible to impose the choice of means of transport on users. The countries of Eastern Europe proceeded in this manner until liberation from communism in 1989. The railway and, to a lesser extent, the waterway, monopolized almost all traffic there, at the price of considerable delays and costs to the economy. But in this case, too, everything has reversed since economic actors have free choice of their decisions. The railroad has seen its traffic collapse, while road traffic is literally exploding. ➢ Unless restrictive measures are imposed, which no one cab seriously consider as a general rule in a market oriented country, the fact must be faced when a new transport investment is planned that only the road can relieve the road. ➢ The main conclusion, though controversial, deserves the attention of policy makers when considering alternative options for relieving congestion.

13. CABAJO AND FRIES (1997)

1	Author(s)	Carbajo, J. and Steven Fries
2	Title	*Restructuring Infrastructure in Transition Economies*. Working Paper 21
3	Book/Journal Title	
4	Type	Working paper
5	Publisher	Office of the Chief Economists, EBRD
6	Date of Publication	May 1997
7	Status of Study	Published, not refereed
8	Key Words	International, macroeconomic, aggregate, transportation, tax, tariff, financing, restructuring, Europe, transitional economy
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; ➢ State funding. Regulation and Institutional Environment ➢ Industry structure and competitiveness; ➢ Economic incentives (taxes, tariffs)
10	Summary of Results (Key Findings)	➢ Infrastructure in the transition economies requires substantial restructuring. ➢ Given the shift in composition of output toward higher value-added products and the increased demand for personal transport, there is likely to be a shift towards greater reliance on road services. ➢ The current East European structure of railway tariffs (and fuel taxes) runs the risk of encouraging excessive substitution of road for rail-based services, and this should be realigned. ➢ Estimates of annual investment requirements range between 2 and 3 percent of east European GDP over the next decade. ➢ A more commercial approach to infrastructure, including greater private participation, is an effective means of facilitating tariff reform and expanding access to private finance for investment. ➢ The results are based on extensive use and comparisons of macroeconomic data from the east European countries. They highlight the shortcomings of central planning in infrastructure development and the trends established by market forces after its removal.

14. U.S. DEPARTMENT OF TRANSPORTATION (1994a)

1	Author(s)	U.S. Department of Transportation (U.S. DOT)
2	Title	
3	Book/Journal Title	*ITS Architecture Development Program, Phase I: Summary Report*
4	Type	Report
5	Publisher	U.S. DOT
6	Date of Publication	November 1994
7	Status of Study	Published, not refereed
8	Key Words	National, macroeconomic, industry, sector, investment, financing, ITS, program, architecture
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding; ➢ Communication and Information Technologies (ITS).
10	Summary of Results (Key Findings)	➢ This document provides information on the Intelligent Transportation Systems (ITS) Architecture Development Program, highlighting the four architectures being developed. ➢ Preliminary qualitative results about the ITS architecture.

15. U.S. DEPARTMENT OF TRANSPORTATION (1995a)

1	Author(s)	U.S. Department of Transportation (U.S. DOT) – ITS, FHWA, FTA, NHTSA
2	Title	
3	Book/Journal Title	*Department of Transportation's Intelligent Transportation Systems (ITS) Projects*
4	Type	Report
5	Publisher	U.S. DOT
6	Date of Publication	January 1995
7	Status of Study	Published, not refereed
8	Key Words	National, macroeconomic, industry, sector, firm, investment, financing, ITS, program
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding; ➢ Communication and Information Technologies (ITS).
10	Summary of Results (Key Findings)	➢ This report describes those ITS projects that are wholly or partially funded by the Department of Transportation's (DOT) modal administrations, including the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA) and the National Highway Traffic Administration (NHTSA). ➢ The report is a complement to the National ITS Program Plan, and is organized to describe those DOT-sponsored activities which support the development of user services, national compatibility planning, deployment, deployment support, and program assessment. ➢ In most the cases results of implementation are not available.

16. U.S. DEPARTMENT OF TRANSPORTATION (1995b)

1	Author(s)	U.S. Department of Transportation (U.S. DOT) - Euler, G. and H.D. Robertson (eds.)
2	Title	
3	Book/Journal Title	*National ITS Program Plan: Executive Summary, First Edition*
4	Type	Report
5	Publisher	U.S. DOT
6	Date of Publication	March 1995
7	Status of Study	Published, not refereed
8	Key Words	National, macroeconomic, industry, sector, firm, investment, financing, ITS, program
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding; ➢ Communication and Information Technologies (ITS).
10	Summary of Results (Key Findings)	➢ The purpose of the *National ITS Program Plan* is to guide the development and deployment of Intelligent Transportation Systems (ITS) in the United States. ➢ The first edition of the Plan is a joint effort of ITS America and the United States Department of Transportation. ➢ The plan is developed through a consensus process involving the entire ITS community. ➢ The executive summary provides a very brief overview of the goals, objectives and recommendations presented in the National ITS Plan.

17. U.S. DEPARTMENT OF TRANSPORTATION (1995c)

1	Author(s)	U.S. Department of Transportation (U.S. DOT) - Euler, G. and H.D. Robertson (eds.)
2	Title	
3	Book/Journal Title	*National ITS Program Plan: Synopsis, First Edition*
4	Type	Report
5	Publisher	U.S. DOT
6	Date of Publication	March 1995
7	Status of Study	Published, not refereed
8	Key Words	National, macroeconomic, industry, sector, firm, investment, financing, ITS, program
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding; ➢ Communication and Information Technologies (ITS).
10	Summary of Results (Key Findings)	➢ The purpose of the *National ITS Program Plan* is to guide the development and deployment of Intelligent Transportation Systems (ITS) in the United States. ➢ The first edition of the Plan is a joint effort of ITS America and the United States Department of Transportation. The plan is developed through a consensus process involving the entire ITS community. ➢ The Synopsis provides an overview of the major subject areas within the *National ITS Program Plan*, with special emphasis on the area of current and future deployment.

18. U.S. DEPARTMENT OF TRANSPORTATION (1995d)

1	Author(s)	U.S. Department of Transportation (U.S. DOT) – ITS America
2	Title	
3	Book/Journal Title	*National ITS Program Plan: Volume I, First Edition*
4	Type	Report
5	Publisher	U.S. DOT
6	Date of Publication	March 1995
7	Status of Study	Published, not refereed
8	Key Words	National, macroeconomic, industry, sector, firm, investment, financing, ITS, program
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding; ➢ Communication and Information Technologies (ITS).
10	Summary of Results (Key Findings)	➢ The purpose of the *National ITS Program Plan* is to guide the development and deployment of Intelligent Transportation Systems (ITS) in the United States. ➢ The first edition of the Plan is a joint effort of ITS America and the United States Department of Transportation. ➢ The plan is developed through a consensus process involving the entire ITS community. ➢ Volume I focuses on the issues of goals, compatibility, deployment, and program assessment of the National ITS Plan.

19. U.S. DEPARTMENT OF TRANSPORTATION (1995e)

1	Author(s)	U.S. Department of Transportation (U.S. DOT) – Euler, G. and H.D. Robertson (editors)
2	Title	
3	Book/Journal Title	*National ITS Program Plan: Volume II, First Edition*
4	Type	Report
5	Publisher	U.S. DOT
6	Date of Publication	March 1995
7	Status of Study	Published, not refereed
8	Key Words	National, macroeconomic, industry, sector, firm, investment, financing, ITS, program
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding; ➢ Communication and Information Technologies (ITS).
10	Summary of Results (Key Findings)	➢ The purpose of the *National ITS Program Plan* is to guide the development and deployment of Intelligent Transportation Systems (ITS) in the United States. ➢ The first edition of the Plan is a joint effort of ITS America and the United States Department of Transportation. ➢ The plan is developed through a consensus process involving the entire ITS community. ➢ Volume II contains detailed descriptions and plans for each of the twenty-nine user services identified in the National ITS Plan.

20. U.S. DEPARTMENT OF TRANSPORTATION (1990)

1	Author(s)	U.S. Department of Transportation (U.S. DOT)
2	Title	
3	Book/Journal Title	*National Transportation Strategic Planning Study*
4	Type	Report
5	Publisher	U.S. DOT
6	Date of Publication	March 1990
7	Status of Study	Published, not refereed
8	Key Words	National, macroeconomic, industry, sector, firm, investment, financing, infrastructure, regulation, safety, accessibility, highway, freight, case study
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding. Regulation and Institutional Environment ➢ Intramodal and intermodal transport ➢ Industry structure and competitiveness; ➢ Economic incentives (federal subsidies)
10	Summary of Results (Key Findings)	➢ The study is organized around a framework in which transportation is viewed as an integral part of the socioeconomic system. ➢ The first four chapters discuss the impact of demographic changes, the future course of the economy, the energy supply, and preservation of environment on the future development of transportation. ➢ The succeeding five chapters describe the setting within which infrastructure issues are reviewed. The relevant factors include trends in passenger travel and freight movement and comparisons of transportation development in the international arena. ➢ The role of government vis-à-vis the transportation industry is explored from the perspective of economic deregulation and of ensuring the traveling public's safety and security. ➢ Several chapters address various components of the transportation system from a modal perspective. ➢ Finally, the results of urban transportation studies are synthesized.

21. U.S. DEPARTMENT OF TRANSPORTATION (1995f)

1	Author(s)	**U.S. DEPARTMENT OF TRANSPORTATION (DOT) – FHWA, FTA, MA**
2	Title	
3	Book/Journal Title	*1995 Status of the Nation's Surface Transportation System: Conditions and Performance, Report to Congress*
4	Type	Report
5	Publisher	U.S. DOT
6	Date of Publication	1995
7	Status of Study	Published, not refereed
8	Key Words	National, macroeconomic, industry, sector, investment, financing, infrastructure, regulation, safety, accessibility, highway, freight, intermodality, HERS
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis; ➢ Federal and State funding. Regulation and Institutional Environment: ➢ Intermodality; ➢ Industry structure and competitiveness; ➢ Economic incentives (pricing)
10	Summary of Results (Key Findings)	➢ This is the second in a series of combined documents satisfying statutory requirements for reports by the Department of Transportation to Congress on the condition, performance, and capital investment requirements of the Nation's highway and transit system. ➢ The introduction of the Highway Economic Requirement System (HERS) that uses marginal benefit-cost analysis to optimize highway investment is one of two significant changes in this version of the report. ➢ The other major change concerns assumptions regarding future travel demand in major metropolitan areas. The travel forecasts in developing investment estimates in this report reflect the current and expected policies adopted locally to manage and satisfy future travel demand. ➢ The report provides quantitative and qualitative estimates of the current and future conditions and performance of the Nation's surface transportation system. It incorporates some important steps, like HERS analysis cited above, multimodal analysis and other, in the recognition of the rapid growth in intermodalism.

22. HICKLING Corp. (1991)

1	Author(s)	Hickling Corporation
2	Title	
3	Book/Journal Title	*National Cooperative Highway Research Program Report 342: Primer on Transportation, Productivity and Economic Development*
4	Type	Report
5	Publisher	Transportation Research Board, National Research Council
6	Date of Publication	September 1991
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, investment, financing, industry, sector, firm, cost-benefit analysis, productivity, restructuring, methodology, logistics
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis; ➢ Federal and State Funding. National and International Assistance ➢ Logistics Management
10	Summary of Results (Key Findings)	➢ The report identifies, describes and critically evaluates methodologies available to analyze the relationship between transportation investment and gains in industrial productivity and competitiveness. ➢ A primer for transportation executives and decision-makers is developed. It documents what is known about the relationship between transportation and the economy and provides guidance on use of economic analysis to identify policies and investments with the potential to foster growth and productivity. ➢ Strategies for the selection and use of various methodologies are presented. ➢ The report describes the steps to identify and obtain the benefits and costs of transportation policies. They are evaluated together in an integrated methodological approach taking into account the time value of money and strategies for coping with risk and uncertainty. ➢ The " Technical Report - Supplement to NCHRP Report 342 is designed for the participating transport analyst. It presents a new approach that enables the analyst to identify and quantify the logistics-related benefits for private firms that stem from transportation investments.

23. NADIRI AND MAMUNEAS (1998)

1	Author(s)	Nadiri, M. I. and T. P. Mamuneas
2	Title	
3	Book/Journal Title	*Contribution of Highway Capital to Output and Productivity Growth in the US Economy and Industries*
4	Type	Report
5	Publisher	U.S. Department of Transport, FHWA
6	Date of Publication	August 1998
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, highway, capital, productivity, time series, cross-section
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; ➢ Federal and State Funding.
10	Summary of Results (Key Findings)	➢ Advanced econometric techniques are applied to study the problem of measuring the contributions of highway capital to private sector productivity growth. The model is estimated using disaggregated data composed of 35 sectors in the U.S. economy for the period 1950-1991. ➢ An increase in highway capital has initial productivity effect: it reduces total cost for a given level of output for all industries. The reduction in production costs induces output expansion in all industries. ➢ When output level increases, the productivity gains of highway capital offset the cost increases required by output expansion. ➢ Given a level of output, an increase in highway capital leads to a reduction in demand for labor and materials and an increase in demand for private capital. ➢ The marginal benefits of highway capital are in the range 0.2 cents to 0.6 cents per year per $1 increase in highway capital. Industry marginal benefits are additive across sectors. Their sum across all industries is about 0.295. ➢ The contribution of highway capital to productivity growth is positive in all industries. At the aggregate level, this contribution is about 25 percent. ➢ An approximate method for determining whether highway capital is optimally provided is to compare rate of return on highway capital investment with the rate of return on private capital. The two rates are nearly equal by the end of the 1980's, which implies a close to optimal investment.

24. FRAUMENI (1999)

1	Author(s)	Fraumeni, Barbara
2	Title	
3	Book/Journal Title	*Productive Highway Capital Stock Measures*
4	Type	Report
5	Publisher	U.S. Department of Transport, FHWA
6	Date of Publication	January 1999
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, highway, capital, productivity, stock, measures
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis (capital stock measures)
10	Summary of Results (Key Findings)	➢ Gross capital stock is obtained by adding up investments. Net capital stock requires that the gross capital stock be reduced by the amount of wear and tear on the asset. The sum of wear and tear, termed "loss in efficiency," and asset retirement is termed "deterioration". ➢ Two issues of particular importance in measuring net highway capital stock are (1) measures of road asset deterioration and (2) quantification of quality changes and facility obsolescence. ➢ Productive capital stock is the appropriate concept for estimating the productivity of capital stock. It is adjusted for current and past declines in efficiency. ➢ The study describes possible methodologies and relevant capital stock concepts. ➢ Existing highway and other public capital stock studies are surveyed. ➢ Recommendations for construction of a quality adjusted productive highway capital stock and for further work are made. ➢ A productive total highway capital series, useful to FHWA and others, is presented. ➢ Productive highway stock estimates are compared to other wealth-based estimates. ➢ The construction of a productive highway capital stock series is detailed. It can facilitate updating and adoption of relevant assumptions and methodologies by other researchers. ➢ A pro-forma productive highway capital stock series for the period 1950 to 1997 are also available.

25. U.S. DEPARTMENT OF TRANSPORTATION (1997)

1	Author(s)	U.S. Department of Transportation (U.S. DOT), FHWA
2	Title	
3	Book/Journal Title	*1997 Federal Highway Cost Allocation Study: Final Report*
4	Type	Report
5	Publisher	U.S. DOT
6	Date of Publication	1997
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, highway, cost, allocation, user, fee, equity
9	Policy Examined	Investment and Financing Policies ➢ Economic analysis (costs). Regulation and Institutional Environment ➢ Economic incentives (charges and taxes)
10	Summary of Results (Key Findings)	➢ Passenger vehicles travel 93 percent of all VMT, account for 96 percent of all vehicles and will pay about 64 percent of all Federal highway user fees in 2000. Trucks pay almost 10 times more Federal highway user fees per mile of travel than passenger vehicles. ➢ Passenger vehicles are expected to overpay Federal user fees by about 10 percent, while single unit and combination trucks will underpay by about 10 percent. However, the lightest truck vehicles pay more than their share of highway costs. The opposite is true for the heaviest trucks. ➢ In general, the more axles under heavy vehicles, the lower their highway cost responsibility at any given weight and the more closely they come to paying their highway cost responsibility. ➢ State government collects over two-thirds of total highway user fees and the equity of their structures strongly affects the overall structure of user fees collected. ➢ Increasing the diesel differentials or eliminating the $550 cap on the HVUT could result in incremental improvements to user fee equity. ➢ Safety, congestion and environmental of highway remain large despite significant progress in reducing those costs through regulatory and highway improvements programs. Imposing charges to reduce those costs is promising, but these social costs are highly localized and are more amenable to local pricing than pricing at the Federal level.

