NCHRP 08-36, Task 103
Mining Recovery Act Data for Opportunities to Improve the State of Practice for Overall Economic Impact Analysis of Transportation Investments

Requested by:

American Association of State Highway and Transportation Officials (AASHTO)
Standing Committee on Planning

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1.0 Introduction

1.1 Study Overview

Practitioners and stakeholders often cite the creation of short-term jobs as an important justification for new transportation investments. However, credible information about the short-term economic impacts is frequently missing from important transportation decision-making processes (such as long-range transportation plans and programming of projects, to mention a few) due to the lack of access to reliable economic data.

Under the Federal American Recovery and Reinvestment Act (ARRA), states, MPOs, transit agencies, and other agencies are collecting and reporting a wealth of data on the short-term jobs impacts of ARRA-funded transportation projects. This creates a unique opportunity to evaluate the strengths and weaknesses of jobs data in describing the stimulative economic impacts of transportation investments. This research assesses the process for reporting short-term job data, reviews previous reports and findings, discusses data limitations, and conducts an analysis of the short-term direct job impact of ARRA spending at the national level and for four individual states. It should be noted that the focus of this research is on direct short-term jobs, thus it does not include an evaluation of indirect or induced jobs. Furthermore, the research says nothing about the long-term impacts of transportation investment on economic competitiveness and performance which are likely to be much more significant than the short-term impacts.

Direct, Indirect, and Induced Impacts

Direct impacts measure the actual dollar amount spent on preliminary engineering and construction. Indirect and induced impacts measure the secondary benefits of transportation spending as regional businesses support the construction activities by providing goods and services to the construction companies. The induced effects occur when people hired by the construction firms spend their income at regional businesses (such as retail or doctor's offices), thus injecting more money into the regional economy.

This research consists of three primary objectives:

- Review previous analysis and reports related to the impact of the Recovery Act transportation spending;
- Develop a conceptual framework for improving economic analysis of the short-term job impact of transportation investments; and

- Compile a database and conduct an analysis of the ARRA data by project type at the national and state levels.

1.2 Organization of the Report

- Following the introductory section, the remainder of the report is organized as follows:

- Section 2 provides an overview of the recovery Act reporting process and a review of previous Recovery Act impact assessments;

- Section 3 describes the process for compiling the database and provides summary statistics for the resulting dataset;

- Section 4 discusses the analysis using the national database, including the development and testing of a conceptual model for estimating job impact of transportation investments;

- Section 5 presents the findings from four case studies of state-specific data; and

- Section 6 provides a brief conclusion.

1.3 Key Findings

- As of May 2011, the Federal Highway Administration (FHWA) has obligated $26.3 billion in funds for almost 13,000 highway projects and reimbursed recipients $19.4 billion. Similarly, the Federal Transit Administration (FTA) has obligated $8.78 billion of Recovery Act funds for about 1,070 grants, and reimbursed $5.4 billion.[1]

- The Recovery Act has significant accountability and transparency provisions, including requirements directing grant recipients and the U.S. DOT to collect, compile, and publish data on the purpose, disposition, and impact of funds. These requirements placed significant burden on state DOTs and the lack of training and inconsistent instructions further exacerbated the burden.

- Estimates of direct job creation and analyses of total employment impacts (inclusive of multiplier effects) related to transportation Recovery Act expenditures vary considerable among the sources consulted for this review, ranging from about 10,300 to over 42,000 jobs per billion dollars in expenditures. The current research provides

[1] Includes FHWA transfers.

the first comprehensive review of the body of ARRA-related analyses conducted to date.

- Lack of data availability, consistency and accuracy all give rise to shortcomings in any attempts to analyze the publicly available data, potentially leading to the large variations in findings.
- The national average was 10.55 direct jobs/$ million, with the ratio differing significantly by project type. For instance, transportation enhancement projects were the most labor intensive and generated the most jobs per $ million spent (17.03). At the other end of the range, pavement improvement (9.01) and safety/traffic management projects (10.32) generated the least jobs per $ million spent.
- Up to 90 percent of the variation in direct job generation impacts can be explained by the combination of project type and other explanatory factors such as wage rates, topography, and congestion levels. The analysis shows that on average, low-wage areas and more congested areas tend to have higher job/expenditure ratios.
- For the four case study states, jobs per $ million of expenditure ranged from 9.0 to 16.8. This figure varied widely by project type with Transportation Enhancements and New Construction categories producing the most direct jobs with figures consistently close to 20.
- Despite the variation and shortcomings of the ARRA data, this research suggests that investments in transportation infrastructure have a positive and significant impact on short-term job creation and retention.

2.0 Review of Recovery Act Impact Analyses

This section summarizes transportation-related transparency and reporting aspects of the American Recovery and Reinvestment Act of 2009 and presents a synthesis of Federal, state, and independent economic and job creation analyses.

The Recovery Act includes provisions requiring detailed reporting of supported transportation projects by purpose, expenditures, and jobs impacts. Data collected and compiled to meet these requirements provides an opportunity for systematic analysis of the economic and employment impacts of transportation investment. The availability of these new data is countered by concerns over data integrity and accuracy as well as challenges in parsing reported jobs impacts and investment effects.

Several Federal agencies and departments have conducted autonomous analyses of the direct and indirect economic impacts of infrastructure investments under the Recovery Act. These reviews largely focus on macroeconomic impacts, utilize existing methodology for broad multiplier estimations, and do not provide detailed analysis by project type, geography, or expenditure levels. The majority of state departments of transportation have fulfilled minimum reporting requirements but they have not completed additional impact analysis. Those states which have analyzed the employment effects of transportation projects generally utilize state-specific input/output models to produce total job creation estimates. For the review completed for this memorandum, only the State of Washington appears to have disaggregated the direct, indirect, and induced employment impact of investment by project type, length, and expenditure level. The State of Texas has commissioned a study to examine these additional impacts. Of the numerous independent analyses completed, many are provided by advocacy organizations, and tend to be overly simplistic. The majority of these analyses utilize jobs data reported by grant recipients and simply sum reported jobs or use basic multipliers to estimate employment effects.

This review did not reveal any publications presenting pre/post comparisons of estimated jobs to actual jobs or any in-depth analyses to quantify the long-term economic benefits of transportation investment, including conditions and performance.

2.1 Summary of American Recovery and Reinvestment Act Transportation Provisions

The American Recovery and Reinvestment Act of 2009 (ARRA or Recovery Act) directed supplemental appropriations for the purposes of job preservation and creation, infrastructure investment, energy efficiency and science, assistance to the unemployed, and state and local fiscal stabilization. Of the total $787 billion investment, approximately $48.1 billion was directed primarily for transportation infrastructure, including:

- $27.5 billion for highway and bridge construction projects;
- $9.3 billion for high-speed rail and Intercity Passenger Rail grants and Amtrak capital and safety grants;
- $8.4 billion for urban and rural transit formula programs, fixed guideway modernization, and New Starts grants;
- $1.5 billion for National Surface Transportation Discretionary Grants, including highway, bridge, public transit, intercity passenger rail, freight rail, and port infrastructure grants;
- $1.3 billion in grants for Airport Improvement Program and aviation facilities and equipment; and
- $100 million in grants for improvements to domestic shipyards.

ARRA Program Terminology

Appropriations: A legal provision authorizing the spending of funds for a specific purpose.

Allocations: An administrative distribution of funds for programs that do not have statutory distribution formulas.

Obligated: Funds that have been set aside by the Federal government for a specific purpose, but not necessarily expended or outlayed.

Expended (Expenditures): Funds that have already being spent in a project by the grantee.

Reimbursed: Funds that have already being reimbursed by the Federal government to the grantee.

Outlays: Payments made by the government.

As of May 2011, the Federal Highway Administration (FHWA) has obligated $26.3 billion in funds for almost 13,000 highway projects and reimbursed recipients $19.4 billion. Similarly, the Federal Transit Administration (FTA) has obligated $8.78 billion of Recovery Act funds for about 1,070 grants, and reimbursed $5.4 billion.[2]

Table 2.1, produced by the U.S. Government Accountability Office in March 2011, reflects the actual rate of transportation-related spending (reimbursements to states not awards) by the U.S. DOT agencies. As of the first quarter of 2011, over 95 percent of the funds have been obligated and nearly 60 percent have been expended.

Table 2.1. Recovery Act Transportation Projects, Obligations, and Expenditures, as of March 31, 2011

Table 1: Recovery Act Transportation Projects, Obligations, and Expenditures, as of March 31, 2011

Dollars (in millions)

	Number of projects		Obligations		Expenditures	
Program	**Awarded**	**Completed**	**Amount**	**Percent obligated**	**Amount**	**Percent expended**
Federal Highway Administration						
Highway infrastructure investment[a]	12,931	7,072	$26,342	99.9%	$18,661	70.8%
Federal Railroad Administration						
High speed intercity passenger rail	57	0	5,354	67.1	94	1.8
Capital grants to Amtrak	154	89	1,291	100.0	1,180	91.4
Federal Transit Administration						
Transit capital assistance program (TCAP)	1,010	146	7,829	100.0	4,265	58.5
Fixed guideway infrastructure	51	23	743	100.0	441	59.4
Capital investment grants	11	11	743	100.0	743	100.0
Office of the Secretary of Transportation						
TIGER grants	51	0	1,489	99.3	77	5.2
Federal Aviation Administration						
Grants-in-aid for airports	372	364	1,088	99.1	1,043	95.9
FAA facilities and equipment	399	378	198	99.0	130	65.7
Maritime Administration						
Assistance to small shipyards	70	30	98	100.0	76	77.6
Total	**15,106**	**8,113**	**$45,175**	**95.5%**	**$26,710**	**59.1%**

Source: U.S. Government Accountability Office, "Recovery Act: Use of Transportation Funds, Outcomes, and Lessons Learned." Statement of Phillip R. Herr, Director, Physical Infrastructure. GAO-11-610T May 4, 2011.

[2] Includes FHWA transfers.

