# U.S. FREIGHT INVESTMENT EFFICIENCY OF WATERWAYS AND HIGHWAYS

By

Erin Leigh Kersh

Thesis

Submitted to the Faculty of the

School of Engineering of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

in

Civil Engineering

May, 2012

Nashville, Tennessee

Approved:

Professor Mark Abkowitz

Professor James Dobbins

**ACKNOWLEDGMENT**

I would like to thank James Dobbins and Mark Abkowitz for their guidance in my graduate school career as well as their insight on this topic. In addition, I would like to thank Ron Coles for sharing his expertise on the waterways industry.

## TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF TABLES

## INTRODUCTION

One of the most important decisions within the domestic freight transportation industry is the amount of federal funding which is designated for the operation, maintenance, and construction of infrastructure. This decision impacts a variety of factors, including the condition of the infrastructure itself, as well as the travel time, safety, and security it provides.

While each freight mode falls under the auspices of the U.S. Department of Transportation (DOT), separate modal agencies have been established within the DOT, each with its own operating budget. While a matter of public record, it is difficult to discern how these funds are allocated and quantify the extent to which the corresponding expenditures are benefiting the freight transportation industry.

The research described herein was performed in an effort to improve our understanding of the extent to which federal transportation expenditures benefit the freight industry, deploying a methodology to quantify the value of corresponding investments in terms of the amount of freight moved on each mode. On this basis, the efficiency of each mode in terms of tons of freight moved per dollar of investment can be compared.

While it would be desirable to conduct a normalized comparative analysis of all freight modes, such an approach is not possible. Rail freight transport was not considered as most rail infrastructure is owned by private companies and the bulk of the Federal Rail Administration (FRA) budget is directed towards passenger rail investments, notably Amtrak. Additionally, freight moved by pipeline was excluded from the study since pipelines carry commodities that are not easily measurable in traditional units such as tons or ton-miles. Air freight was also omitted from consideration as it accounts for such a small portion of total freight moved. It would be desirable to compare freight investment by state, or even corridor. Unfortunately, comparisons among states are not feasible, owing to the varying levels of detail in which state budget categories are published. Given these considerations, this paper will focus on federal highway and waterway freight investment efficiencies.

## BACKGROUND

Investment in freight modes, if done effectively, can lead to greater regional specialization, facility consolidation and market expansion (1). Recently, the U.S. Government Accountability Office (GAO) released a report comparing the costs of various freight modes which are not passed onto consumers. The GAO found that when prices do not reflect the total cost, such as infrastructure investment, congestion and pollution, one mode may appear to have a cost advantage that misrepresents competition. An important aspect of the GAO study was how government taxes and regulations impact the costs that shippers pass on to their customers. Of particular interest is the breakdown of spending by level of government and by mode. While their analysis is expressed in terms of 2010 dollars, the data itself is based on average spending during the period of 2000-2006, as well as information contained in a 1997 cost study (2). As the industry and the economy have changed significantly since then, an update to this study is warranted.

Other projects, such as the one undertaken by Gorman, consider factors beyond what the federal government is investing in various freight modes, including congestion, fatalities and social costs (3). However, this work also relied what would now be considered outdated data, namely that contained in the Federal Highway Cost Allocation

Study of 1997 (4). According to the Federal Highway Administration's (FHWA) website, an updated study is underway which will rely on improved analysis techniques and more current data (5).

As an interim product, however, the FHWA provided a Conditions and Performance Report to Congress in 2008 (6). This report covered a variety of topics, including highway finance and freight transportation. While highlighting the various costs and expenditures which comprise the national transportation system, and forecasting future freight demand, there is no assessment of the relationship between these investments and the quantity of goods moved.