26. ROSKIN, SOWDER AND CARTER(1996)

1	Author(s)	Infrastructure Management Group, Inc. (M. Roskin) and Government Finance Group, Inc. (Sowder, A. and J. Carter)
2	Title	
3	Book/Journal Title	*An Evaluation of the TE-045 Innovative Finance Research Initiative*
4	Type	Report
5	Publisher	U.S. Department of Transportation, FHWA
6	Date of Publication	October 1996
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, investment, financing, innovative, research, Federal, aid
9	Policy Examined	Investment and Financing Policies ➢ Federal and State Funding (innovative finance)
10	Summary of Results (Key Findings)	➢ Since 1994, the U.S. FHWA has been spearheading an initiative, known as TE-045, to introduce new flexibility into the financial characteristics of the Federal-aid highway program. ➢ Throughout this process, FHWA has emphasized four objectives: to increase investment, to accelerate projects, to improve the utility of existing financing opportunities, and to lay the groundwork for long-term programmatic changes. ➢ Eight major types of financing tools have been proposed and tested under TE-045. They can be generally characterized as investment tools or cash flow tools. ➢ Although TE-045, by design, provided no new Federal funds to participating States, the initiative has nonetheless supported significant increases in investment levels. ➢ These increases have occurred when the purchasing power of existing Federal and State resources is multiplied (or leveraged) through newfound opportunities to attract additional funds to infrastructure projects. In addition, the leverage of existing public funds can occur when non-traditional uses of Federal funds serve to enhance the viability of financing projects partially with debt. ➢ The two final objectives of the TE-045 initiative centered on (1) facilitating use of financing tools introduced under ISTEA, and (2) building a base of experience from which to develop future legislation to improve the financial characteristics of the Federal-aid highway program.

27. DRI/MCGRAW-HILL (1994)

1	Author(s)	DRI/McGraw-Hill
2	Title	
3	Book/Journal Title	*The Contribution of Transportation to Aggregate and Sectoral Productivity*
4	Type	Report
5	Publisher	U.S. Department of Transportation, FHWA
6	Date of Publication	May 1994
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, investment, financing, factor, productivity, cross-section, freight, railroad
9	Policy Examined	Investment and Financing Policies ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ This study addresses the issue of measuring the comparative efficiency gains experienced by individual transportation modes as a result of highway investment. ➢ Both railroad and motor freight, from 1963 to 1991, posted among the highest direct productivity gains of any sector in the economy. If evaluated at 1972 prices, the rail sector was in fact the highest-performing sector in the economy, increasing its productivity by 2 percent per year. ➢ Unlike most sectors rail experienced productivity growth from 1963 to 1991 in all inputs (capital, labor, and materials). Motor freight experienced by far the largest portion of that growth from increased labor productivity. ➢ Rail and motor freight were top productivity performers, surrounded by ‘ high technology” sectors. With rail ranking third and motor freight seventh, note that computers rank first, telecommunication services second, and scientific instruments fourth. ➢ The aggregate transportation services sector contributed 8.3 percent to national productivity gains. ➢ Motor freight and railroads, from 1963 to 1991, were responsible for 3.4 percent and 2.7 percent of the economy productivity growth, respectively.

28. LEWIS (1993)

1	Author(s)	David Lewis
2	Title	Ensuring Productive Investment in Transportation Infrastructure
3	Book/Journal Title	*Policy Study No. 159*
4	Type	Report
5	Publisher	Reason Foundation
6	Date of Publication	June 1993
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, investment, financing, federal, productivity
9	Policy Examined	Investment and Financing Policies ➢ Economic Analysis
10	Summary of Results (Key Findings)	➢ Research shows that some types of infrastructure investments (typically in selected airport and highway projects) have very large economic rates of return). ➢ There is little relationship between aggregate spending on infrastructure and economic growth. The main reason is that most infrastructure projects are promoted in terms of "distributional" effects – e.g., the number of jobs they will create in a specific locality. It is shown that this kind of "job creation" seldom involves real economic growth; it simply redistributes resources from one use or location to another use or location. ➢ Economic rate of return, not number of "jobs created," should be the criterion for project selection. ➢ If federal infrastructure programs were re-designed to incorporate appropriate incentives, national infrastructure investment would automatically find a level and mix that yields optimal economic rate of return. ➢ One tool for accomplishing the above purpose is privatization, understood as using private capital for selected infrastructure projects. ➢ For the public sector, the key lies in adopting appropriate objectives, decision criteria and appraisal methodologies by government decision-makers.

29. U.S. DEPARTMENT OF TRANSPORTATION (1992)

1	Author(s)	U.S. Department of Transportation (U.S. DOT), FHWA
2	Title	Assessing the Relationship Between Transportation Infrastructure and Productivity
3	Book/Journal Title	*Searching for Solutions: A Policy Discussion Series*
4	Type	Report No. 4
5	Publisher	U.S. DOT
6	Date of Publication	August 1992
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, regional, public, investment, financing, productivity, slowdown, production function, cost-benefit analysis
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ One possible explanation of the productivity slowdown in the United States since 1973 is that the recent decline in public infrastructure investment has contributed to the slowdown in productivity. ➢ National production function studies suggest that a decline in public capital is responsible for almost half the decline in U.S. productivity. ➢ The public contribution to private production has been largely ignored because economic analysis techniques are oriented to private enterprise. Further, some studies that conclude that public capital has no role in the productivity decline are based on interpretation rather than on tests of statistical significance. ➢ The majority of state level studies indicate that public capital has a small, positive effect on private output and productivity, and that the decline in public capital is a factor in the decline in productivity. ➢ Some estimates show that investments in highways have a significant, positive effect on private output that is two times the significant, positive effect of water and sewer facilities. ➢ Open research questions: Do different industries receive different benefits from transportation infrastructure? How does return on investment in highway construction differs from highway maintenance? Can we isolate the effects stemming from reverse causation?

30. U.S. GENERAL ACCOUNTING OFFICE (1996)

1	Author(s)	U.S. General Accounting Office (GAO)
2	Title	
3	Book/Journal Title	*Surface Transportation: Research Funding, Federal Role, and Emerging Issues*
4	Type	Report to Congressional Committees
5	Publisher	GAO
6	Date of Publication	September 1996
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, public, investment, financing, funding, surface, transportation, federal, research
9	Policy Examined	Investment and Financing Policies ➢ Economic analysis (research funding)
10	Summary of Results (Key Findings)	➢ Decisions about surface transportation research have significant impacts because research provides the knowledge, products, and technologies needed to make transportation more efficient, effective, and save. ➢ From fiscal year 1992 through fiscal year 1996, the federal funding for surface transportation research has reached $2.9 billion. About $2.1 billion went to FHWA, which allocated nearly half of the funds for the Intelligent Transportation Systems projects. ➢ Surface transportation research within the U.S. DOT is focused on improving individual modes of transportation rather than on creating an integrated framework for surface transportation research. ➢ According to public and private transportation officials, the current investment in surface transportation research is inadequate to build knowledge, either in three emerging areas – system assessment, policy research, and intermodal research – or in basic, long term, research. ➢ Policy research is a high priority for the federal government, as well as for state and local governments faced with complex transportation problems. ➢ Intermodal research – on how people and freight move between highways, mass transit, and rail – is increasingly important. Institutional barriers and freight movements are identified as intermodal problems requiring further research.

31. HICKLING Corp. (1991)

1	Author(s)	Hickling Corporation
2	Title	
3	Book/Journal Title	*Methodologies for Evaluating the Effects of Transportation Policies on the Economy*
4	Type	Technical Report, Supplement to NCHRP Report 342
5	Publisher	Transportation Research Board, National Research Council
6	Date of Publication	March 1991
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, investment, financing, industry, sector, firm, cost-benefit analysis, productivity, restructuring, methodology, logistics
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis (methodologies).
10	Summary of Results (Key Findings)	➢ The report identifies, describes and critically evaluates methodologies available to analyze the relationship between transportation investment and gains in industrial productivity and competitiveness. ➢ The supplement to Report 342 is designed for the practicing transportation analysts. It provides the technical background for the material in report 342. The presented approach enables the analysts to identify and quantify the logistics-related benefits for private firms that stem from transportation improvements. ➢ Four main questions are addressed in part I: (1) the economic objectives of infrastructure investment; (2) the relationship between objectives and the choice of appropriate methodology for evaluating infrastructure investments; (3) the capability of methodologies to measure in-full all relevant economic impacts; and (4) the valid and effective application of appropriate methodologies. ➢ Part II applies the evaluation design developed in part I to a representative sample of case studies. ➢ First the analytical approach and the size and the composition of the sample are chosen. Second, it is established whether practitioners choose project acceptance criteria and assessment procedures that are consistent with economic objectives of infrastructure investment. Finally, the application of technical procedures and the identification of general equilibrium impacts of public infrastructure are considered.

32. HOOPER (1987)

1	Author(s)	Hooper, P. G.
2	Title	Productive Change in Transport: a Survey
3	Book/Journal Title	*Transport Reviews*, Vol. 7, No.4, 341-367
4	Type	Journal article
5	Publisher	
6	Date of Publication	1987
7	Status of Study	Published and refereed
8	Key Words	National, international, aggregate, macroeconomic, investment, financing, industry, sector, transportation, productivity, time series, cross-section, method
9	Policy Examined	Investment and Financing Policies ➢ Economic analysis (productivity change in transport)
10	Summary of Results (Key Findings)	➢ This paper points out that there are pitfalls in the common practice of using measures such as output per man-hour as an indicator of productivity. ➢ It is argued that a thorough understanding of the relationships between inputs and outputs can proceed from knowledge of the economic production theory. ➢ The paper describes the relevant theoretical concepts and then examines applications of that theory in transport industries. ➢ It demonstrates multimodal interest in developing more rigorous and satisfying ways of measuring and analyzing productivity difference. The technique employed range from the more complex models at the forefront of economic theory, to rudimentary methods, which are, at best, capable of testing only the simplest types of hypotheses. ➢ It is concluded that the value-added concept of productivity favored in early inter-industry studies led to substantial overestimates of productivity growth in transport. ➢ Some productivity gains should be properly attributed to the achievements of scale and scope effects. Furthermore, a number of studies suggest the need to find satisfactory explanations of firm-specific effects. ➢ It is argued that the greatest successes will come about through improvements in data, which will permit applications of more complex, but proven techniques of analysis in areas such as road and maritime transport.

33. BYRNE AND MARKHAM (1991)

1	Author(s)	Byrne, P. B. and W. J. Markham
2	Title	
3	Book/Journal Title	*Improving Quality and Productivity in the Logistics Process: Achieving Customer Satisfaction Breakthroughs*
4	Type	Book
5	Publisher	Council of Logistics Management
6	Date of Publication	1991
7	Status of Study	Published, not refereed
8	Key Words	National, international, industry, sector, firm, transportation, productivity, quality, logistics, process
9	Policy Examined	National and International Assistance ➢ Logistics management.
10	Summary of Results (Key Findings)	➢ This research is based on detailed survey questionnaire responses from over 400 U.S. based manufacturers, distributors, and retailers. Major Study Findings ➢ Companies that have had major successes in productivity improvement share common characteristics: they are customers oriented, apply Total Quality Management, use structured approach towards improvement, and involve suppliers and customers as partners in quality improvement initiatives. ➢ Logistics quality and productivity improvement is integral to overall improvement. ➢ The logistics process is at the heart of executing a customer satisfaction strategy. Most of the companies have not yet established a foundation of logistics excellence to support a customer satisfaction strategy. ➢ "Gaps" between suppliers and customers inhibit quality improvement in logistics for many companies. ➢ Future improvements in logistics will come from nontraditional areas. Traditionally, they have been measured in terms of cost reductions or productivity gains stemming from improvements in transportation and warehousing. Instead, firms will look to purchasing, materials planning, and informational systems as sources for future productivity gains. ➢ The survey identifies 61 specific high-impact actions that produced major quality and/or productivity benefits from logistics restructuring.

34. MULLER (1995)

1	Author(s)	Muller, Gerhardt
2	Title	
3	Book/Journal Title	*Intermodal Freight Transportation.* 3rd edition.
4	Type	Book
5	Publisher	Intermodal Association of North America, Eno Transportation Foundation, Inc.
6	Date of Publication	1995
7	Status of Study	Published, not refereed
8	Key Words	International, national, aggregate, macroeconomic, industry, sector, firm, investment, financing, regulation, deregulation, assistance, intermodal, freight, transportation, liability, communication, information, technology, competition
9	Policy Examined	Investment and Financing Policies ➢ Communication and information technologies. Regulation and Institutional Environment ➢ Intramodality and Intermodality; ➢ Trade Regulation and Facilitation.. National and International Assistance: ➢ Administrative services and Facilitation; ➢ Standards and Compatibility.
10	Summary of Results (Key Findings)	➢ Intermodal transportation, as defined in the book, is the concept of transporting passengers and freight in such a way that all the parts of transportation process, including information exchange, are efficiently connected and coordinated, offering flexibility. ➢ Intermodal freight transportation is increasingly focused on the customer. ➢ Expediting the flow of data on intermodal shipments is as important as expediting the intermodal transportation and transfer of cargo itself. ➢ The use of advanced communication and information systems has experienced the most rapid change in recent years. ➢ Since the 1970s, growing momentum for transportation deregulation provides a chance for intermodalism to develop to its fullest possibilities. Greater possibilities for intermodalism continue to be fostered by the break down in trade barriers between countries, as illustrated by NAFTA, the European Union, etc. ➢ The practice of intermodalism furnished firms with competitive advantage and improves their productivity.

35. FRENCH & ASSOCIATES (1994)

1	Author(s)	R. L. French & Associates at al.
2	Title	
3	Book/Journal Title	*A Comparison of IVHS Progress in the United States, Japan and Europe through 1993*
4	Type	Report prepared for IVHS America
5	Publisher	IVHS America
6	Date of Publication	March 1994
7	Status of Study	Published, not refereed
8	Key Words	International, national, aggregate, macroeconomic, industry, sector, investment, financing, IVHS, ITS, United States, Europe, Japan
9	Policy Examined	Investment and Financing Policies ➢ Communication and Information Technologies (IVHS/ITS)
10	Summary of Results (Key Findings)	➢ The comparative study of IVHS progress in the United States, Europe, and Japan indicates that all have made great progress in IVHS development, although the focus varied widely from region to region. ➢ In Japan, the main focus has been on deployment of advanced traffic management systems and the development of automobile navigation systems as a platform for in-vehicle information. ➢ The European focus has been on exploration and evaluation of numerous alternatives for a wide range of IVHS services with the view that a common architecture would evolve in due course. ➢ The United States has focused on organization, planning, evaluation, and a top-down systems engineering approach to developing a national IVHS architecture while simultaneously carrying out research and field trials. ➢ IVHS enjoyed strong public sector support in all three regions. ➢ In Japan, the installation of advanced traffic management systems has been addressed through a series of five-year government programs for traffic safety facilities. ➢ Public-sector support of IVHS research and development in Europe has been in the form of centralized planning and coordination as well as by partial funding of research projects by the European Community. ➢ Institutional issues, albeit of different types, are a universal impediment to IVHS deployment.

36. U.S. DEPARTMENT OF TRANSPORTATION (1994b)

1	Author(s)	U.S. Department of Transportation (U.S. DOT), FHWA
2	Title	
3	Book/Journal Title	Rebuilding America: Partnership for Investment
4	Type	Report
5	Publisher	U.S. Department of Transportation, FHWA
6	Date of Publication	1994
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, investment, financing, innovative, research, Federal, aid
9	Policy Examined	Investment and Financing Policies ➢ Federal and State Funding (innovative financing)
10	Summary of Results (Key Findings)	➢ Since 1994, the U.S. FHWA has been spearheading an initiative, known as TE-045, to introduce new flexibility into the financial characteristics of the Federal-aid highway program. ➢ Throughout this process, FHWA has emphasized four goals: to increase investment, to accelerate projects, to improve the utility of existing financing opportunities, and to lay the groundwork for long-term program changes. ➢ Eight major types of financing tools have been proposed and tested under TE-045. They can be generally characterized as investment tools or cash flow tools. ➢ The two final objectives of the TE-045 initiative centered on (1) facilitating use of financing tools introduced under ISTEA, and (2) building a base of experience from which to develop future legislation to improve the financial characteristics of the Federal-aid highway program. Results and Findings ➢ *Fees and charges*. There is greater than anticipated willingness to levy local fees and tolls to provide the funding necessary to accelerate project construction. ➢ *Credit support*. States respected the FHWA ground rules of no "new money" for the first phase of the initiative. A great interest was expressed in various Federal "credit support" concepts, such as lines of credit, and project-specific loans. ➢ *Policy changes*. There is demonstrated need to modernize and standardize obligation and outlay rules to smooth the role of Federal money in the construction stage of the projects.