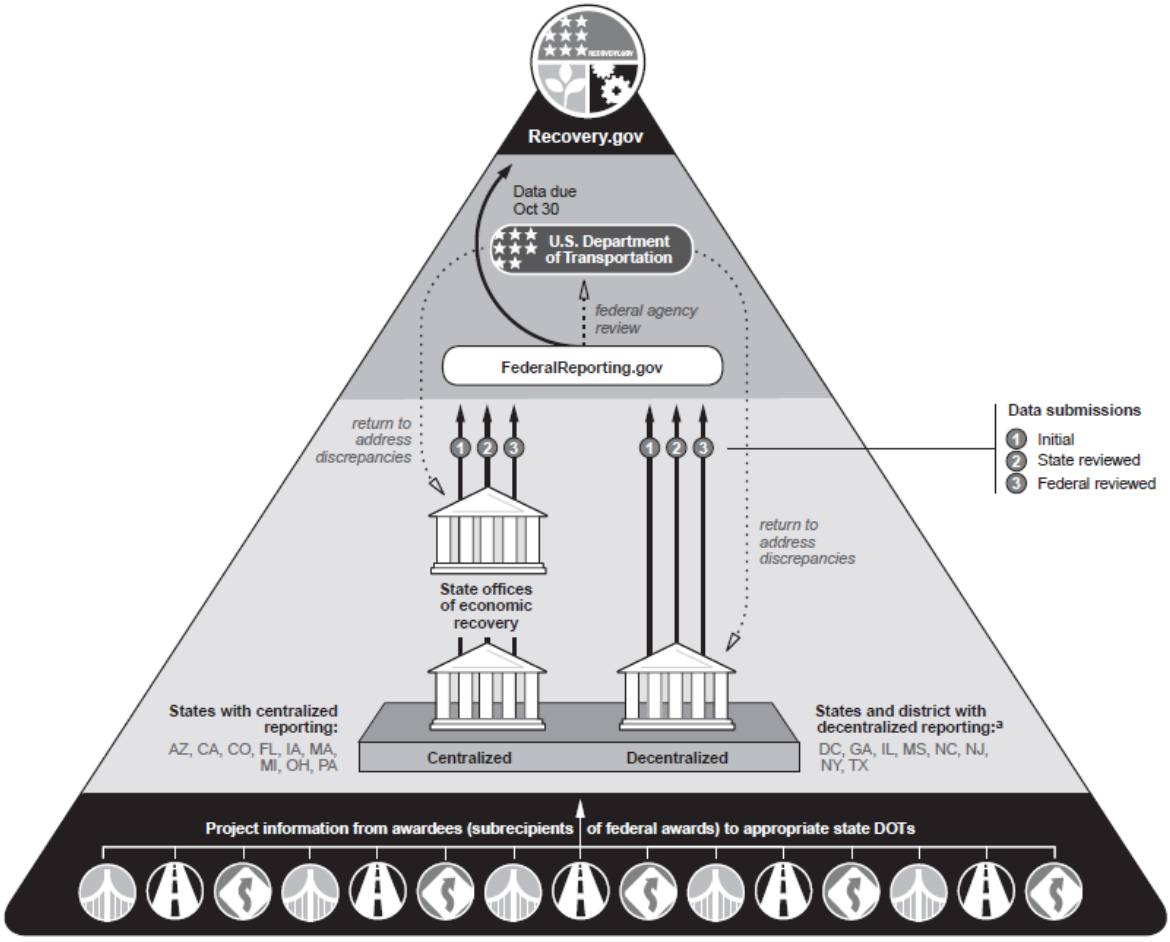
2.2 Reporting Requirements and Process

The Recovery Act included significant accountability and transparency provisions, including requirements directing grant recipients and the U.S. DOT to collect, compile, and publish data on the purpose, disposition, and impact of funds. Two sections of the Act contained specific requirements for reporting, and a third request for reporting was made by the House Committee on Transportation and Infrastructure. The latter was discontinued in January 2011, as the 112th Congress entered in session. Each requirement and process is summarized as follows:

Section 1512 Reports require grant recipients to submit quarterly reports containing detailed information on projects and activities funded to the Office of Management and Budget (OMB). Section 1512 reports generally provide information such as project type, purpose, and status; the number of jobs created or retained in that quarter; and the amount of ARRA funds received and spent. State DOTs are considered the primary grant recipients and are required to report only direct, on-project jobs directly attributable to the ARRA-funded project. Jobs numbers include prime contractors, subcontractors, second tier contractors, and state labor. DOTs are encouraged to use the FHWA's Recovery Act Database System (RADS) in the preparation of Section 1512 reports. The FHWA's Office of Highway Policy Information ARRA Team (HPPI-AT) then audits incoming data and request clarifications.

The general process for Section 1512 reporting by the U.S. DOT is shown in Figure 2.1. OMB is the responsible agency for reporting and has issued guidelines, clarifications, and amendments repeatedly since the inception of ARRA that have affected the reporting process and the jobs numbers reported.

Figure 2.1 FHWA's Recipient Reporting Data Structure (Examples of States)



Source: United States Government Accountability Office, "Recipient Reported Jobs Data Provide Some Insight into Use of Recovery Act Funding, but Data Quality and Reporting Issues Need Attention." Report #10-223. November 2009. Available on-line at: http://www.gao.gov/new.items/d10223.pdf.

Section 1201(c) Reports require additional reporting for funds administered by the U.S. DOT, including periodic reports to Congress with detailed project expenditure and jobs information. Section 1201(c) reports generally provide data on project status and details; expenditure of state matching and ARRA funds; contract amounts appropriated, allocated, obligated, and outlayed; and direct and indirect jobs.

Expressly required is for U.S. DOT to report "the number of direct, on-project jobs created or sustained by the Federal funds provided for projects under the appropriation and, to the extent possible, the estimated indirect jobs created or sustained in the associated supplying industries, including the number of job-years created and the total increase in

employment."[3] To establish job numbers for Section 1201(c), FHWA's HPPI-AT directs each operating administration (Federal Highway Administration, Federal Aviation Administration, Federal Railroad Administration, Federal Transit Administration, and Maritime Administration) to verify the accuracy of incoming data and produce summary statistics. FHWA estimates direct, indirect, and total employment based on expenditure multipliers as used by the Council of Economic Advisors (CEA). CEA estimates that total employment is increased by one job-year for every $92,000 in direct government spending. FHWA's Periodic Reports to Congress include estimated job-years of total employment created through ARRA-funded projects, in aggregate and not broken down by type of project or administering agency.

T&I Recovery Act Reports ask that states comply with information requests from the Committee on Transportation and Infrastructure of the U.S. House of Representatives for projects under the Committee's oversight. State DOTs and MPOs are asked to provide information on the use of ARRA funds within the Highway Infrastructure Investment program and Transit Capital Assistance program. These reports are compilations of information included in 1512 and 1201(c) data, including direct, on-project jobs numbers, total job hours, and payroll of total jobs hours, but are summarized by state and program category. Monthly reports are available by state for each formula program from March 2009 to August 2010. The data available through this source has been used in a number of independent analyses and reviews of Recovery Act spending and job creation.

Table 2.2 summarizes some characteristics and data requirements under Sections 1512 and 1201(c) of the Recovery Act. U.S. DOT agencies have their own reporting systems for Section 1201(c) data. For example, FTA's ARRA fund recipients should report Section 1201(c) data within FTA's Grant Management System (TEAM), whereas FHWA's ARRA fund recipient report the information into the Recovery Act Data System (RADS). The data requirements in the RADS system meet the criteria for both Sections 1512 and 1201.

[3] 111th Congress, American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Section 1201(c) applies only to the U.S. Department of Transportation.

Table 2.2 Summary of Reporting Requirement under Sections 1512 and 1201(c) of the Recovery Act

Data	Section 1512	Section 1201(c)
Frequency of reporting	Quarterly (until all ARRA funds are spent; due on the 10th day of each calendar quarter)	Five reporting periods: 2009 – May 18 and August 16 Annually for 2010, 2011 and 2012 – February 17
Lead Agency	Office of Management and Budget (OMB)	U.S. Department of Transportation (U.S. DOT)
Required/mandatory data		
ARRA Funding	Appropriated Allocated Obligated Outlayed	Award amount Total ARRA funds received/invoiced
Project Status/Stages of Implementation	Out to bid Under contract Underway Completed	Not started Less than 50% complete Completed 50% or more Fully completed
Jobs	Direct jobs	Direct jobs, expressed as quarterly FTEs
Description of jobs	N/A	Mandatory, up to 4,000 characters (no standard categories)
State Funding	Planned Spent	N/A

2.3 Known Issues with Data Reporting

The Recovery Accountability and Transparency Board was established to ensure transparency in the use of Recovery Act funds. The Board conducted an internal audit of reported Section 1512 data in 2009. This evaluation found inconsistencies in methodology used to define jobs and wide variations in total employment reporting, including over and

underestimates.[4] In November of 2009, the United States Government Accountability Office (GAO) developed a comprehensive review of data procedures and reporting techniques, including interviews with Departments of Transportation and Transit Agencies in several states. The GAO report found significant inconsistencies in the estimation of full-time equivalent positions and project period of performance, but recognizes FHWA's effort and systems have substantially improved transportation-related reporting.[5]

In response to concerns over data accuracy, the Office of Management and Budget (OMB) has issued a series of memorandum providing guidance to grantees for reporting jobs numbers. The evolution of reporting methodology and process has corrected known issues and improved accuracy, but also has resulted in early job numbers which are incomparable to later numbers. For example, OMB guidance clarified that, beginning with the second reporting period ending on December 31, 2009, the number of jobs should no longer be reported cumulatively but should be reported on a quarterly basis. In addition, a new methodology was suggested which ended the practice of estimating the number of jobs "created or retained" and introduced a standard methodology for Federal agencies to review the quality of reported data.[6] As a result, consistent data available for analysis is limited to the period beginning January 1, 2010.

A May 2010 GAO review of Recovery Act implementation addressed the topic of assessing the full economic benefits of transportation investments. The report suggests FHWA expressed interest in exploring methods to link Recovery Act expenditures to improvements in road and bridge conditions and the finance and operations of transit agencies. But it was noted that "DOT has not traditionally evaluated the economic benefits of their projects and therefore, according to officials, does not have sufficient data and measures to make defensible claims about economic benefits derived from transportation investment at the DOT level."[7]

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[4] Recovery Accountability and Transparency Board, "Recovery Act Data Quality: Recipient Efforts to Report Reliable and Transparent Information." September 2010. Available on-line at: http://www.recovery.gov/About/board/Documents/Data%20Quality%20Report%20-%20ED%202010.pdf.

[5] United States Government Accountability Office, "Recipient Reported Jobs Data Provide Some Insight into Use of Recovery Act Funding, but Data Quality and Reporting Issues Need Attention." Report #10-223. November 2009. Available on-line at: http://www.gao.gov/new.items/d10223.pdf.

[6] OMB Memorandum M-10-08, Updated Guidance on the American Recovery and Reinvestment Act – Data Quality, Non-Reporting Recipients, and Reporting of Job Estimates, December 18, 2009 (OMB guidance M-10-08).

[7] United States Government Accountability Office, "States' and Localities' Uses of Funds and Actions Needed to Address Implementation Challenges and Bolster Accountability." Report #10-604. May 2010. Available on-line at: http://www.gao.gov/new.items/d10604.pdf.

In a September 2010 follow-up report, the GAO noted that the U.S. DOT had not fully addressed prior recommendations to improve data reporting in FHWA's RADS database outputs, and did not commit to assessing whether transportation investments produced long-term benefits as recommended earlier.[8]

2.4 Review of Recent Federal Analyses

The Council of Economic Advisors (CEA) and the Congressional Budget Office (CBO) are required to produce estimates of the macroeconomic impact of Recovery Act expenditures on the economy. These analyses largely consider broad estimates of long-term economic effects, and do not focus on short-term job creation numbers for specific categories of spending. However, a recent CEA report focused on the effects of public infrastructure spending by measuring the level of infrastructure expenditures in various states against change in heavy and civil engineering and construction employment. The U.S. DOT is required to prepare five periodic reports to Congress on the use and disposition of Recovery Act funds. The House Committee on Transportation and Infrastructure also has prepared reports summarizing the estimated economic impacts of expenditures within various programs with methodology consistent to that employed by the CEA. These analyses are reviewed in brief below.

U.S. Government Accountability Office, "Recovery Act: Use of Transportation Funds, Outcomes, and Lessons Learned." Statement of Phillip R. Herr, Director, Physical Infrastructure. GAO-11-610T May 4, 2011.