Since the scope of the aforementioned studies has not had a clear focus on the efficiency of federal freight investments, some states have taken it upon themselves to evaluate the effectiveness of freight-focused expenditures (7). The State of Louisiana compared its overall spending per capita on all modes of transportation to that of other states (see Figure 1). One limitation of this effort, however, is that the chosen measure of effectiveness was transportation spending on a per capita basis, which would not reflect the value of a significant project in a particular state which impacts its overall investment. For example, the State of Alaska operates a more extensive pipeline infrastructure in comparison to many other states. When one considers this, as well as a lower population density in the State, this skews Alaska to be on the higher end of the per capita spending scale.

The Louisiana study also identified several investment strategies aimed at improving freight transportation efficiency, including modernizing the New Orleans Rail Gateway and upgrading the tracks of six short-line railroads. The State is also seeking to decrease the size of its Department of Transportation and Development (DOTD) in order to better focus resources on aspects of the transportation system which would improve freight movement.

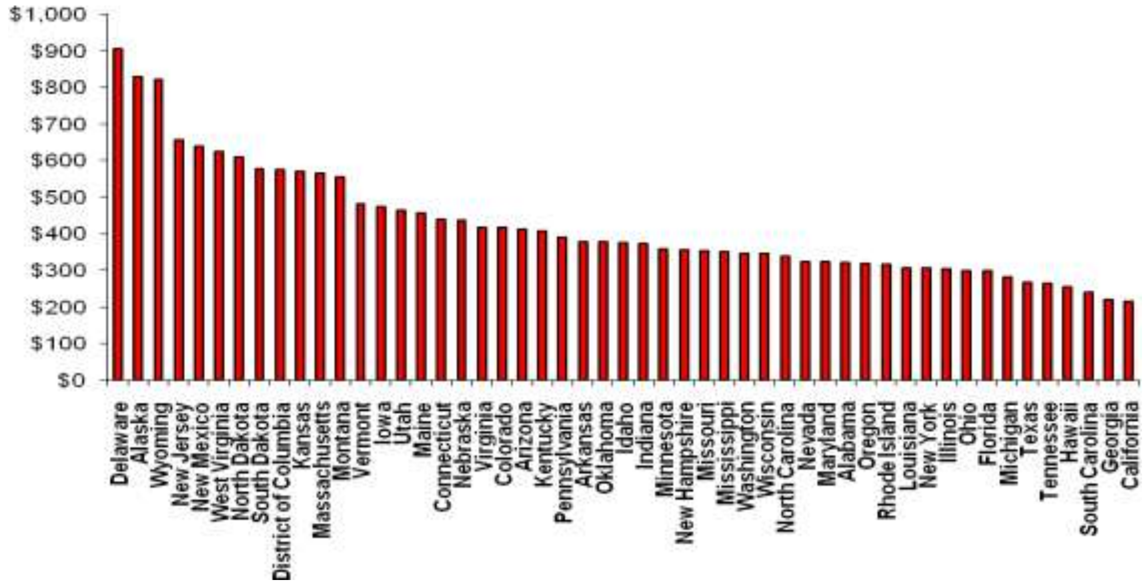


Figure 1: Per Capita Spending on Transportation by State

The State of Massachusetts has also examined how transportation budgets are allocated (8), published as part of its *Long Range Transportation Plan* in terms of the percentage of the budget allocated to each transportation agency. The motivation for their analysis was a belief that tracking spending by mode can help coordination and planning in solving the region's transportation challenges.

Other states have developed specific programs directed at increasing freight movements. For example, the California Goods Movement Action Plan seeks to alleviate congestion and speed up shipments to and from major ports within the State (9). The State of Oregon developed the Connect Oregon program, which invested $100 million into freight-centered projects (9). Approximately 75% of these funds were allocated to non-highway projects at ports, railroads, airports, and the facilities which connect to them. This initiative was considered such a success that the State is considering other similar projects.