37. FORKENBROCK AND AL. (1990)

1	Author(s)	Forkenbrock, D., T. Pogue, N. Foster, D. Finnegan
2	Title	
3	Book/Journal Title	Road Investment to Foster Local Economic Development
4	Type	Report
5	Publisher	The Public Policy Center, the University of Iowa
6	Date of Publication	May 1990
7	Status of Study	Published, not refereed
8	Key Words	National, regional, local development, investment, financing, road, economic analysis
9	Policy Examined	Investment and Financing Policies ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ A project is termed efficient if the present value of its benefits exceeds the present value of its costs. ➢ A state can promote economic development by undertaking highway investments if and only if they are efficient. ➢ Economic development is not "job creation". Employment can be increased by policies that reduce real income. ➢ Policies that simply shift economic activity from one location to another do not promote overall economic development. ➢ A road project promotes development only if it produces transportation cost savings that exceed the project's costs. There is no separate "economic development" justification for highway investment. ➢ When a road project is evaluated as a mean of attracting a particular business to a certain location, this investment is justified only if it is the least costly one. ➢ When assessing the benefits of road projects, it is necessary to take into account that building a particular stretch of road may reduce the benefits derived from existing roads. ➢ Road investment is a poor tool for redistributing income, wealth or prosperity. Direct transfers of income better achieve this aim. ➢ Highway investments that would benefit a small number of persons are unlikely to foster economic development. ➢ A highway investment that seeks to spread development to declining areas cannot maximize it as a whole. ➢ Investing in roads to attract foot-loose industries is generally unwise because this investment is fixed.

38. FERNALD (1999)

1	Author(s)	Fernald, John
2	Title	Roads to prosperity? Assessing the Link Between Public Capital and Productivity
3	Book/Journal Title	The American Economic Review
4	Type	Journal article
5	Publisher	
6	Date of Publication	June 1999
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, investment, public, capital, cross-section, time series, cost-benefit analysis, productivity, Department of Commerce
9	Policy Examined	Investment and Financing Policies ➢ Economic analysis
10	Summary of Results (Key Findings)	➢ This paper explores the correlation between public capital, focusing on roads as its largest element, and macroeconomic productivity. ➢ The author investigates econometrically how changes in roads affect the relative productivity performance of U.S. industries from 1953 to 1989. ➢ The basic stylized fact is that changes in road growth are associated with larger changes in productivity growth in industries that are more vehicle intensive. Thus, the data strongly supports the notion that industries with a lot of vehicles benefited disproportionally from road building. ➢ This finding suggests that the correlation between aggregate productivity and infrastructure reflects causation from changes in the road stock to changes in productivity. ➢ Construction of the interstate highway system peaked in the late 1950's and was largely completed by 1973. The results indicate that this construction boom substantially boosted productivity. In particular, the estimates imply that public investments had above-average rates of return, and contributed about 1 percent point more to total factor productivity growth before 1973 than after. ➢ A conclusion is made that roads were exceptionally productive before 1973 but are not exceptionally productive at the margin thereafter. ➢ Finally, the empirical importance of congestion is explored. Congestion does not appear empirically important before 1973 but becomes important thereafter.

39. MORRISON AND WINSTON (1999)

1	Author(s)	Morrison, S. A. and C. Winston
2	Title	Regulatory Reform of U.S. Intercity Transportation
3	Book/Journal Title	*Essays in Transportation Economics and Policy: A Handbook in Honor of John R. Meyer*. Gomez-Ibanez, J. A., W. Tye and C. Winston (eds.)
4	Type	Book chapter, pp. 469-92
5	Publisher	Brookings Institution Press
6	Date of Publication	1999
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, regulation, deregulation, reform, intercity, trucking
9	Policy Examined	Regulation and Institutional Environment ➢ Industry structure and competitiveness
10	Summary of Results (Key Findings)	➢ This paper focuses on the direct impact of deregulation on transportation industry costs, prices, and service. ➢ Deregulation allowed entry into transportation markets both by new entrants and by incumbent firms. ➢ Competition in less-than-truckload (LTL) trucking has intensified since deregulation, despite the decline in the number of carriers, both because of the growth of low cost regional LTL carriers and because of increased competition from alternative shipment carriers. ➢ *Innovations*. Railroad and trucking firms have tailored their services to shippers' production and inventory policies thus achieving cost savings for shippers. ➢ Improvements in network design and greater use of intermodal operations have enabled trucks and railroads to provide faster and more reliable service. Transportation firms have become more efficient by using information systems to track shipments and route their cargo. ➢ By stimulating competition and by giving carriers greater operating freedoms and incentives to become more innovative, deregulation has lead to substantial improvements in the efficiency of intercity transportation. ➢ Shippers have benefited substantially from the decline in truck rates, which have paralleled the decline in costs. Shippers have also gained from improvements in service time and service time reliability. Including these benefits, the annual net benefits to shippers from trucking deregulation is estimated to be more than $18 billion (1996 dollars).

40. GALLAMORE (1999)

1	Author(s)	Gallamore, E.G.
2	Title	Regulation and Innovation: Lessons from the American Railroad Industry
3	Book/Journal Title	*Essays in Transportation Economics and Policy: A Handbook in Honor of John R. Meyer*. Gomez-Ibanez, J. A., W. Tye and C. Winston (eds.)
4	Type	Book chapter, pp. 493-529
5	Publisher	Brookings Institution Press
6	Date of Publication	1999
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, regulation, deregulation, reform, innovation, railroad
9	Policy Examined	Regulation and Institutional Environment ➢ Industry structure and competitiveness
10	Summary of Results (Key Findings)	➢ The purpose of this study is to construct and substantiate a relationship between two economic forces, deregulation and innovation, believed to be at the center of the railroad renaissance. ➢ The nature of economic, institutional, and managerial problems facing railroads before passage of the Staggers Act is examined in detail. The discussion establishes that the forces causing the decline of railroads were numerous, persistent, and cumulative in their effect. ➢ Moving on to innovation, the study summarizes Edwin Mansfield's pathbreaking work on the economic factors affecting technology development and deployment historically. ➢ Turning to the period after relaxation of regulation in 1980, the study relates in detail numerous ways in which deregulation has fostered railroad innovation and change. ➢ An intriguing picture emerges as the study concludes. During its nearly two-hundred-year history, railroad technology has demonstrably progressed in surges. These stages of rapid transformation were characterized by exploration of widely held, paradigm shifting, vision for the future, after which progress settled back into what is now called "continuous improvement." ➢ It is concluded that future railroad service improvements will be based on optimized network capacity management techniques, faster transit times, and reduction of quality failures.

41. SAVAGE (1999)

1	Author(s)	Savage, I.
2	Title	The Economics of Commercial Transportation Safety
3	Book/Journal Title	*Essays in Transportation Economics and Policy: A Handbook in Honor of John R. Meyer*. Gomez-Ibanez, J. A., W. Tye and C. Winston (eds.)
4	Type	Book chapter, pp. 531-62
5	Publisher	Brookings Institution Press
6	Date of Publication	1999
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, regulation, deregulation, commercial, transportation, safety
9	Policy Examined	Regulation and Institutional Environment ➢ Industry structure and competitiveness ➢ Command-and-control measures (safety standards)
10	Summary of Results (Key Findings)	➢ Trucking accounts for about three-quarters of total commercial carrier fatalities, followed by railroads, which account for about a fifth. ➢ Fatal truck crushes per vehicle mile have declined by more than half in the past twenty years. ➢ Transportation safety is valued by customers but costly to provide. This study explores several questions: how much safety should be provided; to what extent can the free market ensure safety; what kinds of government policies are needed to deal with the market failures. ➢ Economists cannot currently determine whether there is "too much" or "too little" safety. ➢ Several reason are advanced as candidates for explaining market failure in transportation safety: imperfect information; carrier myopia; customer rationality; existence of externalities; and bilateral crashes. ➢ Many of these market failures have been recognized for more than a century. Longstanding legal arrangements have developed to respond to three of them: imperfect information, externalities, and bilateral crashes. ➢ Government intervention should be deployed as a complement to existing legal processes. This intervention can take the form of insurance requirements, provision of safety information, and direct safety regulation. ➢ Problems with traditional methods of regulation have given rise to a new regulatory strategy known as performance standards.

42. MIDDENDORF AND BRONZINI (1994)

1	Author(s)	Middendorf, D. P., M. S. Bronzini
2	Title	
3	Book/Journal Title	The Productivity Effects of Truck Size and Weight Policies
4	Type	Report
5	Publisher	U.S. Department of Transportation, FHWA
6	Date of Publication	November 1994
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, regulation, truck, size, weight, productivity
9	Policy Examined	Regulation and Institutional Environment: ➢ Command-and-control measures.
10	Summary of Results (Key Findings)	➢ While previous studies have indicated that increases in truck size and weight limits could improve motor carrier productivity, this study addresses the question of whether or not freight shippers will also benefit. ➢ This research was undertaken to determine the net effect of truck size and weight policy changes on shipper total logistics cost and how these effects might influence the demand for alternative tractor-trailer configurations. ➢ The data on product characteristics, lane volumes, transportation cost, and other logistics costs, gathered in the shipper survey, were entered into a computer program called the Freight Transportation Analyzer (FTA). The FTA implements a deterministic economic order quantity model adapted to incorporate transportation costs. ➢ A major finding of the study is that, in most cases, use of longer combination vehicles (LCVs) would have a significant favorable impact on the annual total logistics cost of truckload shippers. Savings in annual total logistics cost are as high as 59 percent for turnpike doubles. ➢ The research indicates that, when single trailer freight costs are two or more times greater than the inventory carrying costs, switching from single trailers to LCVs will greatly reduce the shipper's annual total logistics cost. ➢ The study shows that turnpike doubles operating under higher than existing regulatory limits could reduce shippers' annual total logistics cost enough to induce some shippers to switch from rail boxcars and intermodal to LCVs.

43. APOGEE RESEARCH (1991)

1	Author(s)	Apogee Research, Inc.
2	Title	
3	Book/Journal Title	*Case Studies of the Link Between Transportation and Economic Productivity*
4	Type	Report
5	Publisher	U.S. Department of Transportation, FHWA
6	Date of Publication	January 1991
7	Status of Study	Published, not refereed
8	Key Words	National, industry, firm, case study, transportation, investment, logistics
9	Policy Examined	Investment and Financing Policies
10	Summary of Results (Key Findings)	➢ This report develops a series of case studies of how individual firms or specific industries have used transportation as a catalyst to improve their productivity. ➢ This study goes beyond the role traditionally attributed to transportation, that is, the potential for direct savings in terms of vehicle operating costs or reduced travel time. Instead, the focus is how firms react to transportation in terms of their business operations. ➢ Companies from different industries were identified, according to several transportation related productivity changes, and interviewed to develop case studies. ➢ The case studies showed a cascade of benefits stemming from transportation improvements. The effects may be measured in terms of reduced unit cost and better quality. Ultimately these effects make it possible to achieve a higher return to either capital or labor. ➢ The lesson is that industries benefit from improved flexibility and the elimination of bottlenecks. ➢ An important force in productivity savings is often savings in direct labor requirements. ➢ There is a clear, and growing interaction between high technology and transportation. ➢ There is a chain-reaction type of effect linking effective transportation to a series of productivity gains. ➢ One policy implication is the need for investment in a coordinated network, because a series of independent small investment are unlikely to achieve the same effect on industry productivity as large-scale investment. ➢ There appears to be a linkage between productivity gains and the intelligent vehicle-highway systems.

44. TROWBRIDGE AND AL. (1996)

1	Author(s)	Trowbridge, Amity and al.
2	Title	
3	Book/Journal Title	*The Potential for Freight Productivity Improvements Along Urban Corridors*
4	Type	Report
5	Publisher	Washington State Transportation Center
6	Date of Publication	December 1996
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, freight, productivity, urban, corridors, mobility, truck, HOV lane
9	Policy Examined	Regulation and Institutional Environment ➢ Command-and-control measures
10	Summary of Results (Key Findings)	➢ This study considers the impacts that would result from providing " reserved capacity" for trucks rather than restricting trucks. ➢ Reserved-capacity strategies for trucks would offer (1) nearly $10 million in annual travel time savings for the trucking industry; (2) a savings of about 2.5 minutes per average truck trip; and (3) almost $30 million in annual travel time savings for single-occupancy vehicles. ➢ The difference in travel time between the reserved-capacity strategy that would add trucks to the existing HOV lanes and the one that would add exclusive truck lane would be insignificant, providing little justification for an exclusive truck lane. ➢ The expected impact of reserved-capacity strategies on safety would be small, depending on the particular reserved capacity strategies. ➢ Reserved capacity strategies for trucks would accelerate pavement deterioration in the reserved lanes, but the reduction in the pavement deterioration rates of the general-purpose lanes might counterbalance future construction costs. ➢ Surveys of the general public showed considerable resistance to reserved-capacity strategies for truck. However, this resistance is similar to that encountered when HOV lanes were first introduced. ➢ The study recommends that the idea of reserved-capacity strategies for trucks continue to be presented to the trucking industry, to the public, and to other impacted parties for discussion and consideration.

45. ROESELER AND SMITHSON (1980)

1	Author(s)	Roeseler, W. G. and C. W. Smithson
2	Title	
3	Book/Journal Title	*The Impact of Technological Change in Transportation Networks on Regional Productivity and Development*
4	Type	Report
5	Publisher	U.S. Department of Transportation
6	Date of Publication	August 1980
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, regional, transportation, network, technological, change, productivity, development, econometric, methodology
9	Policy Examined	Investment and Financing Policy ➢ Federal and State Funding; ➢ Communication and Information Technologies.
10	Summary of Results (Key Findings)	➢ This research addresses the impact of technological change in a regional rail network and a regional highway system on regional productivity and development. ➢ The area selected for the investigation was the Houston-Beaumont region of Texas. ➢ In the highway system, the most significant and far-reaching change had been brought about by the introduction of the limited access urban freeway. The key result of this change was enormous increase in road capacity, which, in turn, made possible the moving of big volume of traffic into and out of relatively small, well-defined high intensity retail and office centers. ➢ With respect to rail, automation of signalization, coupled with sophisticated containerizing, represented the major technological changes – all resulting in reduced shipping time. ➢ The main finding of this investigation is that technological changes in transportation systems as such have very little measurable impact on the overall economy of a given region. ➢ In the case of rail systems technology, the factors considered in this study would suggest that time loss, and therefore, cost penalties would have resulted from failure not to bring the system up to the state-of-the-art. ➢ In the case of the highway network, introduction of the limited access highway had substantial consequences on the urban form, especially on certain sectors and corridors.

46. U.S. GENERAL ACCOUNTING OFFICE (1994)

1	Author(s)	U.S. General Accounting Office (GAO)
2	Title	
3	Book/Journal Title	*Longer Combination Trucks: Potential Infrastructure Impacts, Productivity Benefits, and Safety Concerns*
4	Type	Report to Congressional Committees
5	Publisher	GAO
6	Date of Publication	August 1994
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, LCV, truck, infrastructure, impact, productivity, benefit, safety
9	Policy Examined	Regulation and Institutional Environment ➢ Command-and-control measures
10	Summary of Results (Key Findings)	➢ This report focuses on the economic impacts of the longer combination vehicles (LCV), including (1) the impacts on infrastructure that might result from expanded LCV operations and (2) the potential benefits from their use. ➢ Nationwide use of LCVs on the interstate highway system could require additional investments of $2.1 billion to $3.5 billion to replace bridges, improve interchanges, and provide staging areas for breakdown and assembly of LCVs. Much of the projected costs would be incurred in the more densely populated areas of the country. ➢ An analysis for the trucking industry projected that nationwide use of LCVs would reduce annual trucking costs by about 3 percent ($3.4 billion). These annually recurring benefits would exceed the one-time infrastructure investment costs. However, expansion of the routes open to LCVs would benefit some sectors of the trucking industry more than the others. ➢ The limited data available on the safety record of LCVs show that they have not been a safety problem on the western highways and eastern turnpikes where they currently operate. However, some operational characteristics of LCVs are identified that could make them a greater safety risk than single-trailer combinations. ➢ Most states that allow LCVs do little to monitor their operations, regulate drivers' qualifications, or inspect the vehicles. Report concludes, considering these factors, that any expansion of LCV routes should be subject to careful analysis.