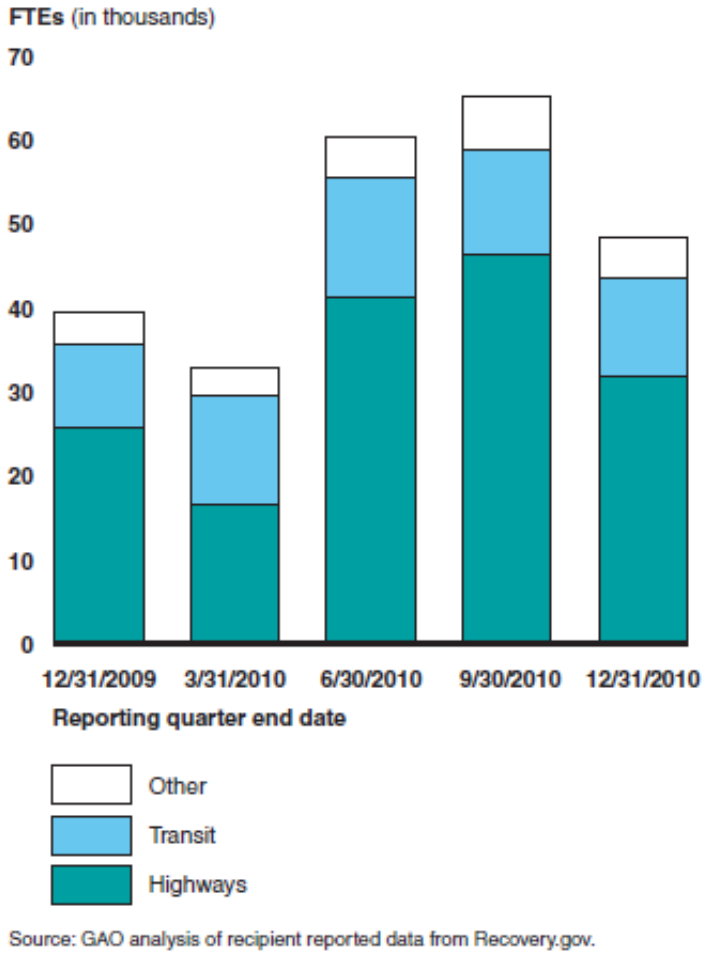
The U.S. Government Accountability Office (GAO) periodically issues reports addressing audit and financial aspects of the Recovery Act distribution and utilization of funds. GAO, along with the Congressional Budget Office, is required to review recipient reported data and job estimates quarterly per provisions in the Recovery Act.

GAO published testimony in March of 2011 reviewing the disposition of Recovery Act transportation funds, summarizing known outcomes and suggesting long-term benefits of transportation investments, and providing some lessons learned from DOTs experiences to date. For this analysis, GAO analyzed some recipient reported (1512) data and interviewed Federal, state, and local officials. The GAO notes that the long-term benefits of transportation investments are not known, including jobs impacts. Testimony includes recommendations that FHWA and FTA determine the types of data and performance measures needed to assess the impact of the Recovery Act and the specific authority they may need to collect data and report on these measures.

[8] United States Government Accountability Office, "Opportunities to Improve Management and Strengthen Accountability over States' and Localities' Uses of Funds." Report #10-999. September 2010. Available on-line at: http://www.gao.gov/new.items/d10999.pdf.

According to the GAO, Recovery Act transportation projects supported about 50,000 FTEs in the last quarter of 2010. Supported FTE counts were higher in previous quarters, reaching more than 60,000 FTEs (see Figure 2.2). No expenditure data was included with this analysis, which is a comprehensive look at all transported-related awards, so average jobs per expenditure estimates are not available.

Figure 2.2 FTEs Reported in recovery Act Transportation Program Recipients for Quarters Ending December 2009 through December 2010



Source: GAO analysis of recipient reported data from Recovery.gov.

Source: U.S. Government Accountability Office, "Recovery Act: Use of Transportation Funds, Outcomes, and Lessons Learned." Statement of Phillip R. Herr, Director, Physical Infrastructure. GAO-11-610T May 4, 2011.

Council of Economic Advisors, "The Economic Impact of the American Recovery and Reinvestment Act of 2009, Sixth Quarterly Report," March 18, 2011.[9]

[9] Council of Economic Advisors, "The Economic Impact of the American Recovery and Reinvestment Act of 2009, Sixth Quarterly Report," March 18, 2011.

The Council of Economic Advisers (CEA) is charged with providing to Congress quarterly reports on the effects of the Recovery Act on overall economic activity and on employment. The CEA's sixth report was released in March of 2011 and provides an assessment of ARRA funds and impacts through the final quarter of 2010.

Key findings suggest that ARRA expenditures (including all public investment outlays, tax expenditures, and transfer to state and local governments) have raised the level of gross domestic product by 2.3 to 3.2 percent and employment by 2.5 to 3.6 million, as of the fourth quarter of 2010, relative to what otherwise would have been. These estimates are based on direct recipient reporting data and statistical modeling.

The CEA's fifth quarterly report includes modeled estimates of direct recipient reported jobs and indirect job impacts by type of public investment outlay. For example, transportation investment was estimated to have supported an average of 100,000 jobs per each of the first three quarters of 2010. Table 2.3 summarizes the major types of public investment outlays, estimates of total job creation through 2010, and an estimate of dollars expenditures per job. Other significant public investment categories are included for comparison and do include some project types which could also be considered transportation. For example, CEA classified high-speed rail under "clean energy" investments.

Table 2.3. CEA Estimates of Total (Direct and Indirect) Job Creation of Public Investment Outlays[10]

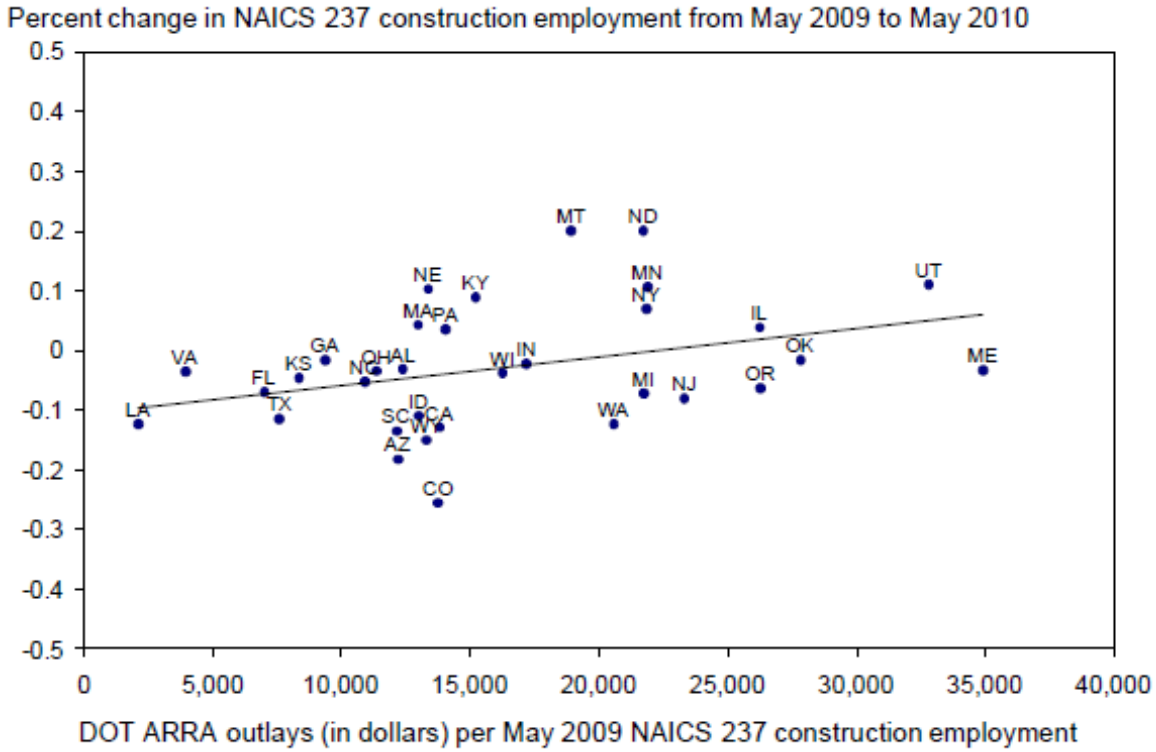
Public Investment Outlay	Jobs Q1 2010	Jobs Q2 2010	Jobs Q3 2010	Total Outlay Q3 2010	Outlay per Job Q3 2010
Transportation Infrastructure	87,200	102,000	132,700	$15.3b	$115,298
Clean Energy	141,700	191,100	224,500	$25.9b	$115,367
Construction of Buildings	60,300	79,700	100,500	$11.3b	$112,438
Environmental Preservation	56,900	79,400	104,800	$10.7b	$102,099

Sources: CEA analysis of appropriations estimates from the Office of Management and Budget (OMB); agency Financial and Activity Reports to OMB through September 30, 2010; simulations from the Department of the Treasury (Office of Tax Analysis). Outlay per jobs are Cambridge Systematics' calculations from reported CEA data.

[10] Council of Economic Advisors, "The Economic Impact of the American Recovery and Reinvestment Act of 2009, Fifth Quarterly Report," November 18, 2010.

An earlier July 2010 CEA report provides detail on the effect of public and transportation infrastructure expenditures on national employment. A simple regression analysis was performed to examine the effect of transportation investments on employment by examining the relationship between U.S. DOT ARRA outlays per construction worker and change in construction employment in each state. Outlay data was drawn from activity reports and employment data was drawn from the Bureau of Labor Statistics, Current Employment Statistics series for heavy and civil engineering construction (NAICS code 237). The analysis shows a statistically significant positive relationship between transportation outlays and change in heavy and civil engineering construction employment. This regression only measures direct, private-sector jobs within a narrow sector of the economy; in practice, additional direct jobs will be produced in other employment sectors, and this relationship does not capture any indirect or induced jobs. Figure 2.3 displays the reported results.

Figure 2.3. Change in Heavy and Civil Engineering Construction Employment against DOT ARRA Outlays



Source: Council of Economic Advisors, "The Economic Impact of the American Recovery and Reinvestment Act of 2009," Fourth Quarterly Report. July 2010.

Congressional Budget Office, "Estimated Impact of the American Recovery and Reinvestment Act on Employment and Economic Output from January 2011 through March 2011."[11]

The Recovery Act requires the Congressional Budget Office (CBO) to comment on recipient reported numbers. The most recent report, released in May 2011, provides estimates of ARRA's overall impact on employment and economic output.

Through statistical modeling, CBO estimates that in the first quarter of 2011, ARRA expenditures raised the level of real gross domestic product between 1.1 percent and 3.1 percent, and increased the number of full-time-equivalent jobs by 1.6 million to 4.6 million, compared with what those values would have otherwise been. To produce these estimates, CBO models impact based on historical values and a multiplier approach for several categories of ARRA spending and tax provisions. Each multiplier represents the estimated direct and indirect effects on the nation's output of a dollar's worth of a given policy provision. For the category, "transfer payments to state and local governments for infrastructure" those multipliers were assumed to be a low of 1.0 and a high of 2.5. These multipliers are commonly used within other analyses, including those performed by the CEA and other state and local agencies.

Table 2.4 provides recent CBO estimates of the impact of Recovery Act total expenditures, of all types, on key macroeconomic indicators since 2009.

