

AMERICAN ASSOCIATION
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T ransportation and the Economy

national and state
perspectives
May 1998





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overview

The American public understands that transportation is important to the economy and to our daily lives. But the full power and importance of transportation's role in the nation's economy has never been understood — until now.

In the past months, many years of research and data collection have begun paying off in a rich series of analytical studies paving the way for a strong, rigorous and quantitative explanation of transportation's role in the economy and the power of transportation investment in advancing national competitiveness and productivity. This document identifies some of this new research and the guidance it provides to public investment decision making. This document also addresses some of the tasks that lie ahead to complete the work that is now showing such substantial rewards.

Among the important research results:

- An AASHTO and National Governors' Association report documents the new world in which modern freight transportation operates: one centered on the highly reliable movement of high value goods in a just-in-time environment and dominated by world-wide competition in which transportation costs can determine market success or failure;
- University research sponsored by the Federal Highway Administration quantifies the relationship between highway investment and the economy based on reductions in business costs; and
- A statistical analysis based on new freight flow data demonstrates that the Woodrow Wilson Bridge carries over one and one half percent of the nation's freight measured by value, establishing a clear framework for defining national importance.

What does such research prove about the economic value of transportation?

- Investments in the total highway system by all levels of government over the period 1980 to 1991 averaged an amazing net rate of return of 14.6 percent. This was above the average rate of return typical for all private investment. Annual rates of return on only investments on the National Highway System were above 20%;

- Almost one-fifth of the increase in productivity in the U.S. economy between 1980 and 1991 was attributable to investment in highways;
- A new accounting tool, called the Transportation Satellite Account (TSA), now provides a way to measure **both** in-house and for-hire transportation services. The TSA reveals that when in-house functions are incorporated, transportation, accounts for five percent of the Gross Domestic Product. In-house transportation services alone account for nearly 2 percent of the GDP, a larger share than the direct contribution to the economy than agriculture or the computer industry; and
- While these benefits alone justify an extensive highway investment, they represent only the benefits of freight transportation. The case for highway investments will be made even stronger as further research examines the benefits accruing to passenger travel.

The State Perspective

- Research by the Federal Reserve Bank of Chicago and the University of Illinois suggests that in the mid-west region of the U.S., encompassing Michigan, Ohio, Indiana, Illinois and Wisconsin, trade activities take on new character. This evolution of trade is spurred by two forces, a significant reduction in the cost of transportation and communications in general, and the integration of the regions into a global economy. Key in this development is the increasing impact of each additional dollar invested in transportation on lowering production costs. Firms search more widely for the highest quality and lowest cost inputs knowing that transportation investments have significantly broadened the effective geography within which they can search;
- Wisconsin in 1988 introduced a Corridors 2020 plan to create a statewide network of two and multi-lane state highways connecting all communities of over 5,000 people. Research on the new and expanding manufacturing establishments in the state has found that 86 percent of the manufacturing jobs in the state in 1996 were located in communities within five miles of a Corridor 2020 route;
- Work now underway by the Maryland Department of Transportation and Towson University parallels at the state level the FHWA analyses of the impact on private sector production costs of highway investments. The research shows that between 1982 and 1996, highway investment substantially reduced the private cost of production. Over the entire period highway

investment reduced the wage and capital costs of industry in the state by 3 percent or about \$1 billion. Preliminary work shows that highway investment was responsible for eight percent of productivity growth in the state in that period; and

- A very recent product of the U.S. Department of Transportation's Bureau of Transportation Statistics and the Bureau of Economic Analysis of the Department of Commerce, called a Transportation Satellite Account, raises the estimate of transportation services in the Gross Domestic Product from a 3 percent to a 5 percent share. Large parts of this increase are in-house trucking fleets, emphasizing the importance of the highway-truck relationship. This work, still going on, shows that transportation costs are a more critical factor in our international competitiveness than previously recognized.

There has been tremendous synergy between the new data collection programs linked with new analytical methods. The work has just begun. Future efforts will complete and expand the studies mentioned here and link them to work going on to measure the capital stock of highways, transit facilities, and terminals, and integrate them with asset management systems.

Building a New Understanding of the Economic Dimensions of Transportation

Transportation is both a key business cost and a basic enabler of economic activity. It should be at the heart of strategies to ensure the economic health of the nation, individual states, and localities. Understanding the economic dimensions of transportation is essential in many ways: to determine effective public and private investment in transportation infrastructure; prioritize transportation projects; estimate the number of jobs created by transportation spending; understand regulatory costs; monitor competitiveness and the economic health of the transportation sector; and forecast revenues from transportation facilities and activities. This understanding requires data on how much transportation buys from other industries, how much other industries spend on transportation, the value of transportation capital, and transportation's role in productivity.

Increased knowledge of these economic issues will permit states to produce the greatest benefits from the expanded resources from the reauthorization of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. States can use such knowledge to determine:

1. What is the appropriate level of investment in transportation to encourage economic health?

This question requires a broad and comprehensive understanding of the linkages between transportation and the economy in the

nation and in individual states. The importance of this question is underscored by analyses that supported reauthorization of ISTEA and that will be needed to support subsequent legislative proposals involving transportation finance in several states;

2. How should projects be prioritized within a multimodal transportation program?

The answer to this question requires the development of cost and benefit measures that can be applied across modes, involving both passenger and freight transportation. The need for better measures of transportation benefits was emphasized in the International Conference on Measuring the Full Social Costs and Benefits of Transportation; and

3. How much revenue is likely to flow from traditional use charges, tolls, region-wide taxes, and other sources?

The need for better revenue forecasting models was emphasized in the AASHTO supported National Conference on Information Needs to Support State and Metropolitan Transportation Decision making into the 21st Century.

This report highlights recent developments at the national level that will help answer the first question, as well as current state efforts on the same subject. By expanding current efforts, national and state transportation agencies will be better able answer all three questions.