47. TRANSPORTATION RESEARCH BOARD (1990)

1	Author(s)	Transportation Research Board, National Research Council
2	Title	
3	Book/Journal Title	*New Trucks for Greater Productivity and Less Road Wear*
4	Type	Special Report 227
5	Publisher	Transportation Research Board
6	Date of Publication	1990
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, LCV, truck, impact, productivity, benefit, safety, Turner proposal
9	Policy Examined	Regulation and Institutional Environment ➢ Command-and-control measures
10	Summary of Results (Key Findings)	➢ This study summarizes the results of a comprehensive study of a new approach to truck size and weight regulation, known as the Turner Proposal. ➢ The Turner Proposal envisions new truck configurations that would reduce road wear caused by truck traffic and increase freight transportation productivity. ➢ Truck users would gain productivity by operating trucks that exceed 80,000 lb. Pavement wear would be decreased by spreading each truck's weight over more axles, reducing the maximum load on each axle below limits. ➢ Savings to carriers or shippers, switching from other trucks to Turner trucks, would average 12 percent of line-haul operating costs. Aggregate freight cost savings would be $2 billion a year (1.4 percent of the cost of truck freight shipping) at 1988 prices and freight volumes. ➢ The safety impact of adopting Turner trucks would be a small decline in truck accidents and small reduction in truck interference with traffic flow, because total annual miles of combination-truck travel would decline compared with the travel that would occur without Turner trucks. ➢ The annualized cost to replace all interstate bridges and one-fourth of all bridges on other systems that are deficient to carry Turner trucks would be $403 million, or about 10 percent increase in bridge capital expenditures. ➢ Nationally, Turner trucks would reduce by $326 million the annual highway agency costs to maintain the road system in the existing condition. ➢ The use of Turner trucks on U.S. roads would constitute a net benefit to the country.

48. FAWAZ (1993)

1	Author(s)	Fawaz, Youssef Mohamad
2	Title	
3	Book/Journal Title	*Alternative Truck/Highway Combinations: An Exploration of Opportunities for Major Productivity Gains in the Truck-Highway System*
4	Type	Ph.D. dissertation
5	Publisher	University of California at Berkeley
6	Date of Publication	1993
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, truck, impact, productivity, benefit, highway, system, case study
9	Policy Examined	Regulation and Institutional Environment ➢ Command-and-control measures
10	Summary of Results (Key Findings)	➢ Conventional efforts to improve trucking productivity have typically focused on the separate components of the system: vehicle, road, or operating protocols. Building on the body of knowledge on system evolution and maturity, this dissertation shifts the focus of analysis from the component level to the system level. ➢ New combinations of trucks, roads, and operations that could achieve sizable productivity gains if introduced into the truck-highway system are explored. ➢ Guidelines for selecting new combination and identifying market niches where new technological formats could establish footholds are presented. ➢ A simulation model to assess the benefits expected from new truck and road combinations is developed. ➢ Grain transportation in rural areas is chosen as a possible market niche. The results of the case study analysis indicate that trucks of up to 200,000 lb. gross vehicle weight operating on a network of low maintenance roads can offer services four to six times cheaper than the costs of present day grain shipping. ➢ A conclusion is made that the major hurdle for introducing the proposed truck-highway combination is institutional and not technological. ➢ While implementing all changes at the same time might present a problem, the study describes a possible scenario so that these changes are taken one step at a time.

49. ASCHAUER (1991)

1	Author(s)	Aschauer, David Alan
2	Title	
3	Book/Journal Title	*Transportation Spending and Economic Growth: The Effects of Transit and Highway Expenditures*
4	Type	Report
5	Publisher	American Public Transit Association
6	Date of Publication	September 1991
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, investment, spending, expenditure, growth, transit, highway
9	Policy Examined	Investment and Financing Policies ➢ Economic analysis; ➢ Federal and State funding.
10	Summary of Results (Key Findings)	➢ This study represents an extension of previous work, which is intended to avoid the pitfalls and limitations of partial equilibrium cost-benefit analysis. ➢ The empirical results of this study provide substantiating evidence that there is positive relationship between general transportation spending and long run economic performance. ➢ It is found that an increase in transportation spending of $10 billion for ten years lifts the labor productivity by over $1, 300 after 20 years. This represents a rise in labor productivity of nearly 4 percent over the level, which would occur in the absence of higher transportation funding. ➢ The benefits of higher transportation spending turn out to be sufficient to outweigh the cost of such a program. The benefit to cost ratio for general transportation spending exceeds unity some eleven years after transportation spending is reduced to its former level. ➢ The evidence suggests that public transit spending carries over twice the potential to impact productivity, as does highway capital. ➢ There are valid reasons (theoretical, econometric, etc.), however, for exercising caution in use of these results for policy purposes.

50. AMERICAN PUBLIC TRANSIT ASSOCIATION (1985)

1	Author(s)	American Public Transit Association
2	Title	
3	Book/Journal Title	*Transit Performance and Productivity 1975-1980: Improvements through the Intergovernmental Partnership*
4	Type	Report
5	Publisher	American Public Transit Association
6	Date of Publication	1985
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, investment, financing, time series, cross-section, transit, performance, productivity
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; ➢ Federal and State funding.
10	Summary of Results (Key Findings)	➢ This study is carried out to explore the relationship between federal assistance and productivity of transit services. More particularly, the study is designed to test a hypothesis being offered by transit critics suggesting that the presence of federal assistance has actually caused declines in performance and productivity of public transit. ➢ The results of this study suggest that just the reverse may be true. First, transit productivity has increased and performance has improved after the enactment of the National Urban Mass Transportation Act of 1974. Secondly, these improvements came about at a time coincident with the initiation and increase in federal assistance to transit operations. Finally, the presence and growth in federal operating assistance has been a major factor in prompting increased commitments from state and local government. ➢ The analysis is carried out in a three-step process. First, the concept of productivity measurement and specific measures most appropriate for transit policy analysis are reviewed. Second, disaggregated data from a representative sample of 44 individual transit system is assembled. Third, changes in various measures of productivity and performance are calculated for the 1970-75 and 1975-1980 periods.

51. PINNOI (1993)

1	Author(s)	Pinnoi, Nat
2	Title	
3	Book/Journal Title	*Transportation and Manufacturing Productivity*
4	Type	Report
5	Publisher	Texas Transportation Institute
6	Date of Publication	October 1993
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, investment, financing, time series, cross-section, highway, street, transportation, productivity, cost, benefit-cost analysis
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; ➢ Federal and State funding.
10	Summary of Results (Key Findings)	➢ This report investigates the contribution of publicly owned highways and streets to manufacturing productivity. ➢ A short-run cost structure with two quasi-fixed factors (private capital and highway and street capital) is specified and estimated. Data from the U.S. manufacturing industry in the 48 contingent states over the period of 1970-1986 are used in the study. ➢ The main result clearly demonstrates that highway and street capital provides positive marginal benefits to firms in the manufacturing industry. That is, an increase in public capital reduces manufacturing costs and improves productivity. However, the contribution of private capital is greater than that of public capital. ➢ A conventional benefit-cost analysis of a specific transportation project should take into account this potential productivity benefit. ➢ The long-run equilibrium levels of private and public capital are not attained. The recent productivity slowdown may be partially explained by utilizing suboptimal levels of capital, both private and public. ➢ The economy-wide marginal benefits of public infrastructure are likely to be larger than reported in this study because it does not incorporate any other benefits than of manufacturers.

52. BABCOCK AND BRATSBERG (1997)

1	Author(s)	Babcock, Michael and Bernt Bratsberg
2	Title	
3	Book/Journal Title	*Economic Impacts of The Kansas Comprehensive Highway Program*
4	Type	Report No. KS-97/2
5	Publisher	Kansas Department of Transportation
6	Date of Publication	June 1997
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, investment, financing, highway, program, transportation, productivity, impact, indirect, induced, output, benefit
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; ➢ Federal and State funding.
10	Summary of Results (Key Findings)	➢ The Kansas Comprehensive Highway Program (CHP) was an eight-year program of highway construction ending June 1997. Overall funding totaled $4 billion. ➢ This study measures the economic impact of the $2.86 billion used for construction of K jurisdiction projects. These are typically those projects on the state highway system outside of cities except for interstate roads, which are classified as K jurisdiction projects regardless of location. ➢ The objectives of the study are: 1) Measure the direct output, income, and employment impacts by highway improvements type of CHP. 2) Measure indirect and induced output, income, and employment impacts by highway improvement type of the CHP. The output impact is the increase in Kansas production as a result of the CHP. The income impact is the increase in Kansas wages and salaries in response to an increase in the income of the workers employed on CHP construction projects. ➢ The economic impact of the CHP highway construction contracts as measured by output is $7.4 billion. The economic impact of the CHP contracts as measured by income is $1.4 billion. The economic impact of the same construction contracts as measured by employment is 117,820 full time equivalent jobs. ➢ Highway investment yields many other benefits to highway users that are beyond the scope of this project.

53. HUSAK AND GLENN (1998)

1	Author(s)	Husak, Volodymyr and Thomas Glenn
2	Title	
3	Book/Journal Title	*The Impact of Transportation Investment on Factor Productivity in Texas*
4	Type	Report No. SWUTC/98/465010-1
5	Publisher	Texas Transportation Institute
6	Date of Publication	May 1998
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, investment, financing, factor, capital, labor, transportation, productivity, impact, Texas, time series, econometric
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; ➢ Federal and State funding.
10	Summary of Results (Key Findings)	➢ This study attempts to replicate the analyses of Aschauer, Munnell and others regarding the impacts of public infrastructure investment on private factor productivity on state level. ➢ The data set provided by the NCHRP study 2-17 (3) "Macroeconomic Analysis of the Linkages Between Transportation Investment and Economic Performance" is used to analyze the relationships between highway capital and Gross State Product and private factor productivity for Texas. ➢ The relationships generated from this data set for Texas are not statistically significant. ➢ There are two main reasons for failure to achieve statistically significant results. The first reason appears to be a lack of sufficient observations due to the short length of time covered by data set. It is combined with the absence of adequate ways to control for significant Texas-specific business cycle volatility during the period covered by this data set.

54. LUKER (1992)

1	Author(s)	Luker, Bill
2	Title	
3	Book/Journal Title	*Public Investment and U.S. Productivity Change: An Evaluation of Recent Research*
4	Type	Report No. SWUTC/92/71241-1
5	Publisher	Texas Transportation Institute
6	Date of Publication	June 1992
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, investment, financing, transportation, productivity, impact, time series, cross-section, econometric
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis (recent research)
10	Summary of Results (Key Findings)	➢ Recent research by Aschauer, Munnell and others has uncovered an apparent relationship between rates of productivity growth and investment in core infrastructure by the public sector. ➢ If valid these findings account for most of the widely reported slowdown in U.S. rates of productivity growth in recent decades, and lend a measure of intrinsic worth to government intervention in the national economy more fundamental than merely Keynesian countercyclical role. This review: ➢ outlines the central results of the dozens of research efforts mounted in the last decade that attempt to explain the U.S. productivity slowdown; ➢ retraces the findings of the researchers most noted for their linking of infrastructure investment with productivity changes; ➢ recapitulates the criticisms to which they have been subjected recently, and; ➢ summarizes the main issues that divide protagonists and antagonists in this area. ➢ Finally, a set of empirical and theoretical issues is introduced that have not been given adequate attention by researchers on either side of the debate.

55. THE DIEBOLD INSTITUTE FOR PUBLIC POLICY STUDIES (1995)

1	Author(s)	The Diebold Institute for Public Policy Studies, Inc.
2	Title	
3	Book/Journal Title	Transportation Infostructures: The Development of Intelligent Transportation Systems
4	Type	Book
5	Publisher	Praeger
6	Date of Publication	1995
7	Status of Study	Published, not refereed
8	Key Words	National, International, Europe, Japan, aggregate, macroeconomic, industry, sector, investment, financing, road, transportation, infrastructure, ITS
9	Policy Examined	Investment and Financing Policies: ➢ Communication and Information Technologies (Intelligent Transportation Systems).
10	Summary of Results (Key Findings)	➢ This study focuses on road and vehicular infrastructures and the roles that Intelligent Transportation Systems (ITS) technology can play in solving the major current and anticipated future societal problems of traffic congestion and delays as well as travel safety. Special attention is given to environmental and economic concerns related to these problems. This book: ➢ considers Intelligent Transportation Systems and services they provide; ➢ accounts for potential ITS benefits resulting from reduced traffic congestion, safety and environmental improvements, and increased driver convenience; ➢ states some technical, legal, economic and social obstacles and issues to the deployment of ITS; ➢ outlines the need for cooperation between the public and private sector in ITS deployment, and; ➢ presents some international perspectives and policies analyses for the biggest players on the ITS field: United States, Europe and Japan. Also some representative ITS implementations are given.

56. U.S. DEPARTMENT OF TRANSPORTATION (1996)

1	Author(s)	U.S. Department of Transportation, Federal Highway Administration
2	Title	
3	Book/Journal Title	*Productivity and the Highway Network: A Look at the Economic Benefits in the Highway Network*
4	Type	Brochure
5	Publisher	Federal Highway Administration
6	Date of Publication	1996
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, investment, financing, transportation, productivity, impact, time series, cross-section, econometric
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ This brochure summarizes the results of a study by M. Ishad Nadiri and Theofanis Mamuneas which estimates industry productivity benefits resulting from the highway network. ➢ This research clearly documents the highway network's contribution to industry productivity growth, national economic performance, and international competitiveness. Key findings include the following: ➢ Over the period 1950 to 1989, U.S. industries realized production cost savings averaging 18 cents annually for each dollar invested in the road system. Investment in non-local roads yield even higher production cost savings, estimated at 24 cents for each dollar of investment. ➢ The highway network's contribution to economic productivity growth was quite large during and immediately following the interstate construction era. Although the impact has declined considerably since the 1970's, highway investment remains an important contributor to economic productivity growth. ➢ The net social rate of return on investment in the non-local system during the 1980's was 16 percent, and the rate of return for the entire road network was 10 percent. This high return to highway capital is due to its network feature, i.e., its benefits are shared by all industries.

57. FELTON AND ANDERSON (1989)

1	Author(s)	Felton, J. R. and D. G. Anderson
2	Title	
3	Book/Journal Title	*Regulation and Deregulation of the Motor Carrier Industry*
4	Type	Book
5	Publisher	Iowa State University Press
6	Date of Publication	1989
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, motor, carrier, regulation, deregulation, truck, case study, act
9	Policy Examined	Regulation and Institutional Environment: ➢ Industry structure and competitiveness; ➢ Command-and-control measures.
10	Summary of Results (Key Findings)	➢ A historic perspective is taken by analyzing the Motor Carrier Act of 1935 and the trucking regulation from 1935 to 1980. ➢ The market structure (concentration, condition of entry and product differentiation) and economic performance of the freight industry are analyzed. A conclusion is made that highway freight transport is inherently a market structure of low concentration, ease of entry, and variation in service quality limited to customers' preferences. The conduct of trucking firms can be expected to be both noncollusive and nonpredatory. ➢ Social benefit of regulation of the freight industry, estimated to $59 million in inventory savings, can not counterbalance to a $5.3 billion additional social cost attributable to the continuation of economic regulation. ➢ The theoretical argument that freedom from geographic and commodity restrictions will enhance intertemporal utilization of truck capacity is supported both by experience in unregulated markets and by the simulation model presented in the book. ➢ Rural impacts of economic regulation and resulting internal subsidization are discussed. ➢ Next, economic consequences and potential for relaxation of entry controls are considered. ➢ Finally, an qualitative and quantitative assessment of the Motor Carrier Act of 1980 is made. It is concluded that in the absence of industry support for some continued regulation, it is unlikely that it would long survive.

58. CLIFFORD AND AL. (1990)

1	Author(s)	Clifford, W., T. Corsi, C. Grimm, C. Evans
2	Title	
3	Book/Journal Title	The Economic Effects of Surface Freight Deregulation
4	Type	Book
5	Publisher	The Brookings Institution
6	Date of Publication	1990
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, motor, carrier, regulation, surface, freight, deregulation, truck
9	Policy Examined	Regulation and Institutional Environment: ➢ Industry structure and competitiveness; ➢ Command-and-control measures.
10	Summary of Results (Key Findings)	➢ The nation's surface freight transportation was deregulated to solve two distinct problems: excessive rates in trucking industry, and insufficient returns on investment in the rail industry. ➢ Deregulation appears to have changed both carrier and shipper behavior. Carriers have taken significant steps to improve the efficiency of their operations and to set rates that are more responsive to market conditions. Shippers have begun to coordinate their production activity more effectively with their transportation services. ➢ Shippers' annual benefit from surface freight deregulation amounts to some $20 billion (1988 dollars). Railroads' and TL carriers' annual profit gains total $2.9 billion and $0.88 billion, respectively. Annual LTL carrier profit losses are estimated to be $5.3 billion, and the annual losses to railroad and LTL labor are roughly $3 billion, which yield an annual net welfare gain of almost $16 billion (1988 dollars). ➢ Although deregulation has made substantial progress in improving efficiency in freight transportation, shippers could gain an additional $5.6 billion (1977 dollars) if rail rates were forced, through competition, to marginal cost. These gains, however, would be at the expense of railroad profits. ➢ Because rail shippers' welfare and railroad profitability can improve, policymakers should continue to promote efficiency and competition among carriers.