[11] Congressional Budget Office, "Estimated Impact of the American Recovery and Reinvestment Act on Employment and Economic Output from January 2011 through March 2011," May 2011.

Table 2.4 CBO Estimated Impact of ARRA Investment on Key Macroeconomic Indicators, 2009 to 2012

	Change Attributable to ARRA							
	Real Gross Domestic Product (Percent)		Unemployment Rate (Percentage points)		Employment (Millions of people)		Full-Time-Equivalent Employment (Millions)[a]	
	Low Estimate	High Estimate	Low Estimate	High Estimate	Low Estimate	High Estimate	Low Estimate	High Estimate
				2009 (Calendar Year Quarter)				
Q1	0.1	0.1	*	*	*	*	*	0.1
Q2	0.8	1.4	-0.2	-0.3	0.3	0.5	0.4	0.7
Q3	1.2	2.5	-0.3	-0.6	0.6	1.2	0.9	1.7
Q4	1.5	3.4	-0.5	-1.1	0.9	1.9	1.4	2.8
				2010 (Calendar Year Quarter)				
Q1	1.8	4.4	-0.7	-1.5	1.3	2.8	1.8	4.0
Q2	1.7	4.6	-0.8	-1.9	1.4	3.4	2.0	4.9
Q3	1.4	4.1	-0.8	-2.0	1.4	3.6	2.0	5.2
Q4	1.1	3.5	-0.7	-1.9	1.3	3.5	1.8	5.0
				2011 (Calendar Year Quarter)				
Q1	1.1	3.1	-0.6	-1.8	1.2	3.3	1.6	4.6
Q2	0.9	2.6	-0.5	-1.6	1.0	2.9	1.4	4.0
Q3	0.6	1.9	-0.4	-1.3	0.8	2.4	1.1	3.3
Q4	0.3	1.1	-0.3	-1.0	0.6	1.8	0.7	2.4
				Calendar Year Average				
2009	0.9	1.9	-0.3	-0.5	0.5	0.9	0.7	1.3
2010	1.5	4.2	-0.7	-1.8	1.3	3.3	1.9	4.8
2011	0.7	2.2	-0.5	-1.4	0.9	2.6	1.2	3.6
2012	0.1	0.3	-0.1	-0.4	0.2	0.7	0.2	0.7

Source: Congressional Budget Office, "Estimated Impact of the American Recovery and Reinvestment Act on Employment and Economic Output from January 2011 through March 2011," May 2011.

Committee on Transportation and Infrastructure, "The American Recovery and Reinvestment Act of 2009 Transportation and Infrastructure Provisions Implementation Status as of March 31, 2011." May 2, 2011.

For the 112th Congress, the minority staff of the House Committee on Transportation and Infrastructure (T&I Committee) prepared a report in May 2011 summarizing implementation status to date of transportation and infrastructure provisions under the Recovery Act, including estimates of economic impact and job creation. This is the most recent in a series of quarterly reports issued the Committee.

The T&I Committee estimates that during the first year of implementation, (February 2009 to February 2010) ARRA projects created or sustained nearly 350,000 direct, on-project jobs. Total employment, including direct, indirect, and induced jobs, reached 1.2 million jobs. The report suggests that over the duration of the Recovery Act, the $64.1 billion of Federal transportation and infrastructure investment will create or sustain more than 1.8 million jobs and $323 billion of economic activity. To generate this estimate, which has remained unchanged since 2009, the T&I Committee assumed each $1 billion of Federal funds invested in infrastructure creates or sustains approximately 34,779 jobs (27,800 without match) and $6.2 billion in economic activity. This methodology is based on the standing guidance issued by the Federal Highway Administration as of 2007. Induced jobs account for approximately 50 percent of the total jobs estimate.[12]

Tables 2.5 and 2.6 display the estimated impacts as of March 31, 2011 and program status by agency. A total of $48.1 billion in transportation program funding has been obligated resulting in nearly 1.4 million jobs and $242.0 billion in economic activity.

[12] U.S. Department of Transportation, Federal Highway Administration, Employment Impacts of Highway Infrastructure Investment. http://www.fhwa.dot.gov/policy/otps/pubs/impacts/index.htm.

Table 2.5. House Transportation and Infrastructure Committee Estimates of ARRA Program Economic Impacts

Agency Appropriation	Appropriated (Billions)	Total Jobs	Economic Activity (Billions)
Federal Highway Administration	$27.50	765,000	$136
Secretary of Transportation	$1.50	41,000	$7
Federal Transit Administration	$8.40	262,700	$47
Federal Railroad Administration	$9.30	259,000	$46
Federal Aviation Administration	$1.30	30,600	$5.50
Maritime Administration	$0.10	2,800	$0.50
Total Transportation Program Funding	**$48.1**	**1,361,100**	**$242.00**

Source: House Transportation and Infrastructure Committee. "The American Recovery and Reinvestment Act of 2009 Transportation and Infrastructure Provisions Implementation Status as of March 31, 2011."

Table 2.6. House Transportation and Infrastructure Committee ARRA Program Implementation Status as of March 2011

Agency Appropriation	Awards/ Projects	Awarded Value (Billions of Dollars)	Work Completed	Completed Value (Billions of Dollars)
Federal Highway Administration	13,335	$26.80	7,043	$7.8
Highways and Bridges	13,335	$26.80	7,043	$7.8
Secretary of Transportation	51	$1.50	0	0
Transportation Investment Generating Economic Recovery (TIGER)	51	$1.50	0	0
Federal Transit Administration	1,072	$8.80	180	$1.3
Transit Urban And Rural Formula	967	$7.20	142	$0.54
Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER)	43	$0.10	4	$0.01
Transit Fixed Guideway Infrastructure	51	$0.74	23	$0.03
Transit New Starts Construction	11	$0.74	11	$0.74
Federal Railroad Administration	167	$9.3	n/a	n/a
Transit Urban And Rural Formula	154	$1.3	8	n/a
Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER)	13	$8.0	0	0
Federal Aviation Administration	771	$1.3	743	$1.1
Airport Improvement Program and FAA Facilities and Equipment	771	$1.3	743	$1.1
Maritime Administration	71	$0.12	31	$0.04
Small Shipyard Grants	71	$0.12	31	$0.04
Total Program Implementation	**15,467**	**$48.0**	**8,005**	**$10.0**

Source: House Transportation and Infrastructure Committee. "The American Recovery and Reinvestment Act of 2009 Transportation and Infrastructure Provisions Implementation Status as of March 31, 2011."

U.S. Department of Transportation, "Section 1201(c) One-Year Report to Congress," May 2010.[13]

[13] Available on-line at: http://www.dot.gov/recovery/docs/arra1201cJan312010.pdf.

The Secretary of Transportation of the U.S. DOT submitted the third of five required periodic 1201(c) reports to Congress in May of 2010. This report presents a summary of award recipients by operating administration, including data for contract values and status, state maintenance of effort levels and direct employment generated. The fourth 1201(c) report is due in February of 2011, but not currently available.

The May U.S. DOT report provides data for direct on-site jobs created for each award based on recipient reports, but does not develop estimates of indirect jobs for each award. "DOT has undertaken research to provide a unified methodology for estimating indirect employment, rather than having grant recipients design methods and report their estimates." For the purposes of the report, DOT provides an estimate of cumulative total employment, including direct, indirect, and induced jobs, based on the level of outlays reported. Since the second report in September of 2009, DOT estimates 95,000 job-years (total employment) were generated. This estimate appears to be consistent with the Council of Economic Advisers' estimate that $92,000 in direct Federal spending produces one job-year ($7,667 creates one FTE job month).

A July 2010 statement by Secretary LaHood before Congress, suggests FHWA has performed additional analysis and research:

"Since the beginning of the Recovery Act, we have been measuring the number of jobs resulting from transportation projects and it continues to grow. We estimate that the Department of Transportation's share of Recovery Act investments has generated 160,000 jobs (based on one person working for a full-year) so far, and that that number will grow quickly over the course of this summer. That number represents the total number of jobs, including jobs created in supplier industries and in consumer goods industries when workers go out and spend their paychecks. If we look just at what we call the "direct jobs" – jobs created on the transportation job-site – we estimate that about 41,700 people are at work each and every day on Transportation Recovery Act projects."[14]

A later estimate from September 2010 provides an estimate that DOT's portion of the Recovery Act will create 523,000 job-years through 2012.[15] The Department's reporting of job creation estimates, both direct job-years, and total induced employment has been inconsistent. The majority of estimates appear to be consistent with the required CEA multiplier, however it is unclear which input values are being used and how actual reported job-years are being considered.

[14] Statement of the Honorable Ray LaHood, Secretary of Transportation. Before the House Committee on Transportation and Infrastructure. July 27, 2010.

[15] Statement of Roy Kienitz, Under Secretary for Policy, U.S. Department of Transportation. Before the Committee on Banking, Housing, and Urban Affairs of the United States Senate. "Investing in Infrastructure: Creating Jobs and Growing the Economy." September 21, 2010.

2.5 Review of Recent State Analyses

According to the National Conference of State Legislatures, every state now has an agency department and often a public web site to provide transparency and accessibility regarding the use of ARRA funds. Many state DOTs also operate additional web sites which provide access to Section 1512 monthly employment reports as well as project listings and other available information. However, relatively few states have gone beyond basic reporting and transparency requirements to conduct independent analyses of economic and employment impacts. The few notable states that have completed additional analyses are summarized below:

Washington Department of Transportation Working with the Governor's Office of Financial Management Input-Output Model, WSDOT employed a unique state highway expenditures model to estimate total direct, indirect, and induced employment for ARRA highway projects. This model is based on state construction multipliers by phase of activity (engineering, construction, etc.) and is presented for single-year and multiyear projects. WSDOT's method of calculating FTE (job-months) is consistent with the methodology used by FHWA and U.S. DOT for ARRA reporting requirements.

WSDOT estimates as of May 2011 indicate that state and local stimulus projects have provided $165.4 million in payroll to employees working over 4.2 million hours since 2009.[16] Workers, for which the average wage paid is more than $39 per hour, earned over $4.5 million, logging more than 106,000 hours on Washington highway projects in April of 2011. In addition, the DOT's web site provides continuously updated estimates for each major project by seasonality and scale of project as shown in Table 2.7 and Figure 2.4.