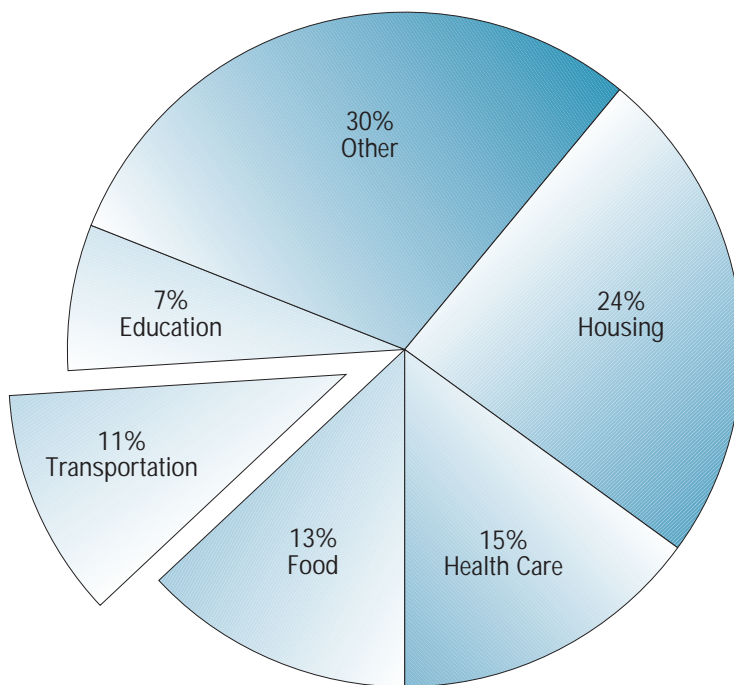
New Tools and Data at the National Scale

Transportation is a major component of the economy as illustrated by the following facts:

- Transportation accounted for eleven percent of gross domestic product in 1995 (see chart on following page);
- The average household spent just over \$6,000 on transportation in 1995, one-fifth of its total expenditures. This compares with \$10,500 for housing, \$4,500 for food, \$3,000 for insurance (excluding vehicle insurance) and pensions, and \$1,700 for health care (see figure on page 6);
- About 94 percent of household transportation expenditures go to purchase, run, and maintain private vehicles. Airline fares were the second largest category at 4 percent of expenditures, and mass transit ranked third at 1 percent;

- Governments spent \$116.5 billion on transportation in 1993. About 31 percent was the federal share, which included grants to state and local governments. Of the total, 60 percent of these expenditures were for highways, 19 percent for mass transit, and 15 percent for aviation;
- Transportation-related revenues of federal, state, and local governments reached \$85 billion in 1993. States collected nearly half of all transportation-related revenues, with 32 percent collected by the federal government, and 19 percent by local governments;
- In 1995, approximately 9.9 million people worked in transportation-related activities, about 7 percent of the total civilian labor force; and

U.S. Gross Domestic Product by Major Social Category - 1995

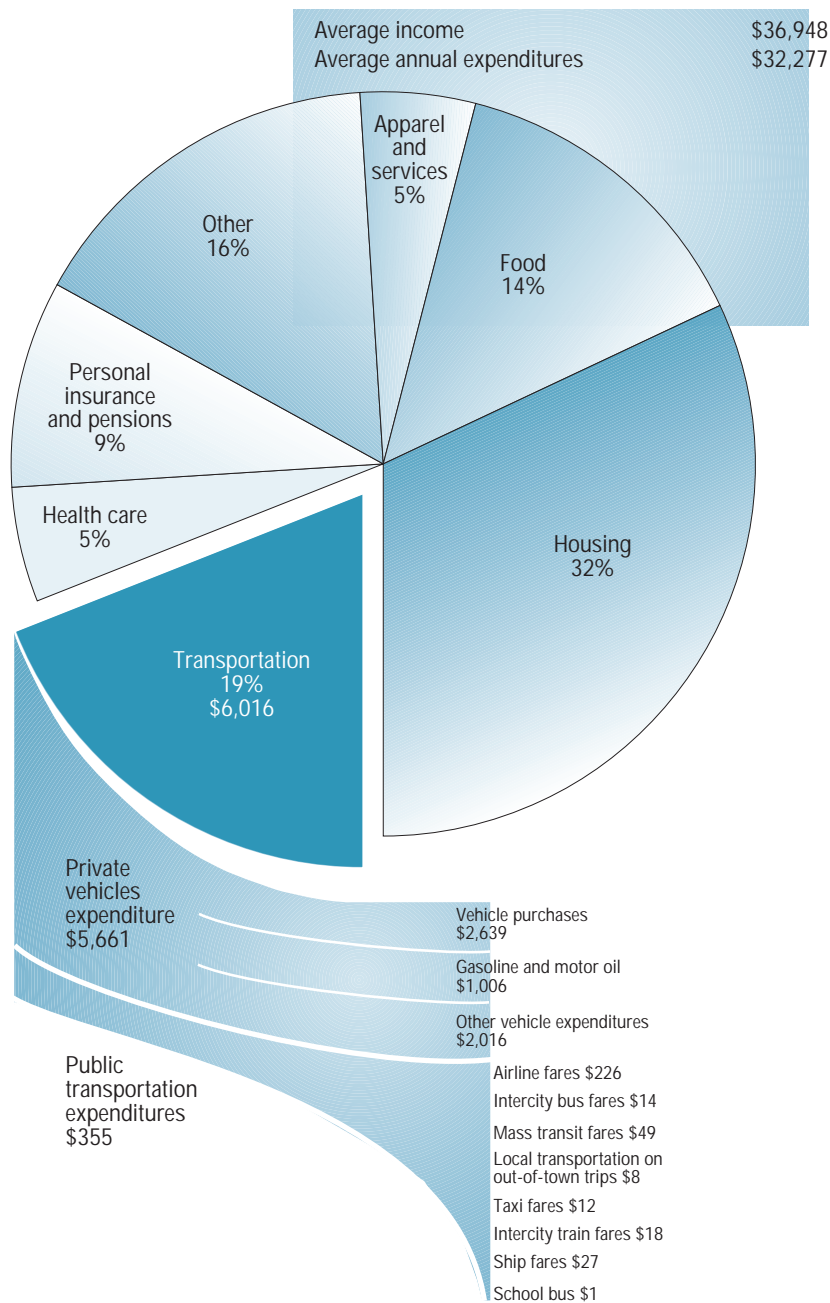


Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Transportation in the United States: A Review* (Washington D.C. 1997)figure 1

transportation accounted for eleven percent of gross domestic product in 1995

the average household spent \$6000 —
 one fifth of its total expenditures —
 on transportation in 1995.

Average Household Expenditures by Major Category - 1995



- Labor productivity in the for-hire transportation industry (as measured by value-added per worker) was 19 percent higher than the average for the economy as a whole in 1992.

The economic importance of the U.S. transportation system goes well beyond its borders. It affects the ability of U.S. businesses to compete in the expanding global economy. Over time, international trade has grown in importance as a component of the U.S. economy. In 1995, total exports and imports of goods and services amounted to 24.7 percent of the nation's Gross Domestic Product, compared with only 11.3 percent in 1970. Commodities trade, which is more closely related to freight movement, also more than doubled in relation to GDP — rising from 8.1 percent in 1970 to 19.5 percent in 1995. The volume of trade also grew rapidly in absolute terms: for example, waterborne commerce in the United States involving foreign trade increased from 581 million tons in 1970 to over 1.1 billion tons in 1995.

The relationship between transportation and the economy has long been recognized. Distance is a factor in our lives and transportation costs money and contributes to the cost of goods. But we have lacked a more definitive understanding of the linkages. Recent groundbreaking by Professor Ishaq Nadiri of New York University quantifies the relationship between highway investment and the economy based on reductions in business costs.