59. KEELER AND YING (1988)

1	Author(s)	Keeler, Theodore and John Ying
2	Title	Measuring the Benefits of a Large Public Investment: The Case of the U.S. Federal-Aid Highway System
3	Book/Journal Title	Journal of Public Economics 36 (1), 69-85
4	Type	Journal article
5	Publisher	North Holland
6	Date of Publication	1988
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, benefit, public, investment, financing, federal, highway, system, cost function, cross-section, time series
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ This paper presents an analysis of an important component of the benefits of Federal-aid highway infrastructure investments in the United States. Specifically, it focuses on the effects of those investments since 1950 on costs and productivity of firms in the U.S. road freight transport industry. ➢ A theoretical and statistical model, based on a translog function, is employed to estimate the truck firm costs. A panel containing regionally aggregated data for all Class I motor carriers reporting to the Interstate Commerce Commission (ICC) is used to run this model. ➢ The outcome of the model documents that the rapid growth of highway infrastructure, which occurred between 1950 and 1973, had a strong and positive effect on productivity in trucking. ➢ The results indicate the benefits of highway investments to be substantial – large enough to justify between one-third and one-half of the cost of the Federal-aid highway system over this period on the basis of the benefits to trucking alone. ➢ Another interesting result is that after 1970 it appears that the marginal benefits of additional highway investments were very near zero. ➢ The other benefits of the U.S. highway infrastructure system need to be estimated, including the benefits to passenger transportation and the benefits to improved freight service.

60. ASCHAUER (1989)

1	Author(s)	Aschauer, David Alan
2	Title	Is Public Expenditure Productive?
3	Book/Journal Title	Journal of Monetary Economics 23 (1989): 177-200
4	Type	Journal article
5	Publisher	North-Holland
6	Date of Publication	1989
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, public, productivity, investment, financing, federal, highway, system, cross-section, time series
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ This paper considers the relationship between the aggregate productivity in the private sector and the public-sector stock and flow variables. ➢ The model is a logarithmic version of a generalized Cobb-Douglas production function. ➢ The empirical analysis focuses on the period 1949 to 1985 and utilizes annual data. The empirical results indicate that: ➢ the nonmilitary public capital stock is dramatically more important in determining productivity than either the flow of nonmilitary or military spending; ➢ military capital bears little reason to productivity, and; ➢ a "core" infrastructure of streets, highways, airports, mass transit, sewers, water systems, etc. has most explanatory power to productivity. ➢ The paper also suggests an important role for the net public capital stock in the "productivity slowdown" of the last decades. ➢ In future research, it would be useful to extend the analysis to permit a cross-country comparison of public investment and productivity gains.

61. ASCHAUER (1990a)

1	Author(s)	Aschauer, David Alan
2	Title	Highway Capacity and Economic Growth
3	Book/Journal Title	Economic Perspectives, 14 (September/October): 14-24
4	Type	Journal article
5	Publisher	
6	Date of Publication	1990
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, public, productivity, investment, financing, federal, highway, system, cross-section, time series
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ This article develops an estimation procedure in order to establish the direction of causation from the level of highway capacity to the growth rate of per capita output across localities. ➢ The model assumes transportation services to be produced by a simple neoclassical technology. ➢ The logic of the approach is quite simple. An increase in the stock of highways for a given locale generates a higher return to local, productive activity by raising the level of transportation services available to producers. This, in turn, stimulates private investment in these productive facilities. The increased investment carries with it higher growth in output and income for the particular locale. ➢ Data are utilized on real per capita income growth and measures of highway capacity and quality across states during the period 1960 to 1985. ➢ The coefficient estimate of 0.22 on the highway capacity variable of the empirical model indicates that a one-standard-deviation increase in the logarithm of highway capacity induces a 0.13 of a percent point increase in the growth of per capita income. ➢ It is shown that the basic relationship between highway capacity and economic growth is not reflective of a reverse causation from per capita income growth to highways. ➢ The decomposition of the data on urban and rural roads confirms the statistical significance of the relationship between highway capacity and private sector productivity.

62. ASCHAUER (1990b)

1	Author(s)	Aschauer, David Alan
2	Title	Why is Infrastructure Important?
3	Book/Journal Title	*Is There a Shortfall in Public Capital Investment? Proceedings of a Conference Held at Harwich Port, Massachusetts*
4	Type	Conference report
5	Publisher	
6	Date of Publication	June 1990
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, public, productivity, investment, financing, federal, highway, system, cross-section, time series
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ A simple model is employed to simulate the effects of higher public investment on the aggregate economy. It is assumed that public investment during the period 1970 to 1980 remained near the average for 1953 to 1969, thereby eliminating most of the actual decline. ➢ The result suggest that the increased public investment would have raised the rate of return to private capital from 7.9 percent to 9.6 percent and the rate of productivity growth from 1.4 percent to 2.1 percent for the 1970-88 period. ➢ Next, the relationship between private productivity and public capital investment across states is explored, by including governmental capital as an intermediate input in a generalized Cobb-Douglas production function. ➢ The result from this model is that while the marginal product of private capital is between 9 and 12 percent, the marginal product of public capital exceeds 200 percent. An attempt is made to demonstrate the robustness of this relationship by varying the assumed depreciation and using instrumental variables.

63. MUNNELL (1990)

1	Author(s)	Munnel, Alicia
2	Title	How Does Public Infrastructure Affect Regional Economic Performance?
3	Book/Journal Title	*Is There a Shortfall in Public Capital Investment? Proceedings of a Conference Held at Harwich Port, Massachusetts*
4	Type	Conference report
5	Publisher	
6	Date of Publication	June 1990
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, public, productivity, investment, financing, federal, highway, system, cross-section, time series
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ The paper explores the impact of infrastructure investment on three measures of state-level economic performance. These data are first constructed and then used to estimate state production functions, to explore the relationship between public and private investment, and to analyze employment growth within a business location model. ➢ Constructed estimates of the public and private capital stocks by state for 1970 to 1986 are used as inputs in a pooled cross-section production function. The results show that public capital has a significant, positive impact on the output at the state level. The regression coefficients imply a marginal productivity of 35 percent for both private and public capital. When public capital was disaggregated, water and sewer systems had the largest impact on output, followed by highways, with other public capital exhibiting a very small impact. ➢ Next, a stock adjustment model is employed, where the desired stock of private capital is related to the level of output, the stock of labor, and the stock of public capital, and also to the marginal productivity of private capital. The results indicate that, on balance, public capital investment stimulate private investment. ➢ Finally, a business location model that includes a measure of the public capital stock is used to analyze employment growth. The results confirm that public capital has a positive influence on employment growth, all else equal.

64. PETERSON (1990)

1	Author(s)	Peterson, George
2	Title	Is Public Infrastructure Undersupplied?
3	Book/Journal Title	*Is There a Shortfall in Public Capital Investment? Proceedings of a Conference Held at Harwich Port, Massachusetts*
4	Type	Conference report
5	Publisher	
6	Date of Publication	June 1990
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, public, capital, productivity, investment, financing, infrastructure, revealed preference
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ The question of whether public capital is undersupplied is addressed directly in this paper. Peterson basically accepts the Aschauer argument that the marginal productivity of public capital is extremely high compared to private capital. ➢ A partial answer to the question whether public infrastructure is undersupplied is obtained through voters' revealed preferences as expressed in bond elections and other referenda. If public officials were trying to satisfy the median voter, as theory suggests, they would submit frequent bond proposals for consideration in order to assess voter demand. As a result, bond elections should be closely contested with bond approval rates and margins close to 50 percent. ➢ It is found that the margin of approval of bond proposals exceeded 66 percent on average. This suggests an undersupply. ➢ Three possible reasons for undersupply of public capital are suggested. The first emphasizes spillover effects. As a result local taxpayers will choose to provide a suboptimal level of infrastructure capital. ➢ A more innovative explanation is the notion that the undersupply may be traced to the "fear of rejection" on the part of public officials. ➢ The third explanation suggests that the political process systematically underweights the benefits that accrue to businesses.

65. DUFFY-DENO AND EBERTS (1991)

1	Author(s)	Duffy-Deno, Kevin and Randall Eberts
2	Title	Public Infrastructure and Regional Economic Development: A Simultaneous Equation Approach
3	Book/Journal Title	Journal of Urban Economics 30, 329-343
4	Type	Journal article
5	Publisher	
6	Date of Publication	1991
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, region, industry, sector, public, capital, productivity, investment, financing, infrastructure, simultaneous, equation
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ The purpose of this study is to estimate the effects of public infrastructure on regional development, as measured by per capita personal income. ➢ The paper makes two contributions. First, public capital stock estimates are used instead of simply using expenditures. Second, a simple model is constructed of both the effects of local public infrastructure on personal income and the effect of personal income on the allocation of local public outlays. The resulting system of equations highlights the potential single-equation estimation bias if public investment is considered exogenous, as is the case with other studies. ➢ Results derived from annual data for 28 metropolitan areas from 1980 to 1984 reveal that public capital stock has positive and statistically significant effects on per capita personal income. ➢ The effects come through two channels. The first is through the actual construction of the public capital stock. The second effect comes through the public capital stock as an unpaid factor in the production process and a consumption good of households. ➢ It is concluded that public capital stock is an important input into the regional production process, which has long-run consequences for enhancing a region's productivity, and thus its competitive advantage. Therefore, well-maintained public infrastructure should be an important component of any policy package designed to promote regional economic development.

66. FORD AND PORET (1991)

1	Author(s)	Ford, Robert and Pierre Poret
2	Title	Infrastructure and Private-sector productivity
3	Book/Journal Title	Economic Studies No. 17
4	Type	Journal article
5	Publisher	OECD
6	Date of Publication	Autumn 1991
7	Status of Study	Published and refereed
8	Key Words	International, aggregate, macroeconomic, region, industry, sector, public, capital, productivity, investment, financing, infrastructure, cross-section, time series
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ The authors accept the essentials of Aschauer's methodology. It assumes an aggregate Cobb-Douglas technology in which output is produced by the usual private-sector capital and labor inputs, plus public-sector capital, or infrastructure. However, this methodology is applied to a broader range of data: several OECD countries and a longer data set for the United States. ➢ The results provide little support for Aschauer's hypothesis. While infrastructure growth slowed in the 1970s in all twelve of the countries examined, this was accompanied by a deceleration of private-sector total factor productivity (TFP) in only half of them. ➢ Time-series regressions tend to yield non-robust and sometimes implausible parameter estimates, suggesting a fundamental problem with the underlying methodology. ➢ Examination of a century of data for the United States implies that there was no relationship between productivity and infrastructure capital in the United States except for the post-war period examined by Aschauer. ➢ Finally, the cross-section correlation between post-war infrastructure investment and TFP growth is not robust either, as it depends on how infrastructure is defined. In overall, the regression results can not support a policy recommendation of a sharp acceleration of infrastructure investment.

67. BERNDT AND HANSSON (1992)

1	Author(s)	Berndt, Ernst and Bengt Hansson
2	Title	Measuring the Contribution of Public Infrastructure Capital in Sweden
3	Book/Journal Title	*Scandinavian Journal of Economics 94, Supplement, 151-168*
4	Type	Journal article
5	Publisher	
6	Date of Publication	1992
7	Status of Study	Published and refereed
8	Key Words	International, aggregate, macroeconomic, industry, sector, public, capital, productivity, investment, infrastructure, cross-section, time series, econometric, Sweden
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ The purpose of this paper is to evaluate alternatives to Aschauer and Munnell's frameworks for measuring the contribution of public infrastructure capital in Sweden to private sector output and productivity growth. ➢ It is concluded that the Cobb-Douglas production function models developed by Aschauer and Munnell have a number of serious drawbacks. When these models are estimated using Swedish data, the estimated coefficients on public infrastructure capital are statistically significant, but do not have meaningful interpretation. ➢ When a number of dual cost functions are implemented the obtained results are more plausible. The main finding is that increases in public infrastructure capital, other things equal, reduce private costs. ➢ It is found that amount of public infrastructure capital that would rationalize the cost savings incurred by the private business sector in Sweden is less than what is in fact available in 1988. However, the extent of excess public infrastructure has been falling in the 1980s. Interpretation of the findings: ➢ First, the estimated benefits do not incorporate the cost and time savings of public capital to final consumers. ➢ Second, it is worthwhile investigating results when public infrastructure capital is disaggregated. ➢ Third, optimal pricing of the public infrastructure should be taken into account in a future research.

68. NADIRI AND MAMUNEAS (1994)

1	Author(s)	Nadiri, Ishaq and Theofanis Mamuneas
2	Title	The Effect of Public Infrastructure and R&D capital on the Cost Structure and Performance of U.S. Manufacturing Industries
3	Book/Journal Title	*Review of Economics and Statistics, 76(1): 22-37*
4	Type	Journal article
5	Publisher	
6	Date of Publication	1994
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, region, industry, sector, public, capital, productivity, investment, financing, infrastructure, cross-section, time series, econometric
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ This study examines the effects of publicly financed infrastructure and R&D capital on cost structure and productivity performance of twelve two-digit U.S. manufacturing industries. ➢ The results suggest that there are significant productive effects from these two types of capital. Their effects on the cost structure vary among industries. ➢ An increase in the two types of capital causes both a downward shift of the cost functions in each industry, generating productivity inducement, and an increase in factor demand. ➢ The marginal benefits of the services provided by the two types of capital and the "social" rates of return to these capitals for the investigated industries are also calculated. ➢ These marginal benefits range on average from 0.0011 to 0.0102. The social rates of return, for the two forms of public capital, vary between 0.0492 and 0.0872. Main conclusions from this study: ➢ The public infrastructure capital does affect the cost productivity of the private sector industries. The magnitude of these effects is, however, smaller than has been reported in the literature. ➢ Second, other types of publicly financed capital affect the cost and productivity of different industries and have high social rate of return.

69. CONRAD AND SEITZ (1994)

1	Author(s)	Conrad, Klaus and Helmut Seitz
2	Title	The Economic Benefits of Public Infrastructure
3	Book/Journal Title	*Applied Economics, 23: 303-311*
4	Type	Journal article
5	Publisher	
6	Date of Publication	1994
7	Status of Study	Published and refereed
8	Key Words	International, aggregate, macroeconomic, industry, sector, public, capital, productivity, investment, infrastructure, cross-section, time series, econometric, Germany
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ The purpose of this paper is to investigate the impact of public infrastructure on private production cost and total factor productivity (TFP) in Germany. ➢ A flexible functional form of a cost function with public infrastructure as an additional external input is used to estimate the shadow-price of public infrastructure services for the manufacturing, trade and transport and the construction industries. ➢ The model has been estimated using annual data for the gross national output for the considered industries for the period 1961-1988. ➢ The estimation results suggest that public infrastructure contributed to TFP and that it is an important complement to private investment activities. ➢ Although infrastructure is a free public good, a considerable "aggregate" willingness-to-pay for this good by the private industry is estimated. It is about 0.15 in the period 1960-1976 and declines to 0.11 in the period 1980-1988. This might be interpreted as a relative decrease in the demand for additional public infrastructure. ➢ The econometric results suggest that infrastructure capital is labor saving but private capital intensive. ➢ It has been shown that disregarding the provision of public capital in TFP measurement leads to biased results and that this "neglected" input is also at least a partial explanatory factor for the generally observed slowdown in productivity growth in Germany.