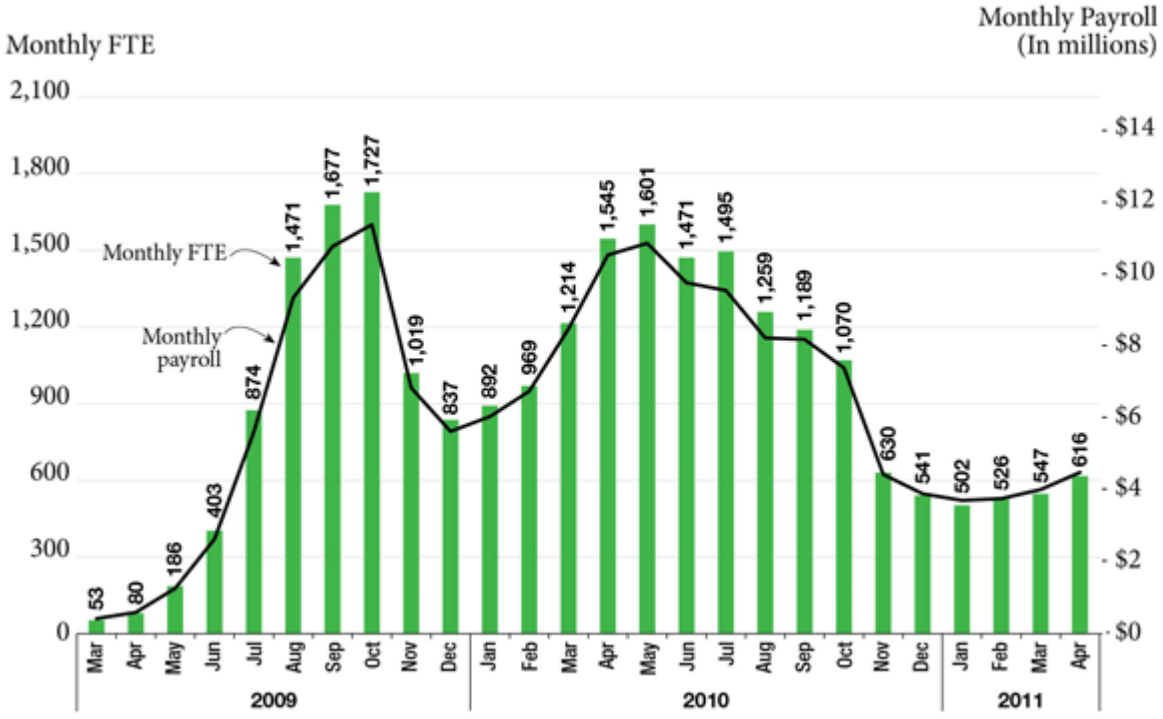
[16] Available on-line at: http://www.wsdot.wa.gov/Funding/stimulus/jobs.htm.

Table 2.7 WSDOT, Total Employment Estimates and Multiple Construction Season Projects

WSDOT Recovery Act Project Type	Total Funding	Direct, Indirect, and Induced Jobs
Interchange Improvements (I-405/NE 8th St to SR 520 Braided Ramps)	$278,577,524	925
Widening (I-405/NE 195th St to SR 527 – NB)	$50,987,267	345
Superstructure Painting (SR 433/Lewis and Clark Bridge)	$50,000,000	230
Rebuild Interchange (I-5/SR 501 Ridgefield Interchange)	$30,000,000	195
Concrete Pavement Rehab (I-5/North Kelso to Castle Rock Stage 2)	$8,270,195	55

Source: Washington State Department of Transportation. November 2010. Note: Selection of projects and activity type for which WSDOT has completed economic analyses.

Figure2.4. Recovery Act Employment Total Employment for State and Local Recovery Act Projects

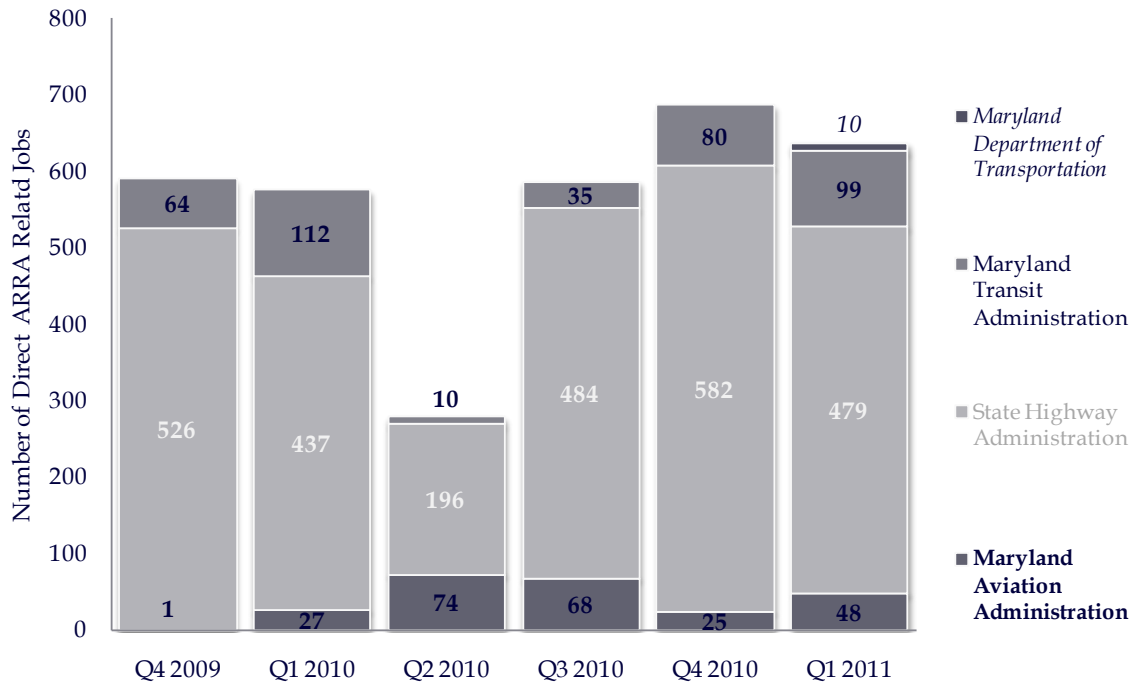


Source: Washington State Department of Transportation. May 2011.

State of Maryland Maryland's performance and recovery information web site is widely recognized as among the best state reporting tools. Figure 2.5 and Table 2.8 display various measures of estimated job growth impacts.

The Department of Business and Economic Development applied the IMPLAN model with predefined multipliers, to estimate the total impact of ARRA spending within the state. The data presented on the state's web site provides economic modeling estimates based on recipient 1512 reports by major spending category, including transportation.[17]

Figure 2.5. Direct Job Impacts by Transportation Agency, 2009Q4 to 2011Q1



Source: Maryland Department of Transportation, "ARRA Project Highlights and Recovery Fact Sheet." February, 2011.

[17] Available on-line at: http://www.statestat.maryland.gov/recoveryjobs.asp.

Table 2.8 Direct Job Impacts by Category of Spending, 2009Q4-2011Q1

Category of Spending	Awards ($millions)	Expenditures ($millions)	Direct Jobs	Indirect Jobs	Induced Jobs	Total Jobs	Expenditures per Direct Jobs
Transportation	$579	$54.1	591.3	186	367	1,144.30	$47,278
Housing	$291	$13.1	455.6	80	198	733.64	$17,856
Environment	$133	$12.4	267.	85	167	519.77	$23,857
Energy	$117	$4.8	44.	5	19	68.59	$69,981
Total	4,220	636.2	4,747.73	2,504	7,321	14,572.73	$43,657

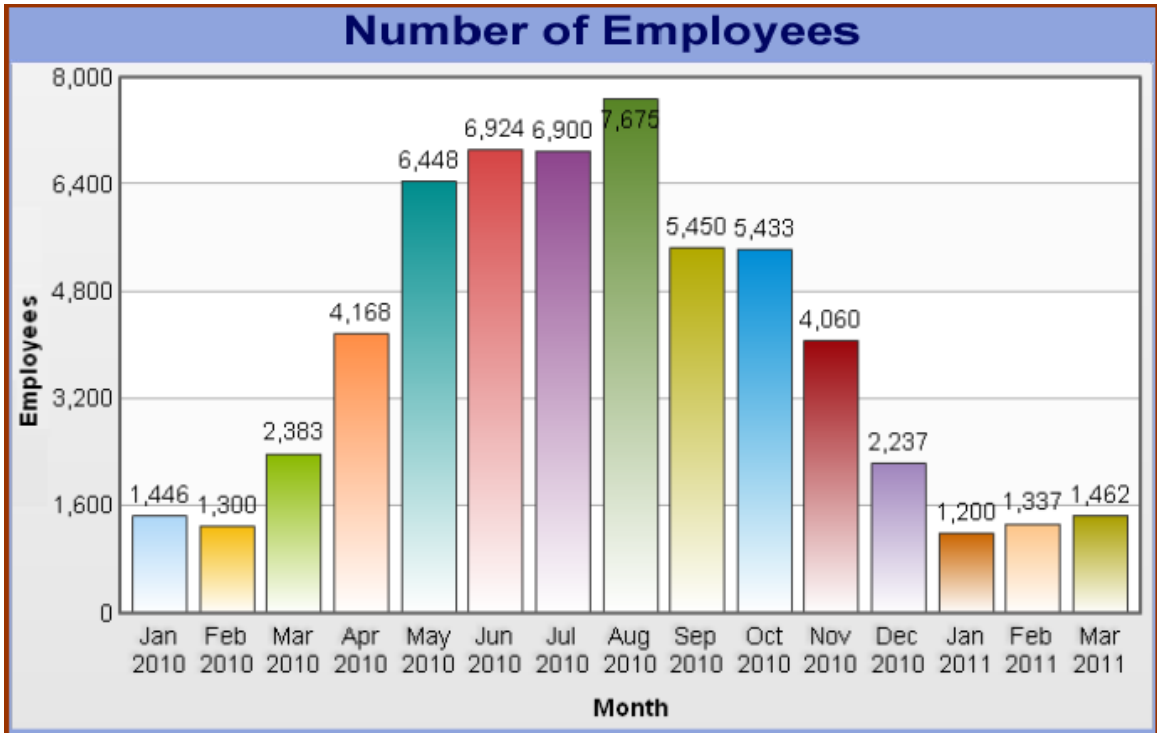
New York State New York State DOT **(**NYSDOT**)** provides guidance on estimated total employment, but does not produce estimates for ARRA-funded projects within the State. To meet the State's performance metrics and accountability requirements for Recovery Act spending, NYSDOT reports only direct, on-project jobs as compiled to meet Section 1201(c) reports to FHWA (see Figure 2.6 below).

According to NYSDOT's most recent performance summary, more than $157,200,000 in payroll and 4,247,000 work hours have been generated on Recovery Act-funded projects through March 2011.[18] NYSDOT reports monthly employment in addition to payroll and hours data. The precise definition of "number of employees" is not provided in the monthly summary (e.g., job-months, full-time equivalent, ARRA partial funding, etc). However, the following economic impact guidance is included on NYSDOT's recovery web site.

"As an average statewide estimate, the Department has chosen 24 jobs per $1 million dollars ($1M) of construction value to calculate the estimated number of direct, indirect, and induced jobs created or saved. The 24 jobs per $1M estimate was based upon a review of several references where estimates range from 11 direct to 38 direct/indirect jobs per $1 million of construction spending. NYSDOT chose to use a more conservative number within this range. Estimated Jobs Created or Saved is used as a benchmark to gauge probable effects resulting from spending on transportation projects."

[18] New York State Department of Transportation, "American Recovery & Reinvestment Act: Overview & Performance Report." Joan McDonald, Commissioner. Volume II, issue II. April 30, 2011. Available online at: https://www.nysdot.gov/recovery.

Figure 2.6. New York State DOT Recovery Act Performance Report – Number of Employees



Source: New York State Department of Transportation, "American Recovery and Reinvestment Act: Overview and Performance Report." Volume II, issue II. April 30, 2011.

2.6 Review of Recent Independent Analyses

A number of reviews and analyses of Recovery Act data have been completed by popular media, advocacy organizations, and public policy institutions, though none offer a complete treatment of available data. To date, no academic literature has been reviewed which presents analyses of Recovery Act expenditures. The majority of independent analyses are overly simplistic or potentially misleading. Examples of recent independent analyses are provided below.