Professor Nadiri's research which was funded by the Federal Highway Administration examined the effects of highway capital on the costs of production, level of output, and demand for labor, capital, and materials in 35 industries comprising the production sector of the U.S. economy between 1950 and 1991. The research found that:

1. Average annual returns on investment in the sixties, the early days of the Interstate System Construction were astronomical, at the level of 40 percent;
2. Although, as would be expected, rates of return declined in later periods, the average net rate of return on investments in the total highway system by all levels of government over the period 1980 to 1991 was still 14.6 percent. (This exceeded the average rate of return typical for all private investment);
3. The average net rate of return on investments in the total highway system by all levels of government in 1990 was 11.7 percent and 10 percent in 1991;
4. The return for the "non-local" road system, that is roughly the 935,000 mile Federal-Aid Highway System, was on the order of 16.5 percent. The return for the National Highway System was about 20 percent;

5. A one percent increase in highway capital reduced industry production costs by seven-hundredths of a percent and increased output by one tenth of a percent; such values seem small but represent large economic gains. These percentages relate to the gross output of the economy, roughly 1.5 times the GDP; and
6. The contribution of total highway capital to total factor productivity growth during the period 1980 to 1991 was 18 percent. That is, almost one-fifth of the increase in productivity in the U.S. economy between 1980 and 1991 was attributable to investment in highways.

All of these benefits are related the business sector. The benefits to private citizens and to governments have not been included. Further work will focus in that area.

While these facts are impressive, they do not provide detailed guidance on how much should be spent on transportation in a particular situation and how those expenditures will affect individual parts of the economy in specific times and places. Research will be needed to further develop these tools.

The Data Linkages

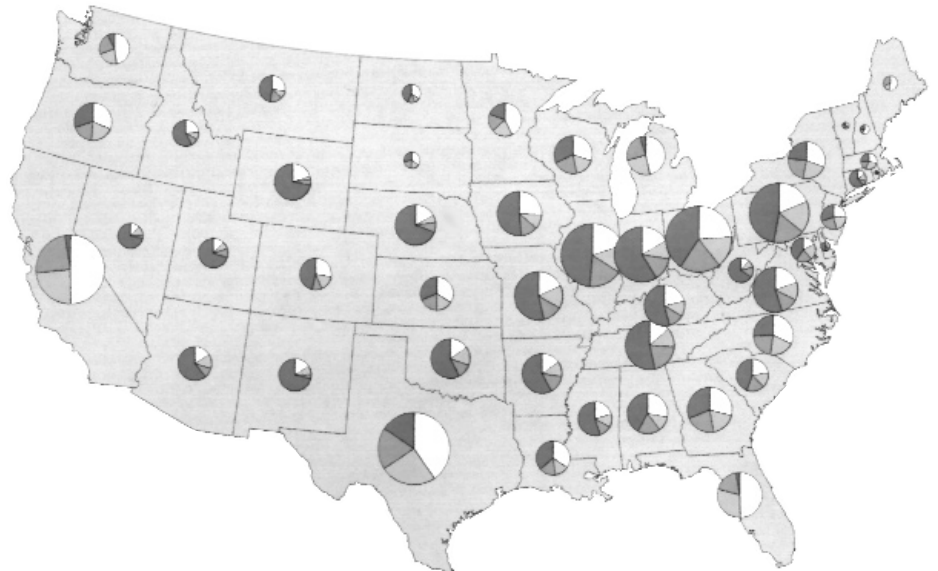
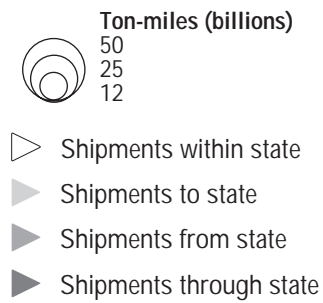
Our new understanding of the economic impacts of transportation has been made possible or substantially enhanced by the availability of major new highly detailed data developed by the Bureau of Transportation Statistics under ISTEA. In almost every example cited, new insights have been opened up by important new statistical programs, most notably the Commodity Flow Survey (CFS).

BTS has also measured the physical movements of people and goods among states, which can be used in the same way as the Truck Inventory and Use Survey to understand economic flows among states. Goods movements are covered by the Commodity Flow Survey (CFS), conducted of more than 100,000 shippers nationwide in manufacturing, mining, and wholesale, to measure what they shipped, where the goods went, and how they got there. Passenger movements are covered by the American Travel Survey (ATS), conducted of more than 80,000 households to measure where they traveled, why they traveled, and how they got there. The CFS was conducted in 1993 and 1997, and the ATS in 1995.

The survey results which have proven to be effective tools at the national scale will prove just as valuable in the future when employed by states as they address their transportation investment challenges. The two maps on the opposite page demonstrate the surveys' analytical power.

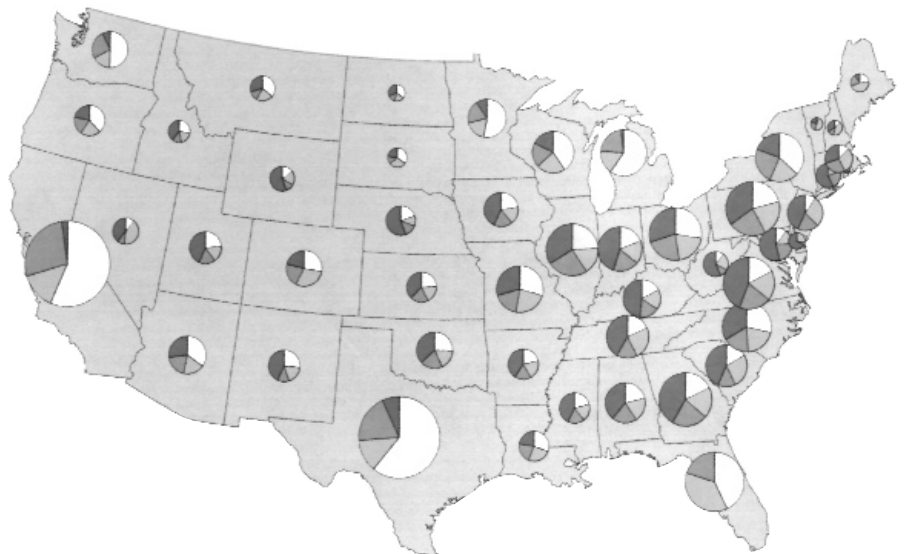
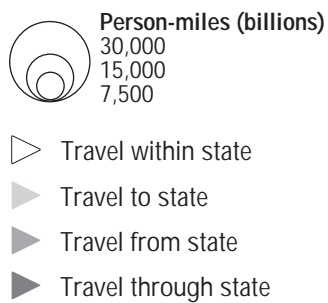
The first shows the flows of truck tonnages within, to, from and through the states. The second map shows a parallel data set for long distance (greater than 100 mile) passenger travel.