70. CRIHFIELD AND PANGGABEAN (1995)

1	Author(s)	Crihfield, John and Martin Panggabean
2	Title	Is Public Infrastructure Productive? A Metropolitan Perspective Using New Capital Stock Estimates
3	Book/Journal Title	Regional Science and Urban Economics 25: 607-630
4	Type	Journal article
5	Publisher	
6	Date of Publication	1995
7	Status of Study	Published and refereed
8	Key Words	National, state, metropolitan, industry, sector, public, capital, productivity, investment, infrastructure, cross-section, time series, econometric
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ This paper studies the productivity of public investment within the context of a neoclassical growth model. A wide range of estimates of public-sector and private-sector investments is employed in evaluating this model. ➢ The data are disaggregated at state and metropolitan level. The period 1960-1977 is used as a benchmark to standardize the estimations. However, conclusions regarding public capital are not changed when other periods are considered. ➢ The obtained model estimations indicate that public infrastructure, however measured, has at most a modest effect on factor markets, and an even smaller impact on growth in per-capita income. ➢ Most infrastructure coefficients in the growth models are statistically insignificant. ➢ In most of the cases the implied production elasticity for private capital exceeds those for public infrastructure. ➢ Neither state nor local investments lead to growth in per-capita income. ➢ A inference is made that there are no substantial unexploited externality gains from public investment. It is based on the fact that local infrastructure contributes more to growth than does state infrastructure. ➢ It is concluded that public infrastructure surely plays an important role in metropolitan economies. However, its marginal contribution is no more than, and may be less than, other forms of investment.

71. MORRISON AND SCHWARTZ (1996)

1	Author(s)	Morrison, Catherine and Amy Schwartz
2	Title	State Infrastructure and Productive Performance
3	Book/Journal Title	*The American Economic Review 86(5): 1095-1109*
4	Type	Journal article
5	Publisher	
6	Date of Publication	1996
7	Status of Study	Published and refereed
8	Key Words	National, state, industry, sector, public, capital, productivity, investment, infrastructure, cross-section, time series, econometric
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis.
10	Summary of Results (Key Findings)	➢ A cost-function model is used to conduct a detailed investigation into the role of state infrastructure (publicly owned highway, water, or sewer capital) in determining state productivity performance. ➢ This analysis is based on cost-side marginal products (shadow values) and productivity-growth measures. Shadow prices are computed as the potential cost savings from a decline in variable inputs (and thus costs) required to produce a given amount of output when infrastructure investment occurs. ➢ The model is estimated using data on the manufacturing sectors of the 48 contiguous states in the United States for 1970-1987. ➢ The results indicate that the return to infrastructure investment is significant: shadow values for public capital are both positive (although lower than for the private capital) and significantly different from zero. These positive shadow values are consistent with a positive marginal product for infrastructure, as well as a significant role for infrastructure in determining productivity growth. ➢ The positive input-cost-saving benefit to manufacturing firms from infrastructure investments declines in all regions between 1970 and 1980, with the most dramatic declines being in the North and East regions. ➢ The results suggest that the net return to investment in public infrastructure accruing specifically to the manufacturing sector could be close to zero.

72. HERTZ (1993)

1	Author(s)	Hertz, Susanne
2	Title	
3	Book/Journal Title	*The Internalization Processes of Freight Transport Companies: Towards a Dynamic Network Model of Internalization*
4	Type	Dissertation
5	Publisher	Stockholm School of Economics
6	Date of Publication	1993
7	Status of Study	Published and refereed
8	Key Words	International, internalization, industry, sector, freight, transport, network, model, case study, longitudinal
9	Policy Examined	Regulation and Institutional Environment ➢ Industry Structure and Competitiveness
10	Summary of Results (Key Findings)	➢ This study investigates the internationalization processes of freight transportation companies in Sweden. ➢ Main reasons for studying internalization of transportation firms: (1) increased importance of international distribution systems; (2) impact of deregulation and harmonization on transportation industry; (3) applications to other service industries. ➢ The purpose of this study is threefold: to develop a model of internalization, applied to transportation firms; to describe and analyze international patterns of transportation companies; and to explain these patterns. ➢ Research method: (1) case studies, (2) 32 interviews with transportation companies, and (3) a dynamic model of internalization. ➢ The book first gives some background and introduces basic concepts about the freight transportation industry. ➢ Next, theoretical framework and the model of analysis are presented, followed by the case studies description and analysis. A dynamic model of the internalization of freight firms is constructed. Finally, theoretical results and managerial applications are discussed. Several questions for further research are then posed: ➢ To what extent can the network model of internalization be generalized and applied to other companies? ➢ What is the role of the economies of scale and scope in the internalization process? ➢ What is the role of the high interdependence between transportation firms called "domino" effect?

73. ECMT (1995b)

1	Author(s)	European Conference of Ministers of Transport (ECMT)
2	Title	
3	Book/Journal Title	*Trends in International Traffic and Infrastructural Needs in Europe*
4	Type	Report
5	Publisher	ECMT
6	Date of Publication	1995
7	Status of Study	Published, not refereed
8	Key Words	International, aggregate economy, macroeconomic, investment, financing, funding, regulation, assistance, case study, economic analysis, network, intramodal, Europe
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; ➢ State funding. Regulation and Institutional Environment: ➢ Intramodal transport.
10	Summary of Results (Key Findings)	➢ The question of trends in international traffic and infrastructural needs is central to European transportation policy because (1) international traffic is the most dynamic component of total traffic, and (2) international traffic is crucial for the economic and social integration of Europe. Changes in the nature of problems and in ways of resolving them: ➢ Transport embraces multimodal techniques and has to take account of effects on the natural and human environment. ➢ The institutional framework is more complex. ➢ Introduction of managerial practices aimed at eliminating "unnecessary" transportation operations. Solutions proposed in this report: ➢ Improving the methods in order to promote informed approach to the planning of international infrastructure. ➢ Classification and ranking of possible policy measures at international level. ➢ Compatibility and harmonization of the national measures taken in respect of international traffic. ➢ Opening European transportation networks broadly to the East towards Baltic and Black seas. ➢ Multimodal approach toward international traffic.

74. OECD (1990)

1	Author(s)	Organization for Economic Co-operation and Development (OECD)
2	Title	
3	Book/Journal Title	*Advanced Logistics and Road Freight Transport*
4	Type	Report
5	Publisher	OECD
6	Date of Publication	1990
7	Status of Study	Published, not refereed
8	Key Words	International, aggregate economy, macroeconomic, investment, financing, funding, regulation, assistance, case study, network, intramodal, logistics, freight, Europe
9	Policy Examined	Investment and Financing Policies: ➢ Communication and information technologies. National and International Assistance: ➢ Logistics Management.
10	Summary of Results (Key Findings)	Objectives of this study: ➢ to summarize national experience in the fields of logistics, physical distribution and communications; ➢ to identify innovations in the electronic exchange of data and information; ➢ to analyze changes in the freight and warehousing industries, and; ➢ to highlight the major developments determining the future role of government. ➢ The main purpose of this report is to review the present status and evolution in logistics operations, and to point out the future implications for road freight transport and infrastructure in general. ➢ The report presents and assesses logistics situation in three major OECD countries. Evaluations are based on case studies selected from diverse sectors. ➢ A macroeconomic analysis of freight industry and infrastructure is performed based on numerous statistics. ➢ The microeconomic analysis aims to identify the impact of the developments in communication and information technologies on the firms involved in shipping, transportation and warehousing. ➢ The report shows how advanced logistics is emerging in developed countries. ➢ Finally, various government policies facilitating development of advanced logistics are considered.

75. BUTTON (1993)

1	Author(s)	Button, Kenneth
2	Title	Freight Transport
3	Book/Journal Title	Transport in a Unified Europe: Policies and Challenges. Banister, D. and J. Berechman (eds)
4	Type	Book chapter
5	Publisher	Elsevier
6	Date of Publication	1993
7	Status of Study	Published, not refereed
8	Key Words	International, investment, financing, regulation, network, intramodal, logistics, freight, transportation, Europe
9	Policy Examined	Investment and Financing Policies: ➢ Communication and information technologies. Regulation and Institutional Environment: ➢ Intramodality and intermodality; ➢ Industry structure and competitiveness.
10	Summary of Results (Key Findings)	➢ This study sets out the existing pattern of freight transportation within Europe. ➢ Freight transport within Europe and between Europe and the rest of the World is frequently a multi-modal activity. ➢ The key factors likely to influence the European freight transport suggest increasing demand for its services. ➢ An important trend, which will have a bearing on the way European freight transport develops, is the emphasis placed on environment and other external costs. Barriers to development of freight transportation: ➢ Common transport can be only applied to a relatively self-contained area, which European community is not. ➢ Attitudes and approaches to transport differ among European states. ➢ The nature of transport systems within Europe varies considerably among countries. ➢ Institutional problems. Policy responses: ➢ International coordination and integration, which must be strategic in its orientation and flexible in its implementation. ➢ Encouragement of modally integrated transport. ➢ Increased emphasis on more soundly based policies regarding the funding and charging for the use of transport infrastructure. ➢ Privatization of transportation infrastructure and activities.

76. BANISTER, CAPELLO AND NIJKAMP (1995)

1	Author(s)	Banister, D., R. Capello and P. Nijkamp (editors)
2	Title	
3	Book/Journal Title	European Transport and Communications Networks: Policy Evolution and Change
4	Type	Book
5	Publisher	John Wiley & Sons
6	Date of Publication	1995
7	Status of Study	Published and refereed
8	Key Words	International, investment, financing, funding, regulation, network, intramodal, logistics, transportation, Europe
9	Policy Examined	Investment and Financing Policies: ➢ Communication and information technologies. Regulation and Institutional Environment: ➢ Intramodality and intermodality; ➢ Industry structure and competitiveness.
10	Summary of Results (Key Findings)	➢ The most dynamic regions in Europe are likely to be those where the transportation and information networks link in with other factors such as a skilled labor force, a high-quality environment and the availability of low-cost land. ➢ The complicated interrelations between the different modes of transport are introduced together with the key European problem of the well-integrated center and the remote periphery. ➢ True Europe integration is dependent upon completing the Pan-European network missing links and networks. ➢ Several methods for analysis of networks are considered: contribution network modeling, so-called MITER model and a regional econometric model of economic growth in the Italian economy, model of business trip distribution in Europe incorporating transportation barriers. ➢ Different regulatory regimes in the transportation sector are examined, focusing on franchising systems. ➢ The concept of maximum environmental capacity use is developed. It can be summarized as the maximum resource use of given environment capital stock compatible with socio-economic and environmental conditions. ➢ Finally, arguments for and against network diversification and fragmentation are examined.

77. NIJKAMP ET AL. (1994)

1	Author(s)	Nijkamp, P., J. Vleugel, R. Maggi. I. Masser (editors)
2	Title	
3	Book/Journal Title	Missing Transport Networks in Europe
4	Type	Book
5	Publisher	Avebury
6	Date of Publication	1994
7	Status of Study	Published and refereed
8	Key Words	International, investment, financing, funding, regulation, network, intramodal, logistics, transportation, Europe
9	Policy Examined	Investment and Financing Policies: ➢ Communication and information technologies. Regulation and Institutional Environment: ➢ Intramodality and intermodality; ➢ Industry structure and competitiveness.
10	Summary of Results (Key Findings)	➢ Main problems related to road transport in Europe are the congestion on major international traffic arteries and the problem of the Alpine barrier. The first of these problems is due to a lack of capacity of existing networks. ➢ A partial solution to the capacity problem may come from the reduction in waiting time at the customs. ➢ The logistics in European road haulage is a big issue. A proposed solution is a centralized information system on goods transported on roads. ➢ One of the reasons for the number of empty vehicles adding to the congestion of the European network is the structure of the transport sector and the organization of transport and logistics by big firms. ➢ There is a case for deregulation and privatization in rail and combined transport. The main questions in this field relate to the new organization, the logistics, and the financing and regulatory regimes by governments. ➢ In European freight transport the trucks and delivery vans are the dominant means of transport. It is foreseen that this imbalance in modal split will continue to grow, as will freight transportation. ➢ At present, growing congestion is not sufficient condition to increase the demand for combined transportation. Only in combination with a removal of the vast amount of bottlenecks, internalization of social costs and in some cases explicit regulation will road congestion act as a bias towards combined transportation.

78. KIRIAZIDIS (1994)

1	Author(s)	Kiriazidis, Theo
2	Title	
3	Book/Journal Title	European Transport: Problems and Policies
4	Type	Book
5	Publisher	Avebury
6	Date of Publication	1994
7	Status of Study	Published, not refereed
8	Key Words	International, investment, financing, funding, regulation, network, intramodal, multi-modal, transportation, Europe
9	Policy Examined	Investment and Financing Policies: ➢ Communication and information technologies. Regulation and Institutional Environment: ➢ Intramodality and intermodality; ➢ Industry structure and competitiveness.
10	Summary of Results (Key Findings)	➢ The main argument of this book is that the European transport policy rests on the national transport policies and national governments. This does not provide an appropriate framework for resolving dilemmas in transport with respect to economic efficiency, social justice and environmental quality. ➢ In the case of road transportation a strategy is designed to strengthen the single market in transport and force road transport users to pay the full costs of their activities. ➢ In the case of rail transportation the policy aim is to renew the rail as an important mode of transportation since it is believed that railways can compete effectively with other modes reducing congestion, environmental damages and regional imbalances. ➢ In the air transportation new legislation enables airlines to obtain access to any route. In practical terms, however, this freedom may prove illusory due to capacity constraints and various company devices. ➢ The development of an efficient multi-modal transportation system in Europe could partially achieve some of the central objectives of the transportation policy through improving efficiency, filling the missing links and transferring traffic to less congested modes of transport. ➢ Development in transportation infrastructure will take place mainly on the major European routes and in the center regions.

79. DKS ASSOCIATES/ HLB INC. (1999)

1	Author(s)	DKS Associates in association with Gene Leverton and Associates, Hickling Lewis Brod Inc., and Willamette Traffic Bureau, Inc.
2	Title	
3	Book/Journal Title	Freight Users/Shippers Logistics Interviews Interstate 5 Corridor
4	Type	Summary report
5	Publisher	Oregon Department of Transportation
6	Date of Publication	1999
7	Status of Study	Published, not refereed
8	Key Words	National, regional, interstate, investment, financing, infrastructure, transportation, freight, user, shipper, corridor, logistics, restructuring, California
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Financing. National and International Assistance: ➢ Logistics Management.
10	Summary of Results (Key Findings)	➢ During the month of June 1999, in-depth interviews were conducted with representatives of 61 Portland-area manufacturers, distributors and carriers. ➢ The interviews aimed at gaining a better understanding how highway service affects logistical decisions and costs of the area's shippers and carriers, and to identify the bottlenecks of the existing highway system. Main findings of this study: ➢ Many firms find it difficult to cope with increasing congestion. Some businesses responded to increased congestion by relocating and flexible shipping patterns ➢ The segment of I-5 that is the focus of this study and the access to Portland International Airport are identified as the most problematic highway stretches. ➢ Some businesses believe that today's congestion is tolerable. They are also convinced, however, that the process of highway improvements should start now, otherwise congestion would affect their productivity and competitiveness. ➢ With a 20 percent improvements in travel time and reliability at least six percent of the firms would restructure their logistics and distribution process. ➢ The regionwide benefits from logistics restructuring are estimated to be between $584 and $1,046 million in 1997 prices over the next 30 years.

80. BOARNET (1997a)

1	Author(s)	Boarnet, Marlon G.
2	Title	Infrastructure Services and the Productivity of Public Capital: the Case of Streets and Highways
3	Book/Journal Title	National Tax Journal, Vol. 50, No 1, 39-57
4	Type	Journal Article
5	Publisher	
6	Date of Publication	1997
7	Status of Study	Published and refereed
8	Key Words	National, regional, county, investment, financing, transportation, services, public, capital, street, highway
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding. Regulation and Institutional Environment: ➢ Economic incentives (road pricing).
10	Summary of Results (Key Findings)	➢ This paper examines the link between highway congestion, labor productivity, and output in a sample of California counties for the years 1977 through 1988. ➢ A county production function is modified to include both the value of each county's street and highway capital stock and a measure of the congestion on each county's highway network. ➢ The study compares two distinct policies – expanding the street and highway stock versus reducing congestion on the existing stock. ➢ The econometric evidence suggests that congestion reduction is productive. The effects of expanding the street and highway stock are more dubious. ➢ Overall, the results provide evidence that using existing street and highway infrastructure more efficiently can produce economic benefits. ➢ This research reinforces the importance of pricing highway infrastructure to reduce congestion and, hence, use existing infrastructure more efficiently. ➢ The obtained elasticities further suggests that congestion reduction policies should focus on those places that are most congested.