From a review of the aforementioned literature, it appears that freight is not a primary consideration in determining federal budget allocations, although there has been little in the way of directed research into evaluating the equity or efficiency of these investments. The most definitive studies in this regard are considered outdated at this point. Therefore, there is a need to re-examine how federal funds are allocated to various freight modes and how well these investments are performing. The following sections discuss an attempt to perform this study.

## DATA COLLECTION

A significant challenge in conducting a study of this type is the availability and quality of relevant data. In this instance, the following information was considered vital in capturing an accurate profile of freight investment and outcomes: 1) highway tonnage, 2) waterway tonnage, 3) highway investment, and 4) waterway investment. Difficulty in obtaining this information is made more complicated by a desire to collect relevant data over a consistent time period. The discussion below describes potential data sources, including commentary on their strengths and limitations.

*Freight Analysis Framework (FAF):* This data source provides estimates of tonnage and value based on commodity and mode, both historically and projected through 2040 (10). Of particular interest are truck flows which are assigned to the highway network, providing a basis for generating tonnage moved by this mode. While the 2007 version of FAF is complete, only provisional FAF data is presently available for 2010. In order to determine the total number of miles traversed by truck traffic, the

Average Annual Daily Truck Traffic (AADTT07) from this data source was utilized. The total number was computed for each segment by finding the product of AADTT07 and the length of the segment in miles. The sum of the individual segments was then found and multiplied by 365 (days/year) to represent an annual mileage of approximately 235 billion truck-miles. It is important to note that the FAF primarily includes long-haul (50 miles or further apart) interstate and highway traffic and does not accurately estimate flows for areas smaller than Bureau of Economic Analysis zones. As such, this number is a conservative estimate of the total number of truck miles travelled in a year.

As the highway network data is expressed on a mileage (rather than ton-mile) basis, truck weight limits were taken into account to estimate ton-miles. This was accomplished by assuming that a truck traveling on the highway carrying no cargo will typically weigh 12,000 pounds, whereas the maximum allowable weight of a fully loaded truck is 80,000 pounds, unless the vehicle has received special permitting. Figure 2 demonstrates how the number of annual truck ton-miles is affected by the assumption of the average cargo utilization of the maximum allowable weight when excluding the empty weight of the vehicle.