Map 1. Ton-miles of truck shipments by state - 1993



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, April 16, 1998.

Map 2. Person-miles of long-distance passenger travel by state - 1993



In a recent application of the Commodity Flow Survey, the survey commodity origin destination patterns were routed over the highway network by computer simulation and used to determine the composition of flows over the Woodrow Wilson Bridge. A brief description of that effort appears on page 24.

Transportation's Economic Importance: Highlights of the Transportation Satellite Accounts

A recent study by the federal government has established that transportation services contribute a much greater share to gross domestic product (GDP) than previously thought. It further finds that the service sector of the economy is as dependent on transportation as is manufacturing. The study indicates a significant role of transportation in supporting the competitiveness of U.S. products.

Transportation's importance in the U.S. economy has long been under represented in national economic data used by government and private sector decision makers. One reason is that, until now, national measures of transportation services only counted the value of for-hire transportation activities, ignoring the sizable contribution of in-house transportation services by non-transportation firms. For example, grocery companies that used their own truck fleets to move goods from their warehouses to their retail outlets were not included in the transportation count. Because the in-house contribution was missing in the national data, the true value of transportation services in the economy was unknown, and, therefore, most estimates of the economic benefits to industry from transportation investments have been too low.

A new accounting tool, called the Transportation Satellite Account (TSA), now provides a way to measure both in-house and for-hire transportation services. Transportation analysts have long recognized that this was a major factor in transportation but only now with the availability of the restructured accounts can they fully quantify the scale of these activities.

The TSA reveals that when these in-house functions are incorporated, transportation, which is traditionally perceived to account for about three percent of the GDP, actually accounts for five percent. It shows that in-house transportation services alone account for nearly 2 percent

what is a satellite account?

The national accounts, formally known as the National Income and Product Accounts, are a set of aggregated economic statistics, balance sheets, and tables that provide an accounting framework within which economic data can be compiled and resented in a format designed for economic analysis. They represent “the books” of the nation’s economy, providing the national estimates of the gross domestic product, the balance of payments, national production, consumption, investment, and other fundamental attributes of the national economy.

Satellite accounts are a relatively new concept, permitting recasting of the national accounts framework in rigorously controlled structures, in order to better understand and analyze special aspects of the economy that may transcend the traditional notion of industries. Satellite accounts are considered an effective tool in such cross-cutting areas as information, environment, energy, tourism and of course, transportation.

Because statistics in the national accounts of the United States undercount transportation’s share in the production cost of every industry, productivity studies based on these statistics inevitably underestimate the contribution of transportation infrastructure investment to the productivity growth of the economy. The new tool amounts to a new accounting framework that provides a rigorous, statistically sound way to go beyond that portion of economic activity traditionally recognized as transportation the services of for-hire transportation firms such as railroads, airlines and trucking firms, and, in addition, measure those transportation activities operated in-house within firms in agriculture, mining, manufacturing, retailing and services, etc., most typically the operation of private trucking employed by firms to move their own raw materials, products and employees.

of GDP, a share that is larger than the direct contribution to the economy of agriculture or the computer industry.

The TSA, developed jointly by the Bureau of Transportation Statistics (BTS) of the Department of Transportation and the Bureau of Economic Analysis of the Department of Commerce, is statistically and conceptually consistent with the national accounts used to calculate GDP, the measure of net output of goods and services in the U.S. economy.

The Relevance of the TSA

TSA offers immense advantages over traditional measures used in the national accounts. It provides more accurate estimates of all transportation services used by industries, and thus a more complete picture of an industry’s transportation intensity. TSA estimates also reflect the level of transportation activity regardless of whether internal or for-hire services are used. For these reasons, the TSA will provide a sounder basis for evaluating transportation investment needs, and

estimating the contribution of transportation infrastructure investments to productivity growth.

While the TSA is an important contribution in understanding transportation's economic role, it does not provide the final picture. Although it has captured in-house trucking and some in-house bus use, such as in the hotel and car rental industry, there are other in-house transportation activities, such as private air transportation services provided by corporate aircraft that will need fuller accounting in the future.

State Perspectives on Transportation Investment

NGA/AASHTO

The National Governor's Association provides an excellent overview of the economic impacts of transportation from the state perspective in *The Economic Importance of Transportation Infrastructure Investment*. A joint document with AASHTO, *Transportation: Driving a Thriving Economy*, extends this work and reports on several new developments in transportation. The documents review the driving forces in transportation developments at this time in the light of the latest research on the linkages between transportation and the economy, and make a compelling case for concern about growing balances in the Highway Trust Fund and the need for increased levels of public investment in transportation.

- The first is the rapid incorporation of just-in-time practices in American business. These practices require sophisticated logistical planning and coordination between suppliers, manufacturers and their shippers. It is estimated that 28% of U.S. production is based on these practices rising to an expected 50 percent by the new century. These practices place tremendous emphasis on:
 - Speed;
 - Reliability; and
 - Intermodal Coordination.
- The second is our growing linkage to the world economy by trade, both imports and exports. In such a competitive world environment transportation's role is key due to the increased distances traveled and the increased share of product costs attributable to transportation. It also is especially significant in the U.S. because transportation can serve as a U.S. competitive advantage overcoming advantages that other nation's might have in lower labor and other input costs.

key findings

Together, for-hire and in-house transportation industries contributed \$313 billion to GDP in 1992, about 5 percent of U.S. GDP. This makes transportation larger than the contribution of the agriculture, mining, or computer industries and comparable to that of the wholesale/retail trade and health industries. The actual values are summarized in Table A below:

Table A. Transportation Services Contribution to GDP

Part of Transport	Value Added	% GDP
Total for-hire	\$191.6 billion	3.1%
Total in-house	\$121.5 billion	1.9%
Grand total	\$313.1 billion	5.0%

- The in-house transportation activity can be seen as a significant industry in its own right. For example, in 1992, the \$122 billion of value-added by in-house transportation was larger than that of the education (\$119.8 billion), computers (8.9 billion), agriculture (\$86.3 billion), and mining (\$74.7 billion) industries.
- In-house transportation services consist primarily of private trucking fleets, a dramatic expansion of the importance of the highway/trucking system to the U.S. economy. The addition of in-house trucking increases the size of the trucking industry by about 150 percent.
- The TSA restructures our understanding of industry use of transportation. The detailed industry by industry uses of transportation services by type of service are shown in Table B.

Table B. Industry Uses of Own-Account and For-Hire Transportation Services

Sector	Use of for-hire services \$ millions	Use of own-account services \$ millions	Total* use of services \$ millions
Agriculture	5,720	13,177	18,897
Mining	2,810	3,870	6,680
Construction	13,286	38,950	52,236
Manufacturing	80,248	21,806	102,054
Communications/ Utilities	8,803	1,187	9,990
Wholesale/ Retail	8,963	42,817	51,782
Services	10,523	42,035	52,558
Finance/ Insurance/ R.e.	21,482	899	22,381
Total Gross Output	151,835	164,743	316,578

The AASHTO/NGA document extends the freight discussion to treat the passenger side issues related to national productivity in highways and transit as well.