81. BOARNET (1998a)

1	Author(s)	Boarnet, Marlon G.
2	Title	Spillovers and the Locational Effects of Public Infrastructure
3	Book/Journal Title	Journal of Regional Science, 38, 3
4	Type	Journal Article
5	Publisher	
6	Date of Publication	1998
7	Status of Study	Published and Refereed
8	Key Words	National, regional, county, investment, financing, infrastructure, transportation, services, public, capital, street, highway, negative, spillovers, California
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis; ➢ Federal and State Funding.
10	Summary of Results (Key Findings)	➢ This paper examines the possibility of negative output spillovers from public infrastructure. ➢ A model of productive public capital shows that, when input factors are mobile, public infrastructure investment in one location can draw production away from other locations. In a linear production function framework, this effect would be manifested as a negative output spillover from public capital. ➢ Using data for California counties from 1969 through 1988, negative spillover effects are shown to exist in the case of street and highway capital. The regression results show that changes in county output are positively associated with changes in street and highway capital within the same county, but output changes are negatively associated with changes in street and highway capital in other counties. ➢ Highway projects are often funded with large state and federal subsidies. The results in this paper suggest the possibility that local projects might draw economic activity away from areas that are helping to subsidize the project. ➢ Overall, this study suggests that both research and policy should more carefully consider the local gains and losses created by public capital projects.

82. BOARNET (1997b)

1	Author(s)	Boarnet, Marlon G.
2	Title	Highway and Economic Productivity: Interpreting Recent Evidence
3	Book/Journal Title	Journal of Planning Literature, Vol. 11, No. 4, 476-486
4	Type	
5	Publisher	
6	Date of Publication	May 1997
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, regional, county, investment, financing, infrastructure, transportation, services, public, capital, street, highway, negative, spillovers
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis; ➢ Federal and State Funding.
10	Summary of Results (Key Findings)	➢ This article reviews the recent literature on public infrastructure and economic productivity, with special attention to the particular case of highway infrastructure. ➢ The presented findings suggest that, at the margin, highway infrastructure have little effect on national or state productivity. This is consistent with the studies that show relatively small land-use impacts from modern highways. ➢ Both productivity and land-use studies suggest that highway building in the United States has entered a new era. The interstate highway system is essentially complete, and, in many urban areas, the network externalities of further highway construction have been largely exhausted. ➢ Highway projects that appear to generate large amounts of growth either may not actually cause that growth or may cause it in part by shifting economic activity from other areas. ➢ Either explanation implies the need for reforms in highway project analysis and funding. This article suggests appropriate policy reforms and directions for future research.

83. BOARNET (1998b)

1	Author(s)	Boarnet, Marlon G.
2	Title	Road Infrastructure, Economic Productivity, and the Need for Highway Finance Reform
3	Book/Journal Title	forthcoming in *Public Works Management and Policy*
4	Type	Research Paper
5	Publisher	
6	Date of Publication	1998
7	Status of Study	Unpublished
8	Key Words	National, aggregate, regional, county, investment, financing, infrastructure, transportation, services, public, capital, highway, spillovers, reform
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis; ➢ Federal and State Funding.
10	Summary of Results (Key Findings)	➢ This paper suggests, based on recent empirical evidence, that highways are associated both with local economic gains (often near a project) and economic losses (often distant from a project). ➢ In a system of centralized highway finance, this creates the possibility of a geographic mismatch between the areas that pay for highway projects and the areas that benefit from those projects. ➢ Efficiently using the available highway capital is potentially as effective as building additional highway stock in enhancing the local impacts of highways. ➢ These ideas suggest the need for more decentralized, project-specific highway finance that includes a role for efficient pricing. ➢ This paper summarizes its policy recommendations in two rules of thumb. First, there should be a geographic correspondence between who funds highway projects and who benefits from the infrastructure. Second, efficiently using the available highway infrastructure should become a more prominent policy objective. Both can be achieved by encouraging the current trend toward more localized highway finance.

84. NADIRI AND MAMUNEAS (1996)

1	Author(s)	Nadiri, M. I. and T. P. Mamuneas
2	Title	
3	Book/Journal Title	*Contribution of Highway Capital to Industry and National Productivity Growth*
4	Type	Report
5	Publisher	U.S. Department of Transportation, FHWA
6	Date of Publication	March 1996
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, highway, capital, productivity, time series, cross-section
9	Policy Examined	Investment and Financing Policies: ➢ Economic analysis; ➢ Federal and State Funding.
10	Summary of Results (Key Findings)	➢ The study examines the contribution of two alternative types of highway capital to output growth and productivity of 35 U.S. industrial sectors for the period 1950-1989. ➢ The measures of highway capital, used in the research, are (1) total highway capital and (2) non-local highway system (NLS) capital. The NLS capital is total highway capital minus local investments in roads and streets. ➢ The magnitude of the elasticity of output with respect to total highway capital at the aggregate level is about 0.05. This number is much smaller than comparable estimate previously reported in literature. ➢ The contribution of highway capital to total factor productivity (TFP) is positive in almost all industries, except in some non-manufacturing industries. ➢ The results suggests that an increase in total highway capital or NLS capital leads to a reduction in demand for all inputs in manufacturing, while in non-manufacturing industries the pattern is mixed. ➢ The net social rate of return on total highway capital was high (about 35 percent) in the 1950s and 1960s, then declined up until the 1980s to about 10 percent. The same is true for NLS capital, although its current rate of social return is higher – about 16 percent. ➢ The main contributors to productivity both at the industry and aggregate levels are exogenous factors that shift industry demands such as income and population growth. Highway capital contributes to long run trend TFP growth.

85. A. STRAUSS-WIEDER, Inc. (1999)

1	Author(s)	A. Strauss-Wieder, Inc.
2	Title	The Role of the National Highway Collectors: Industry Context and Issues
3	Book/Journal Title	
4	Type	Report
5	Publisher	Department of Transportation, Federal Highway Administration
6	Date of Publication	April 1999
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, intermodal, highway, capital, productivity, freight, intermodal, connectors
9	Policy Examined	Regulation and Institutional Environment ➢ Intramodality and Intermodality; ➢ Industry Structure and Competitiveness.
10	Summary of Results (Key Findings)	➢ This report explores changing freight transportation intermodal connectors in the U.S. Transportation System. ➢ The term "intermodal" is defined as a transfer of shipment from one transportation mode to another as the shipment moves from origin to destination. ➢ The nature of transportation demand has changed to meet the new needs of business and consumers. ➢ Changing business practices include the restructuring of traditional manufacturing; product shifts; production runs and JIT; reducing the length of product cycles; "lean manufacturing"; the emergence of high technology and knowledge-based industries; the globalization of the economy; focusing on core competencies within a firm (outsourcing); and focusing on transportation characteristics rather than modes and routes. ➢ It is identified that firms seek five qualities in their freight transportation service – reliability, transit time, efficiency, cost and damage minimization. The Responses of the Transportation Industry ➢ Today's shipper needs emphasize reliable, fast freight service, but cost remains an important component. ➢ Transportation providers have responded with more aggressive competition, as well as mergers and alliances. ➢ Innovation and standardization. ➢ In-transit visibility and flexibility. ➢ Using the best combination of modes. ➢ The opportunities for and barriers to achieving intermodal connector goals are finally discussed.

86. U.S. DEPARTMENT OF TRANSPORTATION (1998)

1	Author(s)	U.S. Department of Transportation, Office of Intermodalism
2	Title	The Impacts of Changes in Ship Design on Transportation Infrastructure and Operations
3	Book/Journal Title	
4	Type	Summary Report
5	Publisher	U.S. Department of Transportation (U.S. DOT)
6	Date of Publication	February 1998
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, intermodal, highway, transportation, infrastructure, operations, megaship
9	Policy Examined	Regulation and Institutional Environment ➢ Intramodality and Intermodality; ➢ Industry Structure and Competitiveness.
10	Summary of Results (Key Findings)	➢ This report presents the input received by the U.S. DOT at four regional meetings addressing the question of how the growth in worldwide containerized trade and the expected growth in volumes of freight handled by major container ports will place additional demands on the U.S. transportation system. ➢ The meeting paid particular attention to the introduction of large containerships (megaships) and their potential impact on freight transportation within U.S. ➢ The fundamental issue addressed in these conferences was how improving infrastructure links to ports is a crucial prerequisite for transportation to function as a system. ➢ There are three major national public policy issues raised by the prospects of extremely large containerships: the historic and ongoing deregulation of the transportation industry, the devolution of transportation programs, and the need for optimizing national freight movement system. ➢ The report concludes that action should be taken to craft policies to position U.S. transportation industry to handle the significant increases in international freight movements and the infrastructure demands of the changing trade flows. ➢ The report acknowledges two ongoing activities within U.S. DOT that will address the transportation system's accommodation of increased future volumes of international intermodal freight: (1) Waterway Management Initiative; and (2) Assessment of the Conditions and Performance of National Highway System Intermodal Connectors.

87. TRANSPORTATION RESEARCH BOARD (1996)

1	Author(s)	Transportation Research Board
2	Title	Paying Our Way: Estimating marginal Social Costs of Freight Transportation
3	Book/Journal Title	
4	Type	Special Report 246
5	Publisher	Transportation Research Board
6	Date of Publication	1996
7	Status of Study	Published and refereed
8	Key Words	National, industry, intermodal, highway, freight, transportation, marginal, social, cost,
9	Policy Examined	Regulation and Institutional Analysis: ➢ Intramodality and Intermodality; ➢ Economic Incentives.
10	Summary of Results (Key Findings)	➢ This study examines whether shippers of domestic surface freight pay the full social costs of the services they use. ➢ The study uses the concept of marginal social costs in measuring whether fright users are subsidized or not. ➢ If the marginal taxes that a shipper or carrier pays for each shipment equal the marginal costs that the shipment imposes on others, then the shipment is paying its way. ➢ Historically, the trucking industry has been reasonably satisfied with the government cost recovery approach, whereas railroads and environmentalists have advocated the use of marginal social cost. ➢ Cost recovery often is an important objective of policy makers in setting fees for government transportation facilities. If cost recovery is the goal it is possible to design fee schemes that provide the required revenue without sacrificing all the efficiency incentives inherent in the marginal cost approach. ➢ Four case studies have been developed to estimate whether freight shippers are paying their marginal social costs for specific freight movements. These case studies reflect a wide range of situations, but they are not intended to represent a majority of shipments in the United States. ➢ Important uncertainties in the estimates must be kept in mind when drawing policy recommendations. ➢ The recommendations are in three areas: first, research needed to close several critical data gaps; second, expansion of the case study analysis; and third, consideration of the policy implications of external costs and subsidies.

88. TRANSPORTATION RESEARCH BOARD (1998)

1	Author(s)	Transportation Research Board, Committee for Study of Policy Options To Address Intermodal Freight Transportation
2	Title	Policy Options for Intermodal Freight Transportation
3	Book/Journal Title	
4	Type	Special Report 252
5	Publisher	Transportation Research Board
6	Date of Publication	1998
7	Status of Study	Published and refereed
8	Key Words	National, industry, intermodal, highway, freight, transportation, policy, option
9	Policy Examined	Regulation and Institutional Analysis: ➢ Intramodality and Intermodality; ➢ Economic Incentives.
10	Summary of Results (Key Findings)	➢ Governments are reexamining the scope of their involvement in freight transportation, investing in facilities not traditionally provided by the public sector, and entering into new kinds of arrangements with the private sector. ➢ Government should apply standard methods for evaluating infrastructure investment proposals. The performance of completed projects should be systematically evaluated according to established guidelines. Options for provisions of federal surface transportation programs aimed at improving intermodal freight efficiency: ➢ Use of highway trust fund for nonhighway freight projects. ➢ Project selection and priority for freight projects. ➢ The U.S. DOT identifies a category of projects of national significance in which government involvement is justified. Regulatory and operational issues: ➢ Government can facilitate the application of information technology in freight in areas such as customs and enforcement. ➢ It should be examined how economic regulation of ocean and coastal shipping affects freight performance. ➢ Improved pricing of transportation facilities operated by government would yield payoffs in improved efficiency. ➢ Mechanisms established for project finance can help ensure that necessary and valuable projects are built and that government avoids participation in projects with low payoff or little public significance.

89. ZAVATERO AND AL (1998)

1	Author(s)	Zavatero and al
2	Title	Mainstreaming Intermodal Freight Into The Metropolitan Transportation Planning Process
3	Book/Journal Title	Transportation Research Record, No. 1613: Freight Transportation
4	Type	Article
5	Publisher	
6	Date of Publication	1998
7	Status of Study	Published and refereed
8	Key Words	National, industry, sector, intermodal, freight, transportation, metropolitan, planing, Chicago
9	Policy Examined	Regulation and Institutional Analysis: ➢ Intramodality and Intermodality.
10	Summary of Results (Key Findings)	➢ The Chicago Area Transportation Study (CATS), as a metropolitan planning organization, developed an approach to integrate intermodal freight transportation into regional plans and programs. ➢ This process began with the establishment of the Intermodal Advisory Task Force (IATF) in 1994 and led to a series of freight-oriented series and products. They include the identification of regionally significant facilities, analysis of improved needs, and the intermodal component of the 2020 Regional Transportation Plan (RTP) for northeastern Illinois. ➢ The IATF established four working groups that directed specific tasks. These tasks were development of a geographic information system-based intermodal facilities inventory, an outreach for industry needs, a review of proposed intermodal improvements, identification and analysis of intermodal connections to the national highway system, and analysis to estimate the economic value of the industry to the region. ➢ `Ultimately six policy statements were developed and incorporated as system-level intermodal recommendations in the RTP. ➢ The process developed by CATS through the IAFT has "mainstreamed" intermodal freight issues, analysis, and policies into the transportation plans and programs of northeastern Illinois.

90. MENDOZA AND AL (1997)

1	Author(s)	Mendoza and al
2	Title	Analysis of Vehicles for International Motor Transport of Freight Between Mexico and other NAFTA countries
3	Book/Journal Title	Transportation Research Record, No. 1602: Freight Transportation (Multimodal)
4	Type	Article
5	Publisher	National Academy Press
6	Date of Publication	1977
7	Status of Study	Published and refereed
8	Key Words	International, industry, sector, intermodal, freight, transportation, Mexico, Canada, NAFTA, regulation
9	Policy Examined	Regulation and Institutional Analysis: ➢ Intramodality and Intermodality.
10	Summary of Results (Key Findings)	➢ Traditionally, the operative and normative practices of motor transportation in the three countries that are part of the North American Free Trade Agreement (NAFTA), Mexico, the United States, and Canada, have been substantially different. In order to make transport more efficient it is necessary to standardize such practices. ➢ Truck size and weight regulations in the three NAFTA countries are reviewed. A series of vehicles are ranked according to their transport productivity and their circulation possibilities through the part of the Mexican network that is most relevant to Mexico's international commerce with the United States and Canada. ➢ The analysis includes the most commonly used vehicles authorized by federal regulations and others that are authorized only regionally but whose more extensive utilization could mean important productivity gains for the freight motor industry. ➢ The vehicle types that are most convenient to use considering the current conditions of Mexican roads are identified. ➢ Other recommendations for making motor transport under NAFTA more efficient are addressed.

91. APFFEL (1996)

1	Author(s)	Apffel, C. and al
2	Title	Freight Components in Louisiana's Statewide Intermodal Transportation Plan
3	Book/Journal Title	Transportation Research Record No. 1552 (Planning and Administration)
4	Type	Article
5	Publisher	National Academy Press
6	Date of Publication	1996
7	Status of Study	Published and refereed
8	Key Words	National, regional, industry, sector, intermodal, freight, transportation, plan, Louisiana
9	Policy Examined	Regulation and Institutional Analysis: ➢ Intramodality and Intermodality.
10	Summary of Results (Key Findings)	➢ Planning procedures used in addressing freight components for Louisiana's statewide intermodal transportation plan is described. User and provider involvement, demand analysis, network analysis, and recommended policies for the water, rail, and intermodal freight components are presented. ➢ Analysis of future demand for facility capacity has been performed in three steps. First, baseline historical patterns have been established through extensive processing of data obtained. Second, volume forecasts for 11 major commodity groups have been made for each of three possible growth scenarios. Third, a strategic outlook has been developed for selected commodity types to examine market structure, productivity trends, and the competitive position of transportation providers in the state. ➢ Network capacity analysis has identified few bottlenecks in the state's main line waterway and railroad networks. ➢ A comparative analysis of maritime terminal productivity and cost was has been performed to assess the competitiveness of ports in Louisiana. ➢ An extensive survey of the physical, operating, and institutional characteristics of terminal roadway and roadway access has been made.