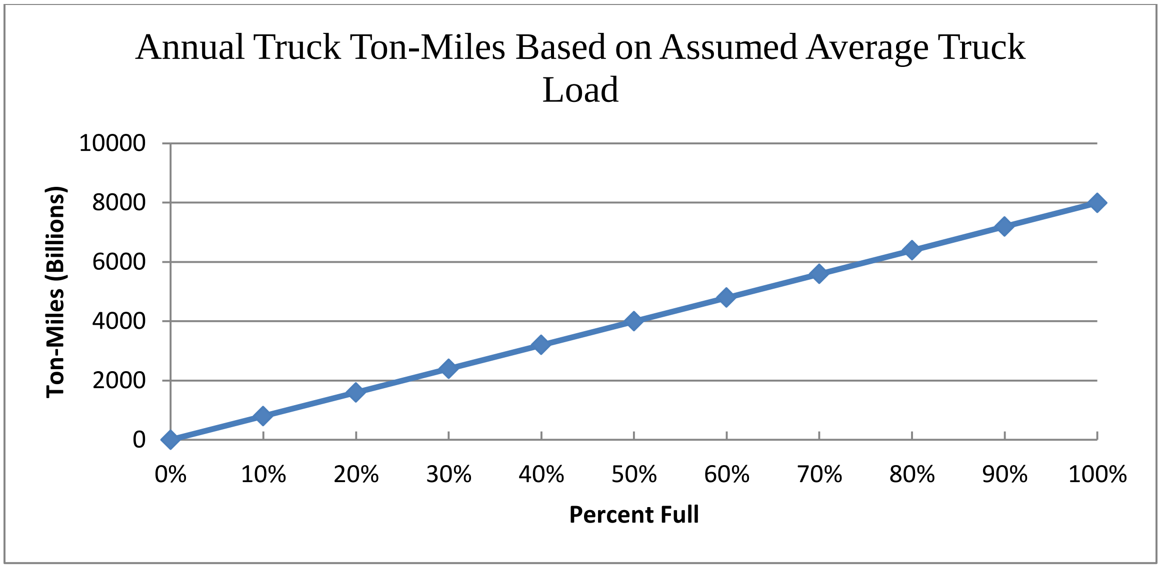


Figure 2: 2007 Annual Truck Ton-Miles Based on Assumed Average Truck Load

*U.S. Army Corps of Engineers Navigation Data Center:* This center collects, maintains and disseminates data describing U.S. waterborne commerce activity, including waterborne tonnage. Of particular interest to this study is the Fact Card produced each year which summarizes this information (11). The 2008 Fact card reported that, during calendar year 2007, 621.9 million short-tons of cargo were moved on the inland waterway system, representing a total of 271.6 billion trip ton-miles. The inland waterway system is defined as waterways including the Mississippi River and her tributaries, the Columbia and Snake Rivers, and the Gulf Intracoastal Waterways.

*Transportation and Housing and Urban Development, and Related Agencies Appropriations Bill, 2008:* This bill was put before the 110$^{th}$ Congress through the Committee on Appropriations (12). Although focused on providing budget estimates and justifications for the year 2008, narrative in the bill includes the enacted appropriations and justifications for 2007 for the various DOT modal agencies. Of particular interest is the FHWA appropriation, which is divided into expenditure categories and accompanied by more detailed discussions of each category, enabling the determination of whether a category is relevant to freight movements. Table 1 shows the distribution of obligations across the largest program categories.

Table 1: 2007 Federal Highway Administration Obligations (in millions of dollars)

| **Federal-aid Highway Category** | **2007 Enacted** |
|---|---|
| **Spending Subject to Obligation Limitation:** | |
| *National Highway System* | 6,770 |
| *Interstate Maintenance* | 4,541 |
| *Surface Transportation Program* | 8,288 |
| *Bridge Replacement and Rehabilitation* | 4,123 |
| *Congestion Mitigation and Air Quality Improvement* | 1,077 |
| *Highway Safety Improvement* | 321 |
| *Equity Bonus* | 2,524 |
| *Transportation Infrastructure Finance and Innovation* | 131 |
| *High Priority Projects* | 2,536 |
| *Projects of National and Regional Significance* | 433 |
| *Other Categories of Spending* | 8,870 |
| **Subtotal** | **39,614** |
| | |
| **Spending Exempt from Obligation Limitation:** | |
| *Emergency Relief* | 192 |
| *Equity Bonus* | 719 |
| *Priority Projects from Previous Authorization Bills* | 92 |
| *Direct Loan Re-estimate* | 7 |
| **Subtotal** | **1,010** |
| | |
| **Emergency Relief (from Supplemental Authority)** | **583** |
| **Reimbursable Program** | **120** |
| | |
| **Total Obligations** | **41,327** |

*U.S. Army Corps of Engineers Navigation Operations and Maintenance Expenditures:* The U.S. Army Corps budget separates spending into categories such as recreation, navigation and hydropower (13). Of these, arguably only navigation expenditures are relevant to goods movement on the waterways. Table 2 summarizes navigation expenditures for 2007, with the fuel taxed waterways line item considered to be the most pertinent aspect to consider in this study.

Table 2: U.S. Army Corps of Engineers Navigation O&M Expenditures

| | FY2007 |
|---|---|
| All Project Sub-Types | $1,202,499,476.92 |
| Deep Draft Harbors & Channels | $635,325,470.57 |
| Shallow Draft Harbors & Channels | $74,921,009.60 |
| Fuel Taxed Waterways | $492,252,996.75 |

**ANALYSIS METHODOLOGY**

The ultimate performance measures of interest in this study are ton-miles per federal dollar invested on highways and waterways, respectively. These figures were compiled by applying the following procedures.