Several examples are provided of modern transportation practices and their importance by Hewlett-Packard Corp., GM's Saturn Corp., Federated Department Stores, and the Limited Company. The AASHTO/NGA report traces a garment produced in Texas and sold to a customer in New York, all within 78 hours, 60 of which is spent in transportation. The Hewlett-Packard story shows the company's emphasis on locating its facilities for good highway access for freight but also to attract and retain a skilled workforce. The role of transit in contributing to productivity is documented in the AASHTO/NGA report. Perhaps the most powerful point made was that by the CEO of the American Automobile Manufacturers Association, saying that they could not envision manufacturing vehicles in the U.S. without the comparative advantage provided by a low cost, reliable and responsive transportation system.

The AASHTO/NGA study emphasizes the need for adequate expenditure to preserve the nation's vast investment in its highways and bridges. The NGA study observes that while levels of funding to date have been barely adequate to preserve system conditions but insufficient to enhance or even preserve performance to deal with growing demand. Given that transportation is critical to the economy, actions by the federal government to under-invest in transportation would constrain the global competitiveness of U.S. firms and the economic productivity of the nation.

A Regional Perspective

Studies by the Federal Reserve Bank of Chicago in cooperation with the University of Illinois establish the crucial economic role of trade between states for those states and the nation. Their Regional Economics Applications Laboratory has performed studies of regional spatial interaction in the Midwest, studying domestic trade in the U.S. and specifically trade flows between Illinois, Wisconsin, Indiana, Ohio and Michigan.

In Illinois it was shown that the state's foreign trade with its major international partners, although very large, was dwarfed by its trade with its regional partners, as shown in Table 1.

Exports to the smallest regional partner are on the order of three times that of the largest foreign trade partner. If a "most favored nation" status were to be conferred by states, Illinois should confer that status on its state partners. In a sample study of flows of fabricated metal firms in the Chicago region it was found that 55% of the purchases made from outside Chicago came from the midwest region (the other four states) and 44% of sales went to the same area.



key findings - continued

- Many industries rely more heavily on in-house transportation than for-hire transportation services. This is notably true for agriculture, wholesale/retail and services industries.
- The share of transportation cost in each dollar of output in all American industries need to be revised upward. Table C shows the total transportation costs embodied per dollar of final demand in major commodity groupings covering the entire non-transportation components of the U.S. economy. Many groups are effectively doubled by the addition of in-house services with wholesale/retail more than tripled. If for-hire transportation use were the sole measure, manufacturing and communications and utilities would have the most embodied transport costs in the U.S. economy. When in-house transportation services are included both agriculture and construction show greater total transport costs than manufacturing.

Table C. Transportation Cost Embodied in a Dollar of Final Demand - 1992 - In Dollars

Commodity Group	For-hire services Cost/\$1	In-house services Cost/\$1	Total* use of services Cost/\$1
Agriculture	0.058	0.085	0.142
Mining	0.041	0.038	0.079
Construction	0.049	0.073	0.123
Manufacturing	0.063	0.027	0.091
Communications/ Utilities	0.066	0.016	0.082
Wholesale/ Retail	0.020	0.046	0.066
Services	0.016	0.007	0.023
Finance/ Insurance/ R.e.	0.026	0.028	0.054

- The TSA illustrates the important role of transportation even in a service-oriented economy. The service sector, as defined in the national accounts, is the largest and fastest growing sector in the U.S. economy. The share of the service sector in GDP rose from 19.2 percent in 1992 to 20.2 percent in 1996. According to for-hire data in the national accounts, new demand for transportation services generated from the growth of service the sector was about \$6 billion. In comparison, the TSA shows that this new demand was nearly \$18 billion, about three times more than the for-hire estimate.
- Transportation industry output, considering both for-hire and in-house activity, is most sensitive to changes in demand for agricultural products. Transportation also has a greater influence on the prices of agricultural products. If only for-hire transportation is considered, transportation output would be most affected by changes in demand for manufacturing products. But, when in-house transportation is considered, transportation output would be most affected by changes in demand for agricultural products.
- The new data indicate that transportation efficiency has a greater impact on the competitiveness of U.S. products in the international market than what is implied by statistics in the U.S. national accounts, particularly on the competitiveness of U.S. agricultural products. Specifically, a \$1 increase in the final demand for agricultural products would cause an increase of 14.2 cents in total transportation industry output, compared with only a 9.1 cents increase in the case of manufactured products. Thus changes in transport costs can directly affect the prices of our products in world markets.
- The traditional system has understated the influence of transportation investment on the economy. These new facts on the role of transportation costs in the overall costs of many, if not all, products and services, indicate that investment in greater productivity in transportation will have substantially greater impacts on overall economic productivity.

Table 1. Illinois Exports with Major Partners in 1995

Country	Volume U.S.\$ - Billions	State	Volume U.S.\$ - Billions
Canada	6.3	Ohio	19.9
Japan	2.2	Wisconsin	18.0
Mexico	2.1	Indiana	17.7
U.K.	1.3	Michigan	17.5
Germany	1.3		

The research suggests that the region is at a stage of mature development in which trade activities take on new character. This evolution of trade is spurred by two forces, a significant reduction in the cost of transportation and communications in general, and the integration of the regions into a global economy.

This results in firms that are broad in scope of activities but with individual establishments within those firms that can be highly specialized, thereby increasing interregional trade, interregional dependence and the interregional multiplier.

One factor that is identified as key in this development is the increasing impact of each additional dollar invested in transportation on lowering production costs. As a result clustering of activities focuses on different attributes as firms search more widely for the highest quality and lowest cost inputs knowing that transportation investments have significantly broadened the effective geography within which they can search.

For several reasons these factors are most germane to the states of the midwest. The modelers suggest that when the economies of the states are large, of similar size and with few major differences in resources something other than traditional comparative advantage theory is needed to understand trade. In these states per-capita incomes are high, and capital investment per worker ratios are high and similar. This gives rise to opportunities for product differentiation that responds to demand for a greater variety of products of high quality. It is the lower transportation costs, the region-wide agglomeration effects, and the effectiveness and ease of information flows, that all combine to facilitate intra-industry trade.

The scale of that trade is extraordinary. The total volume of commodity trade between the five states is \$262 billion per year, about the same order of total trade for the three NAFTA countries. The nature of these flows is shown in Table 2.

This work, although just beginning, is very valuable in the insights it provides into the role of transportation in the new economy of the U.S.