92. HAUSER AND BREESE (1996)

1	Author(s)	Hauser, Edd and Amy Breese
2	Title	Partnerships for Multimodal Transportation Planning
3	Book/Journal Title	Transportation Research Record No. 1552 (Planning and Administration)
4	Type	Article
5	Publisher	National Academy Press
6	Date of Publication	1996
7	Status of Study	Published and refereed
8	Key Words	National, regional, industry, sector, intermodal, multimodal, freight, transportation, planning, case study
9	Policy Examined	Regulation and Institutional Analysis: ➢ Intramodality and Intermodality.
10	Summary of Results (Key Findings)	➢ AASHTO, in cooperation with NCHRP, has initiated a series of research studies dealing with the issue of multimodal transportation planning. This paper comments on some of the findings from one project in this series. This project focuses on the dynamics of partnership formed to carry out the planning, design, and implementation of multimodal and intermodal projects. ➢ An intensive industry scan has been completed, resulting in an interactive database of approximately 60 multimodal projects throughout the country. From these 60 projects, 12 have been selected for more intensive study through a case study approach. ➢ One finding from the case studies is that local governments and private sector partners must be included in earlier stages of multimodal transportation planning than is currently being practiced. ➢ One of the key hypotheses tested with the data available on these partnerships has been the impact of the ISTEA Act of 1991 as a catalysts to stimulate multimodal projects and to improve multimodal planning process. In this regard the study finds that before 1990s, it appears that a major emphasis of partnership formation was simply to secure funding from a variety of sources for such projects. Since ISTEA was passed, however, objectives more frequently cited by partners relate to meeting societal values and traveler needs.

93. FRAZIER AND AL (1996)

1	Author(s)	Frazier, C. and al
2	Title	Analysis of Intermodal Terminal Highway Access to Economic Activity Centers
3	Book/Journal Title	Transportation Research Circular, Number 459
4	Type	Conference Report
5	Publisher	Transportation Research Board
6	Date of Publication	June 1996
7	Status of Study	Published, not refereed
8	Key Words	National, regional, industry, sector, intermodal, highway, access, freight, transportation, economic, activity, center
9	Policy Examined	Regulation and Institutional Analysis: ➢ Intramodality and Intermodality.
10	Summary of Results (Key Findings)	➢ An area of increasing concern to policy makers is the relationship among international service, terminal location, and the surrounding highway network. A better understanding of their impact on the relative costs of intermodal versus single-mode freight movements is needed. ➢ The authors have undertaken a series of structured interviews with providers of intermodal services and have incorporated the information provided into a cost model. ➢ The model allows the boundary conditions between intermodal and highway shipments to be examined. It is also possible to explore how costs affect factors such as terminal location, access difficulty, and shipper distribution about the terminal. ➢ Using the model, three cases are evaluated: (A) variations in customer location, (B) variations in the type of customer pickup and delivery, and (C) changes in terminal efficiency. ➢ Cost data are obtained through a study of the I-95 corridor along the eastern coast between the mid-Atlantic states, Florida and Georgia ➢ The study concludes that the drayage and terminal inefficiencies that can be readily absorbed in long-haul moves – 900 to 1200 miles – cannot be absorbed in short haul markets that were studied. ➢ Results also identify the importance of the proximity of an intermodal terminal to a shipper. Terminal congestion is found to be a factor in short-haul markets, in which lengthy delays can eliminate the cost benefits of intermodal movements of freight.

94. NORRIS AND HAINES (1996)

1	Author(s)	Norris, Bahar and Marsha Haines
2	Title	Implications of Intermodal Freight Movements for Infrastructure Access, Capacity, and Productivity
3	Book/Journal Title	
4	Type	Report DOT – VNTSC – RS667 – PM – 96 - 11
5	Publisher	U.S. Department of Transportation
6	Date of Publication	1996
7	Status of Study	Published, not refereed
8	Key Words	National, regional, industry, sector, intermodal, freight, movement, infrastructure, access, performance, productivity, terminal, capacity
9	Policy Examined	Regulation and Institutional Analysis: ➢ Intramodality and Intermodality.
10	Summary of Results (Key Findings)	➢ This report evaluates the status of intermodal freight in the U.S. with reference to infrastructure access such as inadequate highway connectors and facility clearance, and terminal capacity constraints affecting levels of service. ➢ Though the overall performance of the intermodal freight system is impacted negatively by access and capacity impediments, the study findings point to a significant congestion mitigation effects from intermodal operations. ➢ Compared to the all-highway alternative, the study shows that intermodal operations produce only about one fifth of the VMT that would be generated by trucking alternative. ➢ The study indicates that inadequate clearance and access links, lack of communication, fragmented industry structure, and failure to make needed investments in support infrastructure have tampered efficient port and terminal interchange. ➢ The current and potential benefits from intermodal freight operations have been quantified in a variety of ways. These benefits have significant implications for the overall efficiency and performance of the transportation system. ➢ Challenges to intermodal performance range from inadequate infrastructure and network access, to constrained terminal capacity and door-to-door service delivery problems. These impediments affect industry costs, service quality, and overall performance. ➢ An array of solutions focusing on infrastructure improvement, institutional and deregulatory streamlining, and technological innovations are proposed to improve the performance of the intermodal freight system

95. JACOBY (1999)

1	Author(s)	Jacoby, Arthur
2	Title	Recent Advances in Understanding the Effects of Highway Investment on the U.S. Economy
3	Book/Journal Title	Transportation Quarterly, Vol. 53, No.3 (27 – 34)
4	Type	Journal Article
5	Publisher	Eno Transportation Foundation
6	Date of Publication	1999
7	Status of Study	Published and refereed
8	Key Words	National, aggregate, macroeconomic, public, capital, productivity, investment, financing, logistics, infrastructure, cross-section, time series, econometric
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis.
10	Summary of Results (Key Findings)	➢ A number of research studies by and for the Federal Highway Administration Office of Policy Development document the effects of public highway capital on logistics system and commercial sector economic performance. ➢ This paper considers the Nadiri and Mamuneas's 1998 study (see annotated bibliography No. 23 in this report), which examined the contributions of total highway capital and nonlocal highway capital to the output growth and productivity of 35 industry sectors comprising the U.S. economy. ➢ Nadiri and Mamuneas's econometric analysis provides empirical evidence of the positive impacts of public highway on private sector costs of production. ➢ Their research also estimates the effects of highway capital investment on the production sector's demand for labor, private capital formation, and materials. ➢ In addition, the analysis estimates the marginal commercial benefits of road system investments, calculates the net social rate of return on highway infrastructure spending, and identifies the contribution of highway capital and other economic factors to the productivity growth rate in the U.S. economy between 1950 and 1989.

96. QUEIROZ AND GAUTAM (1992)

1	Author(s)	Queiroz, Cesar and Surhid Gautham
2	Title	Road Infrastructure and Economic Development: Some Diagnostic Indicators
3	Book/Journal Title	
4	Type	Policy Research Working Paper WPS 921
5	Publisher	The World Bank
6	Date of Publication	1992
7	Status of Study	Published, not refereed
8	Key Words	International, aggregate, macroeconomic, road, productivity, development, indicator, infrastructure, cross-section, time series, econometric
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis.
10	Summary of Results (Key Findings)	➢ An investigation of the association between per capita income and the magnitude and quality of road infrastructure is carried out. ➢ An empirical approach is adopted. The selected variables on existing road networks are directly compared or correlated with a country's income. ➢ Cross-section analysis of data from 98 countries, and time series analysis of U.S. data since 1950 showed consistent and significant associations between economic development, in terms of per capita national product (GNP), and road infrastructure, in terms of per capita length of paved road network. ➢ The data show that the per capita stock of road infrastructure in high-income economies is dramatically greater in middle and low-income economies. For instance, the average density of paved roads (km/million inhabitants) varies from 170 in low-income economies to 1,660 in middle and 10,110 in high-income economies, the latter being 5,800 percent higher than the low-income group. ➢ Road condition also seems to be associated with economic development: the average density of paved roads in good condition (km/million inhabitant) varies from 40 in low-income economies to 470 in middle and 8,550 in high-income economies. ➢ The empirical information presented can be used as indicators of areas of weaknesses or strengths in a country's road infrastructure stock.

97. AMERICAN PETROLEUM INSTITUTE (1998)

1	Author(s)	American Petroleum Institute
2	Title	The Benefits Of Road Travel and Transport
3	Book/Journal Title	
4	Type	Research Report
5	Publisher	American Petroleum Institute
6	Date of Publication	1998
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, road, social cost, benefit, transportation
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis.
10	Summary of Results (Key Findings)	➢ The total costs of road travel and transport encompass more than governments' expenditures on roads. ➢ Some studies find that the tangible benefits of road travel and transport exceed, by trillions of dollars per year, even the highest estimates of social costs. The gross value of these benefits ranges from $6 to $10 trillion annually. The consumer's surpluses derived from travel and transportation are the largest components of the gross benefits. Policy Implication of the study: ➢ The standard of living could be improved by using a higher proportion of highway user taxes for major highways. ➢ The intangible benefits of road travel and transportation are important to the American way of life, and may justify some use of general taxes to support travel and transport. ➢ Restrictions on road travel and transport could deprive Americans of huge net benefits. ➢ Special interest exclusions from highway user taxes contain large hidden costs. ➢ Energy and transportation policies established in the era of gasoline lines should be updated.

98. BUECHNER (1997)

1	Author(s)	Buechner, W.R.
2	Title	The Road to Prosperity: The Importance of the Federal Highway Program to the Economic Prosperity of Individual States
3	Book/Journal Title	
4	Type	Research Report
5	Publisher	American Road and Transportation Builders Association (ARTBA)
6	Date of Publication	1997
7	Status of Study	Published, not refereed
8	Key Words	National, regional, state, industry, sector, highway, program, infrastructure, performance, productivity
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis.
10	Summary of Results (Key Findings)	➢ The purpose of this study is to determine how much the economy of each state depends on out-of-state highways, i.e. national system of highways. ➢ Based on data from the 1993 Commodity Flow Survey, this study uses the percent of the state's products shipped out-of-state markets by truck to measure the state's economic benefit from a national highway system. Study findings: ➢ Nationwide, 75.1 percent of the value of products are shipped by truck, while 24. 9 percent use other modes. ➢ One third of products by value are shipped by truck entirely within originating state. ➢ Almost 42 percent of the total value of products are shipped out-of-state by truck and thus depend on the highways of the other states. ➢ Some states are more dependent than the others on highway transportation to move their products. ➢ Arkansas is also the state most dependent on national highways, shipping 63 percent of its products by truck out of state. ➢ The core strategy for reauthorization of the Federal highway program should be to preserve and strengthen the national highway system, since the economic prosperity of the majority of states depends even more on out-of-state highways than on in-state highways. ➢ In economic terms the goal of federal highway funding should be to allocate resources in such a way as to maximize the national benefit from the highway system.

99. JACK FAUCETT ASSOCIATES (1994)

1	Author(s)	Jack Faucett Associates
2	Title	Industry Studies of the Relationship Between Highway Transportation and Productivity
3	Book/Journal Title	
4	Type	Report
5	Publisher	U.S. Department of Transportation, Federal Highway Administration
6	Date of Publication	1994
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, highway, program, infrastructure, productivity, interview, cost, savings
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis.
10	Summary of Results (Key Findings)	➢ The purpose of this study is to determine the importance of transportation to specific industry sectors. The study assesses and describes the economic structure, condition, and performance of the industries, including the typical production and distribution processes involved. ➢ Estimates of cost savings due to highway system improvements are obtained by interviewing 27 firms in six different industries. ➢ Cost savings were developed from three principal sources of such savings: reduced inventory costs; economies of scale in larger volumes of output; and reductions in regional warehouse operations. ➢ Econometric analysis are conducted to fit translog cost function equations for 226 four-digit industries. The changes in the costs due to each one billion dollars investment in highway infrastructure are computed. ➢ The rates of return of highway investment for the 226 industries are estimated. These rates are considerably lower than those that have been yielded by Cobb-Douglas production function studies. ➢ It appears more likely that larger payoffs will be realized from improved utilization of existing infrastructure through congestion pricing and introduction of IVHS technology, more so than from gross additions to the highway network.

100. BELL AND MCGUIRE (1994)

1	Author(s)	Bell, Michael and Therese McGuire
2	Title	Macroeconomic Analysis of the Linkages Between Transportation Investments and Economic Performance
3	Book/Journal Title	
4	Type	Report: NCHRP Project 2-17 (3)
5	Publisher	U.S. Department of Transportation
6	Date of Publication	1994
7	Status of Study	Published, not refereed
8	Key Words	National, aggregate, macroeconomic, industry, sector, highway, program, infrastructure, productivity
9	Policy Examined	Investment and Financing Policies: ➢ Economic Analysis.
10	Summary of Results (Key Findings)	➢ The purpose of this research project is to improve our understanding of the linkage between transportation investment and economic performance. ➢ The literature review section critically reviews currently available literature examining the linkage between infrastructure investment and economic performance. The authors conclude that infrastructure investments have modest positive effect on the nation's private economic activity. It is also concluded that the level of analysis is too general to help government decision-makers establish priorities for allocating scarce transportation resources. ➢ To improve the understanding of the linkage between transportation investment and economic activity the authors develop a desegregate data set. It includes information about different types of infrastructure, economic activity by industry, and national data by region. ➢ Several empirical models are employed to test the linkage between transportation investment and economic performance -- industry-specific production functions, a traditional public goods demand model and a neoclassical growth model. ➢ The results show that the link between transportation investment and private economic performance varies by transportation mode, by industry and by state. Demographic and economic trends also have important implications for transportation investments. Finally, this study demonstrates the value of additional information about the link between transportation investment and economic performance obtained from the more disaggregate approach.

101. BUECHNER (1998)

1	Author(s)	Buechner, W.R.
2	Title	The Federal Highway Program and Highway Safety: An Economic Analysis
3	Book/Journal Title	
4	Type	Report
5	Publisher	American Road and Transportation Builders Association (ARTBA)
6	Date of Publication	1998
7	Status of Study	Published, not refereed
8	Key Words	National, industry, sector, highway, program, infrastructure, highway, performance, safety
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding.
10	Summary of Results (Key Findings)	➢ The Federal highway program ins one of the nation's most important programs to improve public health and safety. ➢ Motor vehicle crashes cost American society over $159 billion each year. That is more than seven times what the federal government is investing in the highway improvement program. ➢ ARTBA's analysis of public highway investment and traffic fatality and injury rates over the past 40 years shows a two-for-one public health return on investment. ➢ According to the U.S. Department of Transportation's (DOT) 1997 report to Congress, a sustained annual investment of over $79 billion would be necessary to make all economically beneficial investments. ➢ To achieve significant reductions in the highway fatality and injury rates in the post-Interstate construction era, additional public attention and government financial resources must be focused on safety improvements, with a greater focus on two-lane roads and high-risk intersections in rural and suburban areas. ➢ A 20-year (1974-95) U.S. DOT study shows that relatively low-cost improvements made to the roadway and road environment can have safety and economic payoffs. ➢ For example, construction of medians between lanes for traffic separation has been shown to reduce fatal accidents on improved roadways by 73 percent. Realigning roadways can reduce fatal accidents by 66 percent, as does removing roadside obstacles. Replacing a dangerous bridge with a new one has bee shown to reduce fatal accidents by 86 percent.

102. TOEN-GOUT AND SINDEREN (YEAR)

1	Author(s)	Tone-Gout, M and J. van Sinderen
2	Title	The Impact of Investment in Infrastructure on Economic Growth
3	Book/Journal Title	
4	Type	Research Memorandum 9503
5	Publisher	Erasmus University Rotterdam
6	Date of Publication	1994
7	Status of Study	Published and refereed
8	Key Words	International, aggregate, macroeconomic, industry, sector, program, infrastructure, economic, growth, Netherlands
9	Policy Examined	Investment and Financing Policies: ➢ Federal and State Funding.
10	Summary of Results (Key Findings)	➢ This paper investigates the effects of infrastructure investment in the Netherlands on economic growth and employment both in the short and the medium term. ➢ In the paper are presented calculations of the contribution of the government investment to economic growth in the period 1974-94. In order to disentangle these effects the authors use a Macroeconomic Semi Equilibrium Model (MESEM) for the Dutch economy in which investment by the government affects both the demand side and the supply side of the economy. The way in which this investment is financed is also incorporated in the policy analysis. ➢ Public investment in Netherlands decreased significantly in the period 1970-84. This cannot be explained by a drop in demand for infrastructure, but rather was mostly dictated by budgetary consideration. ➢ The simulations done by MESEM show that the increase in economic growth in the Netherlands in the period 1984-94 compared to 1974-83 can be explained for a considerable part by the reverse in the downward trend of public investment. ➢ The authors argue that reshuffling government expenditures can best finance infrastructural improvement. A second option for financing public investment is to appeal to the capital market. ➢ The policy conclusion of this paper is that general shift in government spending priorities in the past has negatively affected the contributions of public investment level.