Center for Neighborhood Technology, et al., "What We Learned From the Stimulus," January 2010.[19]

[19] Available on-line at: http://www.cnt.org/repository/What%20We%20Learned.ARRA-jobs-report.pdf.

A January 2010 report issued by a group of public advocacy organizations produced estimates of job creation as a result of ARRA expenditures, with a focus on comparing public transportation effects to highway effects. Using data provided to the House Committee on Transportation and Infrastructure which reports expenditures and direct jobs within key program funding areas, the report found:

- Every billion dollars spent on public transportation projects produced 16,419 job-months; and
- Every billion dollars spent on highway infrastructure projects produced 8,781 job-months.

The report, which simply divides the reported contracted amount in each program area by the number of reported direct, on-project jobs, provides estimates for Illinois and Texas. Per one billion dollars in Illinois, transit projects were estimated to produce 29,868 job-months, and highway projects 11,759. In Texas, the factors were 38,317 job-months for transit investments and 7,596 for highway. By way of comparison, a 2009 report by Economic Development Research Group which updated FHWA's 2007 impact figures for public transportation found an average of 36,100 jobs were created for every billion dollars spent on capital and operations for public transportation.[20]

American Association of State Highway and Transportation Officials, "More Projects and Paychecks: Transportation's Summer of Recovery," September 2010.[21]

AASHTO released a report in September 2010 highlighting a number of examples of projects funded through the Recovery Act. The report does not contain detailed job or economic impact estimates for the ARRA program, instead providing strong anecdotal evidence of impacts through project briefs and interviews with officials, contractors, and workers. The projects selected for review include highway and transit and cover a broad range of activities and geographies. AASHTO has launched a web site devoted to detailing the Recovery Act through state profiles, and includes briefing papers on a variety of projects in each state. The site may be viewed at: http://recovery.transportation.org/.

AASHTO's February 2010 report included an estimate of the total employment effects of the ARRA program through December 2009. Citing House Transportation and Infrastructure Committee analysis, the report indicates that the $20.6 billion expended on 10,600 highway and transit projects through December 2009 was responsible for 280,000

[20] American Public Transportation Association, "Job Impacts of Spending on Public Transportation: An Update." Prepared by Economic Development Research Group, Inc., April 2009. Available on-line at: http://www.apta.com/gap/policyresearch/Documents/jobs_impact.pdf.

[21] Available on-line at: http://recovery.transportation.org/ARRA-2.pdf.

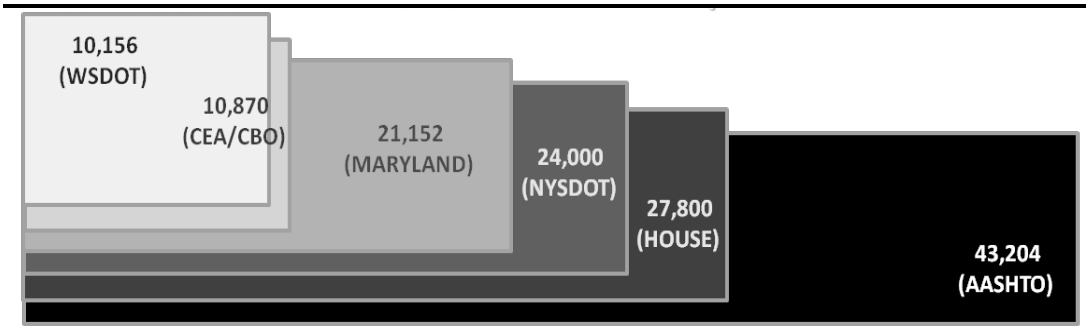
direct, on-project highway and transit jobs and almost 890,000 jobs direct, indirect, and induced jobs.[22]

2.7 Summary

Estimates of job creation and analyses of total employment impacts related to transportation Recovery Act expenditures vary considerable among the sources consulted for this review, due largely to definitional differences in job impact concepts. Figure 2.7 presents the range of employment estimates per $billion of highway construction spending. The low-end estimates (in the 10,000 to 11,000 range) count only direct construction jobs. Higher numbers (in the 21,000 to 28,000 range) reflect total jobs including indirect effects on suppliers and induced effects of worker wage re-spending. Those calculations of total impact depend on the size and breadth of the study area economy, so they are naturally lower for smaller states (e.g., Maryland), higher for larger states (e.g., New York) and largest for national impacts. The end job impact estimates reflect total jobs per $1 billion of Federal aid spending on capital investments and include counting additional jobs generated by the required 25 percent state matching funds. Since the job impact measures used in actual reporting of Recovery Act jobs are primarily direct, full-time equivalents, they tend to be lower than any of these other job impact concepts.

[22] American Association of State Highway and Transportation Officials, "Projects and Paychecks: A one-year report on State Transportation Successes under the American Recovery and Reinvestment Act," February 2010. Available on-line at: http://recovery.transportation.org/ARRA-1.pdf.

Figure 2.7. Estimates of Jobs Created per $1 Billion Investment



WSDOT	Modeled state-level estimates of direct jobs for single-season highway construction projects, 2010.
CEA/CBO	Generic multiplier for direct jobs for total Federal spending, 2010.
MD	IMPLAN modeled state-level estimates for total job impact of transportation-related spending in state, 2010.
NYSDOT	State DOT estimated multiplier of total jobs of highway-related spending in state, 2010.
HOUSE T&I	FHWA estimated multiplier for total Federal-level jobs from nonmatching Federal transportation spending, 2007
AASHTO	Independent analysis of total national-level jobs from transportation-related Federal and state spending, 2010.

Source: Calculations by Cambridge Systematics, Inc. For illustrative purposes only.

Additionally, several issues may present challenges when attempting to leverage reported jobs data for detailed impact analysis, such as:

- **Data Availability –** Because of adjustments in reporting requirements and guidance, Section 1512 data reported in 2009 are not comparable to data reported after January 1, 2010. Therefore, 2010 appears to be the most reliable year for data reporting and includes the most significant project expenditures; however verified data (such as U.S. DOT periodic reports of Section 1201(c) data) will not be available until into the first quarter of 2011.

- **Data Consistency –** The method and units of analysis for reported jobs numbers varies between sources and appears to be a source of public confusion. Section 1512 and 1201(c) directs recipients to report the total number of hours and payroll amounts of direct, on-project workers. These hours are converted into job-months and into full-time-equivalent positions for some reports (1512), and converted into job years for other purposes [1201(c)]. In addition, some recipients report additional job numbers as "persons paid in part, or in full, with Recovery Act funds."

- **Data Accuracy –** Nearly every review and audit of reported data has revealed inconsistencies and inaccuracies. Often times projects are reported with zero expenditures and significant jobs numbers or vice versa. Contract start and end times in FHWA's RADS database has been flagged as a recurring issue by the GAO. While each operating administration, the FHWA, and the OMB perform quality control checks, a cursory review of many data sources reveals inaccuracies and oddities in reporting.

- **Data Impact –** The employment effects of expenditures to date may be muted as funds directed to highway programs have been used primarily for pavement improvement projects, and public transportation funds used primarily for upgrading facilities and bus fleets. These types of projects dominate the recovery Act databases and analyses and tend to inflate expenditure figures, while showing relatively few associated jobs numbers. Identifying and validating data on a number of differing projects, which are completed and have reported accurately, may prove challenging.

3.0 Database Development and Methodology

3.1 Data Description

FHWA provided jobs and cumulative ARRA expenditure data from third quarter of 2009 through first quarter of 2011. Over the course of seven quarters ranging from third quarter 2009 to second quarter 2011, FHWA's ARRA records covered 14,527 highway and bridge infrastructure projects. This includes projects taking place within the 50 states and District of Columbia, plus four U.S. outlying territories (Guam, Virgin Islands, Northern Mariana, and Puerto Rico). The data indicate that $19.1 billion was spent over this period. As noted above, the public use dataset includes information on three classes of information: a) description of the projects themselves, in terms of type, location and status, b) reports on expenditures by time period, and c) reports on jobs by time period.

The dataset was built by FHWA based on separate reports provided by each of the individual states and territories. One of the known issues with this dataset is that it is dependent on the efforts of each state (or territory) to obtain reports on hour and wages provided by highway construction contractors and their subcontractors. A major concern with the data is that the commitment of Federal funds to states for authorized projects and the reporting of contractor wages are two totally distinct and independent processes. That makes it quite likely that the two are reported in different time periods. Generally, there is a time lag between reported expenditures of funds and reported jobs and wages for the same project. However, there are also cases where the opposite occurs and the wages are reported before the expenditures appear to be reported. Data variations of this type are common with large programs that have complex reporting. Using Microsoft Access, the datasets were consolidated by award number to calculate total job-years and level of Federal spending per job created. According to the Council of Economic Advisers, $92,000 in government spending creates one job-year.

Numerous issues were identified during the data compilation process. Thus, steps were required develop a usable database, including:

- Over 3,600 records reported zero jobs and/or zero ARRA spending. For data analysis, those records were removed.
- Over 2,000 records reported quarter ARRA spending amounts that declined or were zero by the last quarter reported (2011 Q1). About half of those are completed projects in earlier quarters. The remaining records included a combination of projects that did not submit data every quarter (therefore, when data was consolidated, spending was

assumed at zero for that quarter), rounding over quarters (e.g., 2010 Q2 ARRA spending = $60,540.22; 2010 Q3 ARRA spending = $60,540), and (what appears to be) data entry errors.

- Data on improvement type are not provided, but lengthy project descriptions that varied significantly across reporting entities/agencies are included. Data from the FHWA weekly summary report from the first week of January are linked using the "award number" in both files with the "improvement type" and "status" data from the weekly summary report. Using this method, the improvement type and project status (e.g., underway, completed) are identified for over 12,900 records. Some records had no project type category shown and were eliminated.
- Additionally, records for projects that: (a) had no zip code location data, as required for appending of explanatory data on local factors, or c) were not appropriate for analysis because they were still in an "early stage" (with early expenditures but little or no job reports yet in) are eliminated.

The resulting dataset includes 10,873 records that could be reliably used for further analysis.

3.2 Summary Data Statistics

Table 3.1 summarizes the summary statistics for the FHWA ARRA data. In general, the spending/job-year is over three times the estimate from the Council of Economic Advisers. There is significant variability throughout the data, as observed by the minimum and maximum estimates of spending/job-year.

Table 3.1. Summary Stats

	All Data	All Data – No Zeroes
Total Records	14,526	10,873
Direct Job-Year	52,093	49,006
ARRA Spending (Maximum)	$14,577,261,639	$14,378,202,905
Spending/Job-Year	$279,832	$293,396
Median	$202,728	$226,314
Minimum	$0	$0
Maximum	$165,121,954	$165,121,954

Source: Cambridge Systematics and Economic Development Research Group analysis of public ARRA data.

Tables 3.2 and 3.3 are pivot tables generated from the "non-zeroes" data set. Table 3.2 summarizes the data by state. The estimated spending per job-year ranges from $10,000 (Northern Mariana Islands) to $580,000 (Utah).