Table 2. Commodity Flows in the Midwest - U.S.\$ - Billions

State	Value of Commodity Outflows from the Midwest to:			
	Midwest	Rest of U.S.	Total	% to Midwest
Illinois	73.3	155.2	228.5	32.2
Indiana	52.0	75.7	127.6	40.7
Michigan	48.0	81.6	129.6	37.1
Ohio	57.2	138.5	195.6	29.2
Wisconsin	35.5	60.6	93.0	34.9
Total	263.0	511.4	774.4	34.0

State	Value of Commodity Inflows to the Midwest from:			
	Midwest	Rest of U.S.	Total	% to Midwest
Illinois	58.7	126.7	185.4	31.7
Indiana	46.3	52.6	98.9	46.8
Michigan	67.9	83.4	151.3	44.9
Ohio	59.9	110.9	170.8	35.1
Wisconsin	30.1	42.4	72.6	41.5
Total	263.0	416.0	679.0	38.7

and the world. It emphasizes the economic integration of this particular region, tied together with transportation and communications, and provides insight into the nature of the workings of other regions as well.

Wisconsin Economic Research

One of the states in the midwest region, Wisconsin, has done extensive economic study of the role of its highway system and other forms of transport in the state of its economy. In 1988 the state introduced a Corridors 2020 plan to create a statewide network of two and multi-lane state highways connecting all communities of over 5,000 people. The development of this backbone network came about as the result of forums held by the Secretary of Economic Development and the Secretary of Transportation. Equally important as traffic volumes and service in designation of the routes was the ability to serve key trade, manufacturing, agriculture, forestry, tourism and recreation centers that support the state's economy.

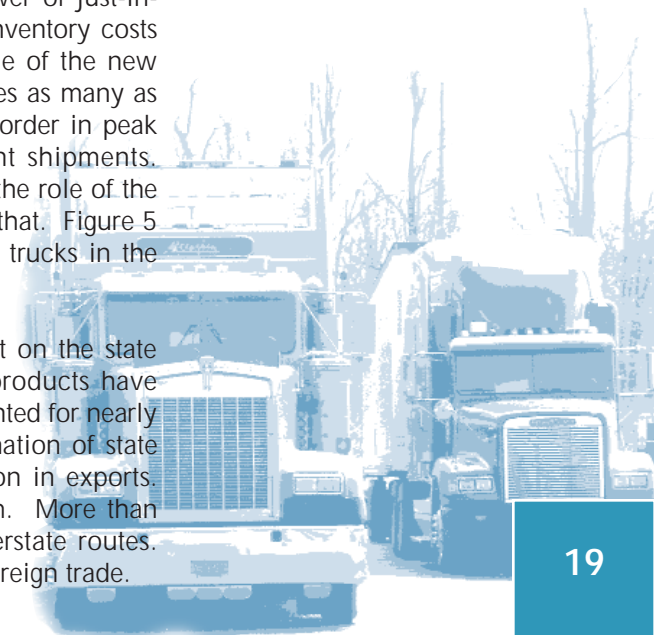
The ability to enhance Wisconsin's economy was the most influential factor in evaluating candidates for the state's Major Projects program. Another program, the Transportation Economic Assistance Program, provides state grants to local governments for transportation improvements that are essential to economic development. With \$36 million in grants awarded to 146 projects, the grants have leveraged \$1.5 billion in capital investment in the state in the form of buildings, machinery and equipment, and increased the previous state annual payroll by \$841 million.

Wisconsin highway investment has responded to the factors that have been mentioned — the growing role of international trade and the emphasis on just-in-time processes in logistics. Their studies make the point that national and state surveys show that highway accessibility has been rated one of the most important factors in the location of manufacturing firms. This fact is shown in the accompanying map that shows that:

- 86 percent of the manufacturing jobs in the state in 1996 were located in communities within five miles of a Corridor 2020 route;
- 77 percent of the state's manufacturing firms in 1996 were located in communities within five miles of a Corridor 2020 route; and
- 87 percent of the 1,912 new and expanding firms in Wisconsin in the period 1990-1996 were located within five miles of a Corridor 2020 route.

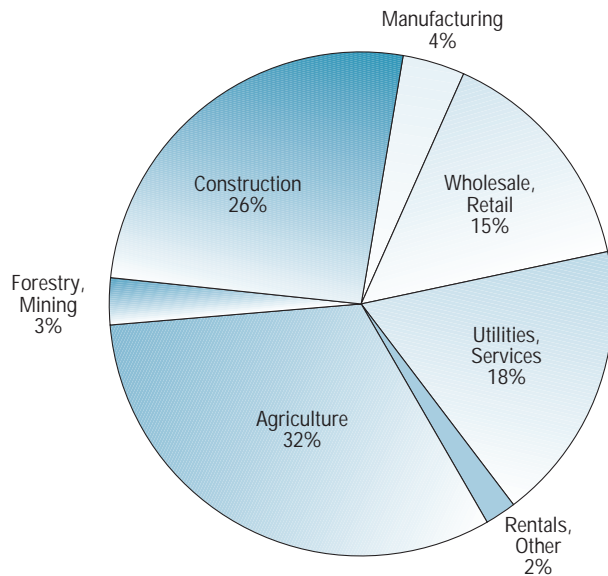
They see the 137 percent increase in truck traffic on the state trunk system between 1980 and 1995 as evidence of the power of just-in-time delivery in their economy. The ability to reduce inventory costs and respond to changes in market demand is a keystone of the new economy. The General Motors plant in Janesville receives as many as 1,000 parts deliveries per hour within 20 minutes of an order in peak production periods, resulting in smaller, more frequent shipments. Although the emphasis here has been on manufacturing, the role of the truck fleet in Wisconsin is, of course, much broader than that. Figure 5 on the following page depicts the many roles played by trucks in the state.

The growth in foreign trade has also had a sharp impact on the state economy and transportation system. Exports of state products have grown by 130 percent since 1988 and now in 1996 accounted for nearly 225,000 jobs in Wisconsin. Canada is the major destination of state exports, accounting for \$2 billion of the state's \$7 billion in exports, emphasizing the need for a quality state highway system. More than half of exports to Canada are shipped by truck via interstate routes. Wisconsin is one of the states with a positive balance of foreign trade.

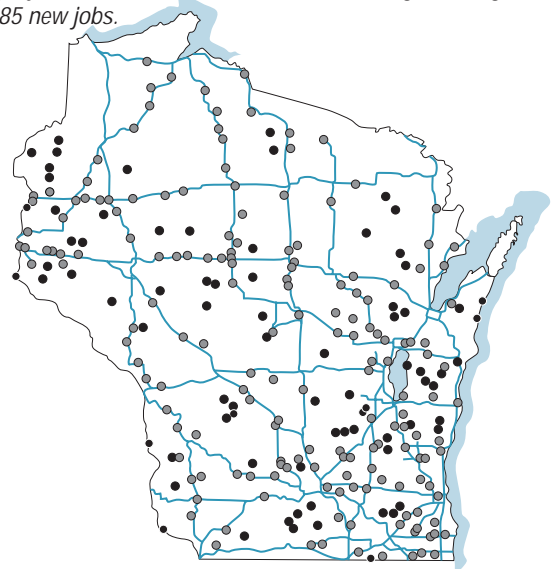


Transportation and the Economy: National and State Perspectives

Activities of Working Trucks in Wisconsin



New/Expanding Manufacturers, 1990-96, Located in Rural Wisconsin Communities (population < 5000)
647 projects were located in rural communities, generating 12,085 new jobs.