Both the U.S. Army Corps Navigation Data Center ton-mileage statistics and the U.S. Army Corps of Engineers Navigation operations and maintenance expenditures were accepted at face value. This is because the Navigation Data Center data is already reported in the desired format and the Corps of Engineers expenditures have been appropriately disaggregated.

Recall that Figure 2 displayed the relationship between ton-miles traveled as a function of the average cargo weight of each truck shipment. At this juncture, it is necessary to establish an average cargo weight per shipment so that the proper amount of ton-miles can be derived. To do so, the FAF data was supplemented by information contained in the newest edition of Freight Facts and Figures from 2011 (14). This report provides the truck weight in average pounds (including the empty weight of the truck), along with the number of trucks and vehicle miles travelled in each weight range. While this data does not include trucks with an average weight of 10,000 lbs or less, since most trucks weigh six tons when empty, it was felt that this exclusion should not drastically alter the results. Table 3 displays the 2002 data from this source, as it is the most recently available data.

Table 3: 2002 Trucks and Truck Miles by Average Weight

| | **2002** | |
|---|---|---|
| **Average weight (lbs)** | **Number (thousands)** | **VMT (millions)** |
| **Total** | **5,415** | **145,624** |
| **Light-heavy** | **1,914** | **26,256** |
| 10,001 to 14,000 | 1,142 | 15,186 |
| 14,001 to 16,000 | 396 | 5,908 |
| 16,001 to 19,500 | 376 | 5,161 |
| **Medium-heavy** | **910** | **11,766** |
| 19,501 to 26,000 | 910 | 11,766 |
| **Heavy-heavy** | **2,591** | **107,602** |
| 26,001 to 33,000 | 437 | 5,845 |
| 33,001 to 40,000 | 229 | 3,770 |
| 40,001 to 50,000 | 318 | 6,698 |
| 50,001 to 60,000 | 327 | 8,950 |
| 60,001 to 80,000 | 1,179 | 77,489 |
| 80,001 to 100,000 | 69 | 2,950 |
| 100,001 to 130,000 | 26 | 1,571 |
| 130,001 or more | 6 | 329 |

In order to determine the average overall truck shipment weight, the average of each weight range was multiplied by the vehicle miles travelled for that range. The sum of these products was then divided by the total vehicle miles travelled to yield the average weight. As this data was not available for the selected year of 2007, the average weight was found using information on truck miles by average weight during the 1987-2002 period, reported in five year increments (14). Table 4 presents these results.

Table 4: Average Truck Weight from 1987-2002

| Year | Average Weight |
|---|---|
| 1987 | 55,084 |
| 1992 | 54,691 |
| 1997 | 55,552 |
| 2002 | 55,157 |

Since the average weight has not significantly changed over the fifteen year period for which data was available, it was concluded that the 2002 value represents a valid estimate of the average tonnage of U.S. freight trucks for the 2007 study year.

Unlike the U.S. Army Corps budget, information contained in the Transportation and Housing and Urban Development, and Related Agencies Appropriations Bill is not segmented into more detailed spending categories. Where the level of detail was considered sufficient, the information was used to derive freight transportation investment. As noted in the following descriptions of category spending, where assumptions had to be made, they were done in a way that likely overestimates highway spending that impact freight investment.

*National Highway System (NHS):* This system is defined as serving major population centers, intermodal transportation facilities, and other major destinations. NHS funding applies to roads in the federal interest, such as interstate highways, urban freeways and certain other arterials. As these roads are heavily utilized for freight transportation, this aspect of the budget was included in the investment calculation.

*Interstate Maintenance (IM):* This program focuses on projects which rehabilitate, restore, resurface, and reconstruct the Dwight D. Eisenhower National System of Interstate and Defense Highways. Due to the importance of the interstate system in serving freight movements, this budgetary category was also included in the investment calculation.