Table 3.2. ARRA Data by State, 2009Q3 to 2011Q1

State	Direct Job-Years	ARRA Expenditures	Expenditures per Job-Year	Total Records
Alabama	733	263,990,256	360,021	240
Alaska	305	132,857,024	435,383	27
American Samoa	29	3,587,535	124,093	1
Arizona	1,000	209,581,091	209,612	172
Arkansas	788	158,046,753	200,457	116
California	3,025	842,151,802	278,380	648
Colorado	772	252,854,179	327,610	94
Connecticut	371	106,917,954	288,154	119
Delaware	198	48,937,735	246,961	31
District of Columbia	293	44,382,139	151,707	22
Florida	2,329	515,577,018	221,379	402
Georgia	1,302	351,902,745	270,276	321
Guam	4	71,829	19,953	1
Hawaii	65	32,642,223	502,461	15
Idaho	379	112,699,409	297,630	78
Illinois	2,129	682,279,575	320,414	715
Indiana	1,545	451,379,822	292,112	950
Iowa	1,973	372,412,569	188,793	180
Kansas	671	164,923,263	245,871	136
Kentucky	783	259,548,650	331,362	95
Louisiana	610	153,577,165	251,877	96
Maine	237	119,085,220	502,247	77
Maryland	569	216,233,846	380,034	146
Massachusetts	441	161,316,220	365,675	83
Michigan	2,944	694,955,603	236,054	806
Minnesota	1,230	395,102,412	321,185	185
Mississippi	983	267,428,811	271,981	161
Missouri	1,256	391,637,226	311,923	301
Montana	546	160,421,973	294,011	85
Nebraska	743	157,866,185	212,424	105
Nevada	336	95,797,505	285,405	63
New Hampshire	204	96,533,711	472,095	35

State	Direct Job-Years	ARRA Expenditures	Expenditures per Job-Year	Total Records
New Jersey	514	296,546,294	577,430	78
New Mexico	652	165,797,062	254,462	73
New York	1,063	386,899,119	364,119	327
North Carolina	1,669	392,485,957	235,208	347
North Dakota	330	145,762,923	441,239	146
Northern Mariana	5	46,800	10,029	1
Ohio	1,511	373,748,228	247,330	337
Oklahoma	1,009	395,002,856	391,642	259
Oregon	690	243,676,177	352,913	428
Pennsylvania	2,083	643,941,411	309,154	284
Puerto Rico	214	26,045,566	121,826	21
Rhode Island	286	90,137,875	314,934	62
South Carolina	816	245,009,089	300,402	168
South Dakota	371	161,065,492	433,775	52
Tennessee	1,540	431,872,616	280,438	354
Texas	2,557	566,715,486	221,617	303
Utah	336	194,775,364	580,013	119
Vermont	357	103,159,013	289,077	67
Virgin Islands	34	4,236,232	123,604	3
Virginia	515	120,233,667	233,564	105
Washington	1,023	449,987,134	439,849	217
West Virginia	452	146,354,205	323,823	136
Wisconsin	1,808	728,197,714	402,664	414
Wyoming	380	149,807,177	394,527	66
Grand Total	49,006	14,378,202,905	293,396	10,873

Table 3.3 summarizes data by project status. As of the third quarter of 2010, almost 5,700 projects had been completed, and 4,500 projects were under construction. Only a small fraction of the projects were awaiting a notice to proceed (NTP). Spending per job-year ranged from $104,600 (awaiting NTP but awarded) to $313,200 (completed).

Table 3.3. ARRA Data by Project Status, 2009Q34 to 2011Q1

Status	Direct Job-Years	ARRA Expenditures	Expenditures per Job-Year	Total Records

Awaiting NTP and Not Awarded	40	11,891,881	300,368	12
Awaiting NTP But Awarded	473	49,444,833	104,611	160
Completed	18,171	5,691,576,734	313,227	5,690
Underway	27,140	8,230,058,410	303,244	4,503
(blank)	3,183	395,231,047	124,167	508
Grand Total	49,006	14,378,202,905	293,396	10,873

Source: Cambridge Systematics Analysis of date available at http://www.recovery.gov.

3.3 Methodology

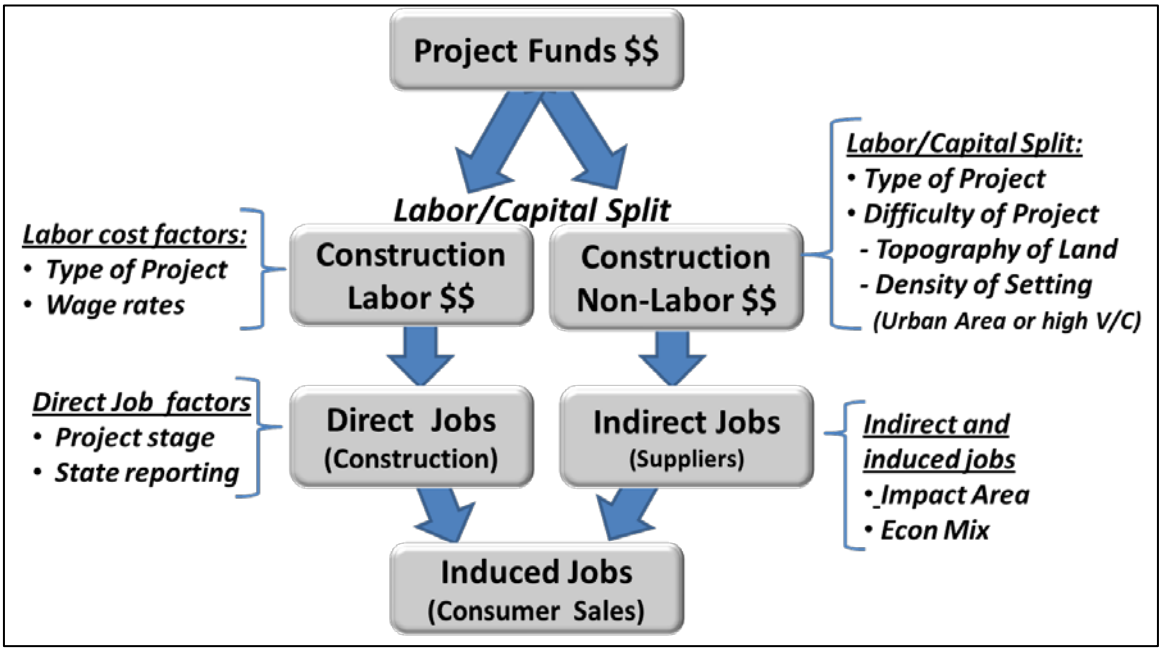
The analysis of the ARRA data is conducted in two phases. The Phase I analysis uses quarterly project records from the public dataset provided by the Federal Highway Administration (FHWA), covering 1.75 years (seven quarters). It included key information at the project level concerning cumulative Federal expenditure, current quarterly FTE (full-time equivalent) employment, project location, and project completion status. By merging information from the biweekly reports we also know the project type (in terms of one of eight possible project types). Together, this allows for analysis of the direct jobs generated by ARRA funds, and how the ratio of jobs per $million of project spending differed by state and by project type.

The Phase II analysis adds more detailed information on payroll and hours worked for four states that voluntarily provided their quarterly or monthly project records for ARRA-funded projects. By appending this information onto public records for the four states, we were able to further assess the average labor cost, hours of work, and labor share of total project expenditures, which also helps explain differences in the ratio of jobs per $ million among various project types.

The analysis process consisted of an examination of how and why job impacts differed by type of project and by location. It was based on a conceptual framework, illustrated in Figure 3.1, which laid out the factors affecting project cost and job impact. As shown in that graphic, ARRA funds were spent on both a) construction labor in the form of wages in the road construction industry, and b) non-labor construction spending via purchases of required parts and materials. The first form of spending ("a") leads to direct construction industry jobs, which are counted as part of the ARRA program. The second form of spending ("b") leads to jobs in manufacturing, sales and distribution industries, which were not tracked by the ARRA program although they can be estimated via economic input-output models (which track interindustry buying and selling patterns). Those are commonly referred to as "indirect jobs." As workers re-spend their wages on consumer purchases of food, clothing, shelter, and recreation, additional jobs are created throughout the rest of the economy. This last category is commonly referred to as

"induced" jobs. This report focuses primarily on the measurement of direct construction jobs.

Figure 3.1 Conceptual Framework for Examining and Explaining Job Impacts



The number of construction jobs generated by ARRA highway spending has varied widely among projects, depending on specific characteristics of the project and its setting. As shown in the conceptual framework graphic, the mix of spending on labor and capital purchases can depend on the type of project and its location. For instance:

Types of projects that involve infrastructure materials and supporting structures (such as bridges, tunnels and some safety projects) will have a high capital/labor ratio and hence can appear to generate fewer construction jobs (but more indirect supplier jobs) per million dollars spent. The reverse is true for projects that require relatively little materials or structures (such as transportation enhancements).

Projects in areas with high labor costs would appear to have fewer construction jobs per million dollars spent.

Projects with high traffic volumes (often in urban areas) would tend to require more workers for traffic rerouting, thus appearing with more construction-related jobs per million dollars spent.

Projects in areas with sloped terrain would tend to require more support structures and hence appear to have a smaller ratio of jobs per million dollars spent.

Differences in job generation among locations (both states and areas within states) can thus be attributed to differences in project difficulty attributable to factors such as

topography, urban setting or traffic volumes and the cost of labor (wage rates). The analysis provided in this report examines differences in job generation rates and the extent to which they can be explained by these various factors.

Regression equations are developed to statistically assess factors contributing to state variation in jobs generated per $ million of expenditures. That includes analyzing the role of local explanatory factors such as differences in economic, topographic and transportation conditions. The following sections present the findings of the phase 1 and phase 2 analyses.

4.0 Analysis of the National Dataset

4.1 Overall Findings

The total dataset included 14, 527 project records covering 2009Q4 to 2011Q1. It showed total Federal expenditures of $19.1 billion, directly creating approximately 205,200 full-time equivalent jobs. Note that a full-time equivalent (FTE) is defined as the hours of work equivalent to one year of full-time work. That is also sometimes described as a job-year. In reality, there was a great deal of part-time jobs and temporary jobs that did not last a full year. Those all were treated as fractions of an FTE.

Table 4.1 shows per-quarter spending, and associated number of jobs occurring in each quarter. It shows that while there were indeed over 205,000 FTEs created during the study period, the reported number of FTEs occurring in any one quarter ranged from just over 17,000 to well over 47,000 FTEs. (That is slightly less but generally in line with the GAO report of June 2011, which found that jobs per quarter ranged from 31,460 to 65,110 FTEs.) The average found here was equivalent to 29,314 FTE jobs occurring at any one time, which is equivalent to around 35,000 full and part-time jobs.

Table 4.1 FHWA Spending of ARRA Funds and Direct Jobs Generated, by Quarter

Time Period	Spending	Jobs	Jobs Per Million Dollars Spent
2009 Q3	$2,456,169,570	23,842	9.72
2009 Q4	$3,551,794,672	26,084	7.34
2010 Q1	$1,598,268,733	17,005	10.64
2010 Q2	$3,022,205,466	41,912	13.87
2010 Q3	$3,951,823,198	47,024	11.90
2010 Q4	$2,992,633,566	31,187	10.42
2011 Q1	$1,486,599,496	18,146	12.21
Total (7 Quarters)	**$19,056,494,701**	**205,200**	**10.77**

Source: FHWA dataset (full 14,527 records), tabulated by EDR Group and Cambridge Systematics.