- Rural community with new/expanding firms within 5 miles of Corridors 2020 Highway. (467 projects were located in 175 communities that were within 5 miles of a C2020 Highway, generating more than 8,724 jobs - 22% of total jobs during 1990-96)
- Rural community with new/expanding firms more than 5 miles from Corridors 2020 Highway.
- Corridor 2020 Highway.

Table 2, drawn from the Commodity Flow Study conducted by the BTS of the U.S. DOT, demonstrates the role of highways in the state economy. Overall, state commodity flow activity accounted for 1.7 percent of the weight and 2.4 percent of the total value shipped in U.S. in 1993.

Tourism Travel Impacts Economy

Wisconsin has also assessed tourism within the interactions of the transportation system and the economy. Tourism represents a \$6.6 billion industry in Wisconsin supporting about 183,000 jobs about 7% of state employment.

Table 3. Product Output in Wisconsin Ranked by Value

Type of Product	Percent of Value	Mode of Transport	Percent of Value	Domestic Destinations	Percent of Value
Food & Similar	22.3	Truck	83.8	Wisconsin	35.1
Machinery, Computers	10.9	Parcel, Courier	8.9	Illinois	11.1
Paper, Pulp, etc.	8.3	Truck/Rail	.4	Michigan	5.8
Transport Equipment	8.0	Rail	2.5	California	3.8
Electrical Machinery	6.3	Air	1.1	Ohio	3.4
Other Commodities	44.3			Other States	35.6

The state estimates that there is a total of about 30 million visitor nights in the state each year, generating stays in hotels and camp sites, and visits to restaurants, shops and recreational and cultural activities. Results from the new American Travel Survey by BTS from 1995 provide details on these visits.

The 1996 impacts of this activity include more than \$639 million in state revenues and \$461 million in local government revenues. Changing trends in tourism toward shorter, more frequent trips and year round activity places emphasis in state planning on effective highway transportation.

The American Travel Survey data shown in Tables 5a and 5b demonstrates the importance of road travel to the tourism industry.

Table 4. Visitor Stays* in Wisconsin

Type of Account	Residents (Millions-Nights)	Out of State Visitors (Millions-Nights)
Hotels & Motels	22.3	3.3
Rented Cabin	.5	.5
Second Home, Cabin	1.1	.5
Camper, Tent, RV	.9	.3
Friend's Homes	4.3	4.9
Visitor Nights	9.6	9.9

* Excludes foreign visitors. Also excludes those who are passing through the state, which is a substantial number.

Source: American Travel Survey

Table 5a. Wisconsin Residents' Long Distance Travel (Trips over 100 Miles in Length - 1995)

Wisconsin Residents (Travel in Wisconsin) Travel Purpose	Person Trips (Millions)	Percent Private Vehicles on Highway	Vehicle Miles of Travel (Millions)
Business Trips	2.3	98%	642
Visit Friends/Relatives	4.0	100%	735
Personal Business	2.3	97%	489
Leisure, Vacations	5.3	97%*	1001
All	14.0	98%	2900

* Add chartered and scheduled intercity buses and it's about 100 percent.

Table 5b. Non-Residents' Long Distance Travel (Trips over 100 Miles in Length - 1995)

Non-Residents (Travel into Wisconsin) Travel Purpose	Person Trips (Millions)	Percent Private Vehicles on Highway	Vehicle Miles of Travel (Millions)
Business Trips	1.9	62%	666
Visit Friends/Relatives	4.9	90%	1485
Personal Business	1.5	84%	473
Leisure, Vacations	3.7	94%	1045
All	12.1	86%	3700*

* Not all of these miles occurred in Wisconsin. However, given that the median round-trip distance for visitors is only about 450 miles compared to about 280 miles for residents of the state, a large share of the miles must be within Wisconsin. Also excludes travel by foreign visitors.

Source: American Travel Survey

Maryland Examines the Impacts of Highway Spending

The Maryland DOT research at the Regional Economic Studies Institute at Towson University parallel the approaches identified in previously cited national research by FHWA to comprehensively assess the economic impacts of Maryland's State Highway System.

The Maryland approach considers both the immediate and direct impacts of state highway spending, and also looks at the longer-term impacts on user costs stemming from improvements in the transportation system.

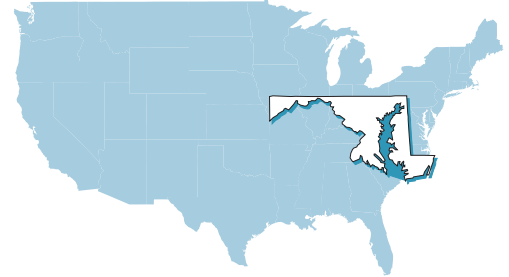
In regard to total employment and other effects of highway spending the study's preliminary work indicates that between 1991 and 1996 State Highway Administration expenditures, averaging \$933 million annually, supported about 23,000 jobs, approximately one percent of the State's employment. An input/output model of the regional economy traces each dollar spent by the highway administration through its employees and contractors including tracing their spending back through the system. Construction and government are the major sectors affected in the immediate effects of spending, accounting for more than 60 percent of the job impacts.

Table 6 provides detail on the industries supported by this spending.

Another set of immediate impacts are those reflected in the state tax revenues generated by the program. **The average annual spending rate of \$933 million generated over \$200 million in tax revenues**, including \$41 million in income taxes, \$96 million in sales taxes, and \$70 million in payroll taxes.

Table 6. Transport Supported Employment

Sector	1996
Agriculture	99
Mining	25
Construction	8855
Durables Manufacturing	393
Non-Durables Manufacturing	179
Transportation & Utilities	277
Retail & Wholesale Trade	4863
Finance, Insurance, Real Estate	43
Services	4177
Government	4517
Total	23426



The more significant impacts are those that are longer term in nature stemming from reduced production costs in manufacturing and other sectors. The Towson University researchers are employing techniques that philosophically are similar to that employed by Nadiri, cited in the FHWA national research discussed above. Applied at the national and state levels the research is producing similar results. It is very noteworthy that the two efforts are producing similar results.