*Surface Transportation Program (STP):* Funds from this program may be used by states and localities for federal-aid highways, bridge projects on public roads, transit capital projects, and bus terminals and facilities. While not all aspects of this program are relevant to freight, such as bus terminals, without a further breakdown of these categories, a more accurate representation of relevant spending cannot be determined. While STP funds were included in this study as part of the investment of interest, it is recognized that by doing so, the estimate of total expenditures will be overrepresented, resulting in a performance measure that will reflect a slightly lower investment efficiency.

*Bridge Replacement and Rehabilitation:* This program allows states to improve any bridge, including those on rural minor collectors and local roads, through replacement, rehabilitation, and maintenance. Effective bridge maintenance is important for freight movements in order to ensure proper weight limits and clearances. Consequently, these program expenditures were considered a relevant investment category.

*Congestion Mitigation and Air Quality Improvement Program (CMAQ):* CMAQ funds are used to support initiatives which help maintain air quality standards for ozone, carbon monoxide, and other particulate matter. While truck use does contribute to air quality problems, this category is not heavily focused on the U.S. highway infrastructure; therefore this budget aspect was not included as a freight investment.

*Highway Safety Improvement Program (HSIP):* The objective of this program is to reduce highway fatalities and injuries on public roads. As reducing roadway hazards and traffic incidents leads to more efficient freight movement, this portion of the FHWA budget was included as a freight investment.

*Equity Bonus:* This category provides additional state funding to ensure each state's total funding meets certain equity considerations. As each state is guaranteed a minimum rate of return on contributions to the Highway Trust Fund, this category was included as a freight investment.

*Emergency Relief (ER):* ER funds are designated for repair or to reconstruct federal-aid highways and bridges after severe damage from natural disasters or catastrophic failures. As getting highways back up and running after a significant event is extremely important to the movement of goods, these program funds were included in freight investment calculation.

*Transportation Infrastructure Finance and Innovation Act (TIFIA):* TIFIA provides funds to develop major infrastructure facilities through non-federal and private participation. It is designed to provide loans, loan guarantees, and standby credit lines to supplement project revenues. Given that this program is designed to stimulate highway improvements, it was also included in the freight investment calculation.

*High Priority Projects and Projects of National and Regional Significance:* These funds are provided for projects identified in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). As it was assumed that such projects would correlate with improvements in freight travel time, safety or security improvements, these funds were included as a freight investment.

## ANALYSIS RESULTS

Utilizing the data as previously described, the performance measures of interest, ton-miles per freight dollar spent on highway and waterway modes, respectively, were derived. Table 5 displays a summary of these results.

Table 5: Highway and Waterway Freight Investment Efficiency

| | |
|---|---|
| Highway Freight Investment | $40,250,000,000 |
| Highway Ton-Miles (billions) | 5,069.81 |
| Waterway Freight Investment | $492,252,997 |
| Waterway Ton-Miles (billions) | 271.6 |

| | |
|---|---|
| Highway Ton-Miles/$ | 125.96 |
| Waterway Ton-Miles/$ | 551.75 |

While the results displayed in Table 5 indicate that federal freight investment in waterway movement is far more efficient than for highway transport, it is important to recognize that the highway measure is based on an assumed truck weight per shipment. Even though a strong argument was made for the average truck weight used in this study, larger cargo loads per shipment would cause improvements in the efficiency measure. Table 6 shows how the average truck weight can impact the ton-miles per dollar spent on the highway system. Note that even under fully loaded conditions, however, the waterway investment is still more efficient by roughly a factor of 3.

Table 6: Change in Highway Investment Based on Truck Weight

| Percent Full (by weight) | Ton-Miles (billions) | Ton-Miles Per Dollar |
|---|---|---|
| 0% | 0.0 | 0.0 |
| 10% | 798.8 | 19.8 |
| 20% | 1597.7 | 39.7 |
| 30% | 2396.5 | 59.5 |
| 40% | 3195.4 | 79.4 |
| 50% | 3994.2 | 99.2 |
| 60% | 4793.1 | 119.1 |
| 70% | 5591.9 | 138.9 |
| 80% | 6390.7 | 158.8 |
| 90% | 7189.6 | 178.6 |
| 100% | 7988.4 | 198.5 |

**DISCUSSION**

The results of this study indicate that waterway freight investment is significantly more efficient than highway freight investment. However, certain assumptions had to be made that, with better information, might impact the analysis results. This is particularly the case with regard to: 1) other uses of the infrastructure beyond freight transport, 2) how breakdowns of the FHWA budget were interpreted, and 3) recognition of the difference in the size of the highway and waterway freight networks.

While investments are made on both highways and waterways for the benefit of freight movements, these investments also serve other uses and have utility other than freight transport. The benefit of the highway system to motorists should not be underestimated. Highways enable Americans to travel to/from work, go on vacations, and inhabit different parts of the country. A study performed in Missouri estimates that the state’s Interstate Highway System saves the average resident almost $2,500 annually through such aspects as safety benefits and saved time as well as reduced housing and transportation costs (15). Additionally, highways support military mobilizations and evacuations in the face of approaching hurricanes. Similarly, in a report generated for the Inland Waterways Users Board (IWUB), alternative benefits stemming from investments in the waterways are discussed. These benefits include recreation, flood damage control, mosquito control, and increased property values (16).

Each mode also has its collateral costs. The 2013 FHWA budget estimate states that the economic impact of highway crashes is at least $230 billion per year (17). As such, increased spending in highway safety would help to reduce costs on the back end. Similarly, a twenty-three year study of inland navigable waterway oil spills found that the annual cost of such spills is $2.7 billion (in 2002 dollars) (18). However, while these various other factors and benefits of transportation spending are important aspects to consider, quantifying all of them would be nearly impossible to do on a national level.

The inability to more accurately identify aspects of the FHWA budget that should be apportioned to freight movements is also problematic. While the Transportation and Housing and Urban Development, and Related Agencies Appropriations Bill was not sufficiently disaggregated into spending categories, the budget estimates submitted for the use of the Committee of Appropriations do segment each major spending category based on strategic objectives and performance goals. For instance, performance goals such as environmental stewardship, security, preparedness and response, and organizational excellence each contribute to the overall spending of the Surface Transportation Program (19). While promoting freight movements is mentioned in this report, once again, freight specific spending is not designated or distinguished. A more pertinent break down of spending would be to designate who the end user of the investment is in order to better determine how efficiently money is being spent on the freight industry.

Lastly, one reason why it may be difficult for highway freight investment efficiency to compare favorably with that of waterway is the sheer size of the highway network. According to Freights Facts and Figures, 2011, there are only 11,000 miles of waterway infrastructure versus over four million miles of public roads (14). This provides truckers with more route choices than waterborne vehicles and affords trucks the "last mile" benefit (being able to deliver to any place in the U.S.). The construction, operation, and maintenance of such a large network makes maintenance of a consistent level of service a difficult task. For instance, the Freight Transportation Improvement and Economy study found that second-order benefits of transportation investment allow firms to consolidate production and warehousing facilities. In doing so, trip length actually increases as facilities are moved further away from the product's final destination (20). This increase in trip length could then serve to have trucks on the roadways for longer periods of time, increasing congestion, emissions, and traffic incidents, thereby negating the very benefits of the original investment.

**CONCLUSIONS**

This study focused on two objectives: 1) determining relevant federal investments on highway and waterway freight modes and 2) calculating investment efficiency for each of these modes. This was accomplished using data collected from multiple transportation agencies and federal sources based on the availability of the most recent information. This offers the potential for determining appropriate policy decisions and the importance of making proper future investments.