Like the FHWA research the fundamental approach is to assess the reductions in industry costs due to improvements in the states highway system. An industry benefits from highways based on cost savings. These overall savings contribute to industry productivity and to the overall productivity of the Maryland economy. These estimates exclude benefits that slightly over spill over the state boundaries to other states.

Maryland research shows that between 1982 and 1996 highway investment caused substantial reductions in the private cost of production. Over the entire period highway investment reduced the wage and capital costs of industry in the state by 3 percent or about \$1 billion. Half of overall growth in the Maryland economy in this period was explained by increased investment in capital stock and expanded workforce; the remaining half was explained by productivity growth. Research shows that highway investment was responsible for ten percent of that productivity growth or four percent of overall growth.

The rates of return observed over the period are very similar to those observed in the national research. As in the FHWA research, these returns exceed average private sector returns for the period; as anticipated, were greatest in the early stages of the program; and, benefits

analysis was limited to that deriving from business sector freight movements, and excluded the benefits to passenger travel, to private households and to government.

As this work continues it will become more important to monitor the parallels in this state work and that of the national activity.

One of the new capabilities that this document exhibits is the synergy between new analytical methods and new data capabilities developed by the BTS under ISTEA. In almost every example cited, new insights have been opened up by important new statistical programs, most notably the Commodity Flow Survey (CFS). The following study provides a compelling example of the kinds of new capabilities that can be employed in analyses with new tools. In this case an analysis of the tonnage and value of goods crossing the Woodrow Wilson bridge.

truck shipments across the woodrow wilson bridge: a case study

Most benefit-cost analyses of major highway projects limit user benefits to time savings and safety. The value of the time saved is typically based on passenger travel and not business logistics, thus sharply under-representing the value of highways to the movement of freight. This shortcoming has been due to a lack of data rather than understanding of the economic factors involved. The value of the facility for freight requires local knowledge about the content and value of truck movements, including trucks passing through the locality. Such information was not available until the recent completion of the Commodity Flow Survey (CFS), described in an earlier section of this report.

The Woodrow Wilson Bridge, where Interstate 95 crosses the Potomac River just south of Washington, DC, is intuitively a facility of importance to trucking. The Wilson Bridge is one of the few links between the Maryland and Virginia sides of the Washington region, and is part of the main highway corridor along the Atlantic seaboard. The bridge also requires major investments to deal with physical deterioration and capacity issues.

The Maryland Department of Transportation (MDOT) recognized that trucking would be a key part of the benefits of investments in the Wilson Bridge, but that the intuitive importance of trucking would need to be quantified. As a consequence, MDOT asked BTS to estimate the value of shipments over the Wilson Bridge based on the CFS.*

BTS estimated that, in 1993, the Wilson Bridge supported truck shipments by manufacturers, mining establishments, and wholesalers of over \$58 billion and 30 million tons, or 1.3 percent of the total value and 0.5 percent of the total tons of truck shipments by all U.S. manufacturers, mining establishments, and wholesalers.

These shipments had a higher value-to-weight ratio as compared with shipments across the rest of the country. The value of the Wilson Bridge shipments averaged \$2,169 per ton or \$1.08 per pound, which was about the same as truck-rail intermodal shipments (\$2,045 per ton), but about three times higher than the average value of \$690 per ton of all truck shipments in the 1993 CFS.

Among the reasons for the high value are commodity mix and distances moved. The top four commodities crossing the bridge by value were food and kindred products, transportation equipment, chemicals and allied products, and electrical machinery and equipment. The top four commodities by weight were food and kindred products, petroleum and coal products, pulp paper and allied products, and chemicals and allied products. The average distance moved, measured in ton-miles per ton, was between 430 and 440 miles, and was about the same in each direction.

The CFS provides impressive statistics on the freight moving across the bridge, as well as insights on what markets and kinds of commodities would be affected by the bridge. However, these statistics alone do not provide a comprehensive picture.

First, the estimates miss a significant portion of truck movements. The CFS does not cover shipments by establishments classified as farms, forestry, fishing, construction, transportation, and most forms of retail, services, and government. Also, the estimates do not include the truck portions of parcel and postal delivery and intermodal shipments. These missing pieces are especially important in the Washington area.

Second, BTS estimated traffic going over the bridge by assigning CFS truck flows to most likely routes on major intercity highways. The routing models and the CFS data are not precise enough to distinguish long-haul through traffic among the three major river crossings in the Washington metropolitan area: the I-95 Wilson Bridge, the I-495 American Legion Bridge, and US 301 bridge. Oak Ridge National Laboratory calculated the value and weight of all CFS shipments crossing the Potomac on the three bridges, and then divided the value and tons among the bridges in proportion to the number of tractor-trailers on each bridge. This assumes that the origin-destination pattern and commodity mix of truck moves is not significantly different for each bridge. While the Oak Ridge method appeared to work well for the current study, significant refinements to the routing models would be necessary to apply this approach to facilities where a greater variety of alternate routes and local anomalies exist.

Third, analytical techniques are needed to place the value of shipments into a benefit-cost framework. The freight logistics literature demonstrates that higher valued commodities are typically more time sensitive, and that the costs of their production and distribution are more sensitive to timeliness and reliability. Those relationships need to be set into a benefit-cost accounting framework as have the value of personal time and the value of life.

* Truck Shipments Across the Woodrow Wilson Bridge; Value and Tonnage in 1993 (Bureau of Transportation Statistics, TranStat number 3, BTS/98-TS/3, April 1998)

In 1993, the Wilson Bridge supported truck shipments by manufacturers, mining establishments, and wholesalers of over \$58 billion and 30 million tons, or 1.3 percent of the total value and 0.5 percent of the total tons of truck shipments by all U.S. manufacturers, mining establishments, and wholesalers.

conclusions

This report has documented the important results of new studies just becoming available describing the economic linkages between transportation and the U.S. economy. These studies, conducted at the national and state levels, provide the strongest case to date regarding the power and importance of transportation in the nation's economy. While there has always been an implicit understanding on the part of the public of the economic benefits of transportation investment these studies make those benefits tangible and explicit.

Many of the studies are still underway and will expand their scope of analysis in future months. Undoubtedly this will expand the range of benefits identified as well. These studies provide several new ways of looking at the costs and benefits of transportation investments, all of which increase the scale of prospective benefits.

The overwhelming conclusion that must be drawn from these studies is that not only has transportation investment been a key engine of productivity growth and economic development in the past but that its role will increase in the future. The factors that make for a key role for transportation investment in enhancing productivity and economic development in the future are:

- the continued increases in the value of goods and services demanding greater flexibility and reliability in transport;
- the increasing dominance of just-in-time delivery systems in all facets of manufacturing and distribution;
- the increasing internationalization of U.S. economic activity;
- the increasing maturity of American markets demanding broad market sheds for products; and
- the rising role of tourism as an economic development driver.

As we seek to maintain and expand our economic role in the world transportation investment will be central to success in meeting the challenges of the future.

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