While it was determined that federal freight investment in waterways is more efficient than for highways, significantly more factors are at play than just the front-end investments that were the basis for the analysis methodology that was used. However, compiling an exhaustive list of the benefits derived and costs incurred from a national transportation system would be nearly impossible. The differences in operating characteristics of each mode, such as geographic availability, speed and reliability, and safety should also be considered.

This effort demonstrated the challenge of collecting and analyzing data across multiple sources which did not necessarily offer the ability of a direct comparison. Particularly in the highway industry, there is a need for a better understanding of the end users who benefit from these transportation investments in order to make a more appropriate comparison. For future studies, a more suitable scale for determining investment spending strategy and efficiency would be on a state level. This can also help to determine whether or not individual states achieve similar investment efficiencies as observed at the federal level.

## REFERENCES


1. Lakshmanan, T., & Anderson, W. P. (January 2002). *Transportation Infrastructure, Freight Services Sector and Economic Growth: A Synopsis.*
2. Office, U. G. (January 2011). *A Comparison of the Costs of Road, Rail, and Waterways Freight Shipments That Are Not Passed on to Consumers.*
3. Gorman, M. F. (June 2007). *Evaluating the Public Investment Mix in US Freight Transportation Infrastructure.*
4. U.S. Department of Transportation Federal Highway Administration (August 1997). *1997 Federal Highway Cost Allocation Study.*
5. "Highway Cost Allocation Study - Office of Transportation Policy Studies." Federal Highway Administration, 6 Oct. 2011. Web. 19 Mar. 2012. <http://www.fhwa.dot.gov/policy/otps/costallocation.htm>.
6. U.S. Department of Transportation Federal Highway Administration (2008). *2008 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance.*
7. Louisiana Department of Transportation and Development (August 17, 2009). *Report to the Commission on Streamlining Government.*
8. The Boston Indicators Project (2008). *Transportation Funding by Mode.*
9. American Association of State Highway and Transportation Officials (May 2007). *America's Freight Challenge.*
10. "Freight Analysis Framework." *Freight Management and Operations*. Federal Highway Administration, 27 Feb. 2012. Web. 19 Mar. 2012. <http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/>.

11. "The U.S. Waterway System - Transportation Facts." *Navigation Data Center*. U.S. Army Corps of Engineers, Dec. 2008
12. United States. Cong. Senate. Appropriations. Transportation and Housing and Urban Development, and Related Agencies Appropriations Bills, 2008. 110 Cong., 1st sess. S. 1789.
13. “Corps of Engineers Operations & Maintenance Business Information Link Database.” U.S. Army Corps of Engineers.
14. "Freight Facts and Figures 2011." *Office of Freight Management and Operations*. Federal Highway Administration, Nov. 2011.
15. "The Interstate Highway System in Missouri: Saving Lives, Time, and Money." *Missouri Department of Transportation*. TRIP, June 2006. Web. <http://www.modot.org/i44planningforprogress/documents/TRIP.pdf>.
16. Bray, Larry G., C. Michael Murphree, and Chrisman A. Dager. "Toward A Full Accounting of the Beneficiaries of Navigable Waterways." Jan. 2011.
17. "Budget Estimates Fiscal Year 2013." Federal Highway Administration. Web. 20 Mar. 2012. <http://www.dot.gov/budget/2013/fhwa_fy_2013_budget_estimate .pdf>.
18. Etkin, Dagmar Schmidt. "Modeling Oil Spill Response and Damage Costs." *Epa.gov*. 2004. Web. <http://www.epa.gov/osweroe1/docs/oil/fss/fss04/ etkin2_04.pdf>.
19. *Budget Estimates Fiscal Year 2008*. Federal Highway Administration. Web. 20 Mar. 2012. <http://www.fhwa.dot.gov/budget/fy2008/index.htm>.

20. "Freight Transportation Improvements and the Economy." Federal Highway Administration, June 2004.