Table 4.1 also shows the national average of direct jobs created per million dollars of expenditure. For the seven quarter period, the national average was 10.77 FTE jobs created per million dollars expended. This estimate is very close to the U.S. DOT's "JobMod" model estimate of 10.3 FTE jobs directly generated per $ million of highway construction expenditure.

4.2 Project Type Influence on Jobs

The ARRA highway spending was distributed among eight different project types:

- Bridge Improvement,
- Bridge Replacement,
- New Bridge Construction,
- Other types of construction,
- Pavement Improvements,
- Pavement Widening,
- Safety and Traffic Management, and
- Transportation Enhancements.

Table 4.2 shows a summary of average jobs and expenditures per project, broken down by project type. Also shown is the ratio of direct jobs generated per million dollars expended. While the average is 10.55 direct jobs/$ million, the table shows that the ratio differed by project type. For instance, transportation enhancement projects are the most labor intensive and generate the most jobs per $ million spent (17.03). At the other end of the range, pavement improvement (9.01) and safety/traffic management projects (10.32) generate the least jobs per $ million spent.

Despite the appearance that many of the project types had jobs per expenditures ratios above the national average, the overwhelming number of projects have been of a type which is less labor intensive (more than half of the projects are pavement improvement). The difference in ratio of jobs per million expended may be explained by differences in the labor and non-payroll portions of the project budgets. Non-payroll expenses include capital items (defined as expenditures on equipment, machinery) and material inputs (such as concrete and asphalt, as well as structural steel and reinforcing bars).

Table 4.2. Average Direct Jobs, Expenditures, and Job/Expenditure Ratios, by Project Type

Average Project-Specific Reported Numbers and Ratios				
	# of Projects	Average Jobs	Average Expenditure	Average Jobs/Million
Bridge Improvement	464	23.59	$ 1,945,779	12.12
Bridge Replacement	554	18.18	$ 1,576,189	11.53
New Bridge Construction	49	58.55	$ 4,987,147	11.74
New Construction	144	85.62	$ 6,840,744	12.52
Other	438	10.96	$ 908,941	12.05
Pavement Improvement	5,995	14.52	$ 1,610,658	9.01
Pavement Widening	341	93.3	$ 7,350,216	12.69
Safety/Traffic Management	663	12.99	$ 1,258,779	10.32
Transportation Enhancements	1,073	10.62	$ 623,311	17.03
All	9,748	18.51	$ 1,754,353	10.55

Note: Jobs in terms of full-time equivalents (FTEs).

Source: Analysis dataset drawn from public ARRA data, tabulated by Cambridge Systematics and Economic Development Research Group.

The differences in job generation rates can also be viewed in terms of the share of jobs accounted for by different project types. Table 4.3 shows that the pavement improvement projects accounted for 55 percent of all expenditures but just 46 percent of the jobs. Of course, this does not mean that it would make sense to avoid investing in pavement improvements. Rather, the findings indicates that some types of projects (such as pavement improvements) just had a greater share of total cost going for materials that can generate indirect rather than direct jobs.

Table 4.3. Share of Total Direct Jobs and Total Expenditures, by Project Type

Arra Reported Percentage Allotment		
Project Type	Reported Jobs	Reported Expenditures
Bridge Improvement	6%	5%
Bridge Replacement	5%	5%
New Bridge Construction	2%	1%
New Construction	6%	5%
Other	3%	3%
Pavement Improvement	46%	55%
Pavement Widening	17%	14%
Safety/Traffic Management	5%	5%
Transportation Enhancements	7%	4%

Source: Analysis dataset drawn from public ARRA data, tabulated by Cambridge Systematics and Economic Development Research Group.

4.3 State-Specific Differences in Job Generation

The ratio of total reported jobs per million of reported spending differed widely among states from the national average of 10.55, often by as much as +/- 50 percent. Figure 4.2 provides a graphic showing each state's reported average of jobs per million expended relative to the national average. For ease of visualization, confidence bands were drawn equal to 1.5 and 0.5 times the national average to highlight the stability around the national average.

Of the places which were noticeably outside of the confidence band, all but one were overseas island territories. It is believed that local differences in labor cost may be responsible for those differences, as labor costs are significantly lower in Guam, Virgin Islands, Northern Mariana, and Puerto Rico than in the 50 states. The only U.S. state which is also dramatically outside the margin, Arizona, can be explained as an outlier because it contained only one project (after preliminary data screening) which was used to compute its average.

While the state ratios varied widely, much of this was due to differences in the mix of projects among states. Tables 4.4 and 4.5 show the extent of the variation in project mix. By accounting for differences in the mix of projects, we can actually explain approximately 81 percent of the variation in direct job impact rates between states.[23]

[23] Variation is the absolute magnitude difference between the reported and the predicted jobs. This was calculated by multiplying the project specific jobs per million *by* the project reported expenditures for each project and tabulating the results.

Figure 4.2 Ratio of Direct Jobs per $ million of Spending, by State

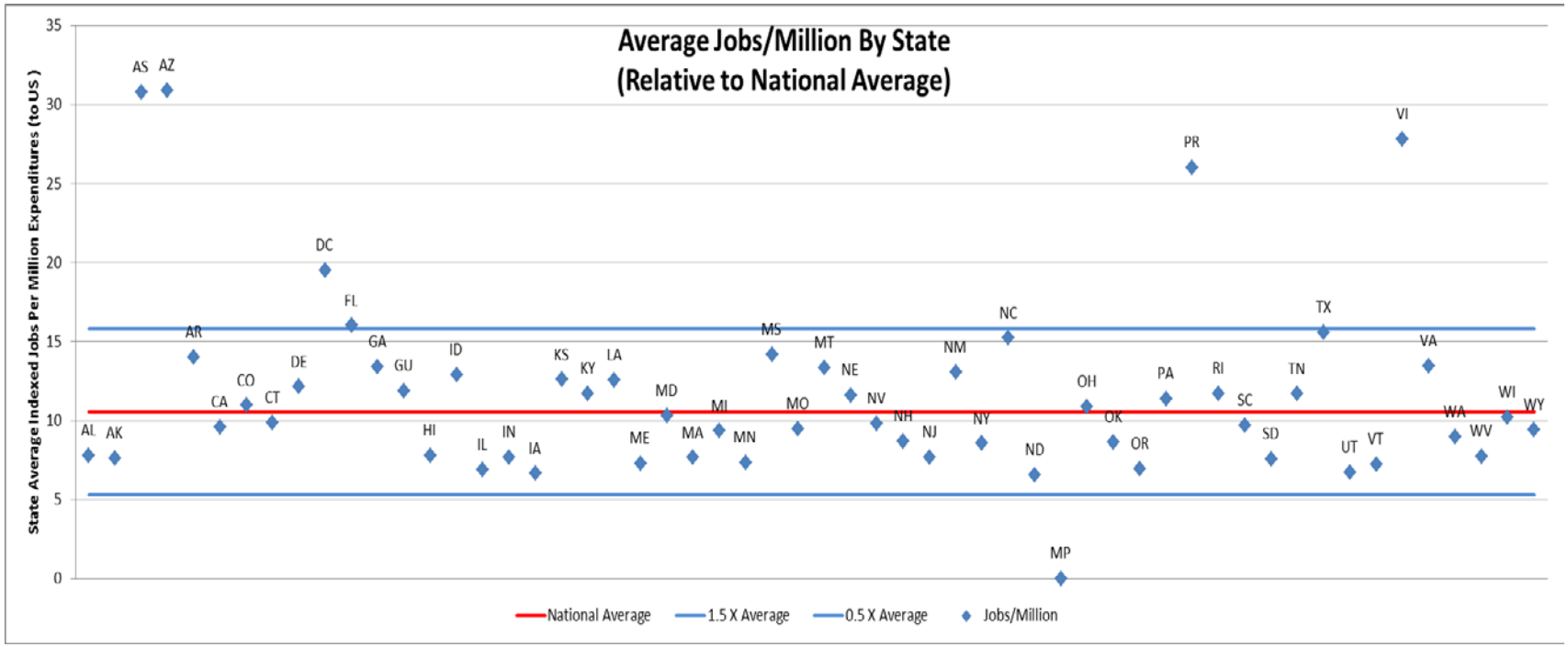


Table 4.4 Number of Projects, by State

Project Breakdown by State By Project Type (incomplete info and projects not started removed)										
	Bridge Improvement	Bridge Replacement	New Bridge Construction	New Construction	Other	Pavement Improvement	Pavement Widening	Safety/Traffic Management	Transportation Enhancements	Total
AL	1	5	0	2	10	194	3	9	12	236
AK	2	0	0	1	0	18	1	1	4	27
AS	0	0	0	0	0	1	0	0	0	1
AZ	0	0	0	0	0	0	0	0	0	0
AR	1	4	2	6	1	64	19	16	3	116
CA	6	3	0	3	17	493	14	42	72	650
CO	0	4	1	3	2	31	8	13	32	94
CT	11	5	0	0	4	62	1	20	17	120
DE	3	1	0	1	5	11	0	3	6	30
DC	2	0	0	0	0	6	1	3	2	14
FL	10	0	2	5	2	200	23	35	105	382
GA	0	28	0	7	2	209	11	36	26	319
GU	0	0	0	0	1	1	0	0	0	2
HI	3	1	0	1	0	10	0	1	0	16
ID	8	0	2	1	4	41	7	0	15	78
IL	42	27	0	7	34	519	2	47	30	708
IN	70	18	15	5	10	708	12	71	43	952
IA	5	19	2	6	4	120	1	5	17	179
KS	2	16	1	4	4	76	11	8	14	136
KY	1	0	0	6	1	32	7	5	43	95
LA	0	12	0	6	0	39	9	2	28	96
ME	5	3	0	0	4	57	0	4	2	75
MD	7	2	0	0	0	95	4	33	14	155
MA	3	2	0	0	2	63	0	7	6	83
MI	24	13	0	0	26	512	8	21	21	625
MN	5	26	3	1	4	85	2	36	22	184
MS	6	14	0	3	1	103	3	17	17	164
MO	8	4	2	13	17	172	26	6	52	300
MT	3	4	0	3	4	52	4	4	10	84
NE	7	17	0	4	1	63	3	4	5	104
NV	0	0	1	1	0	41	1	1	10	55
NH	0	0	0	2	0	21	2	0	9	34
NJ	7	4	0	1	18	36	0	5	5	76
NM	0	3	0	2	0	41	6	1	15	68
NY	45	39	0	1	34	170	4	18	15	326
NC	17	21	1	4	22	128	23	19	107	342
ND	1	4	0	0	1	131	0	0	7	144
MP	0	0	0	0	1	0	0	0	0	1
OH	30	27	3	10	11	194	10	32	20	337
OK	6	56	4	0	0	131	7	8	41	253
OR	1	0	0	1	109	116	2	28	26	283
PA	75	31	0	1	2	125	2	19	28	283
PR	2	0	0	0	0	17	2	0	0	21
RI	6	1	0	0	3	36	0	13	3	62
SC	0	8	0	2	3	88	8	22	37	168
SD	0	0	0	0	0	36	1	0	14	51
TN	0	54	1	4	7	135	14	6	21	242
TX	0	22	4	8	8	190	31	19	19	301
UT	4	3	0	3	6	55	10	13	25	119
VT	8	3	0	0	1	44	2	0	7	65
VI	0	0	0	2	1	0	0	0	0	3
VA	0	0	1	6	30	45	11	11	1	105
WA	2	7	2	7	7	118	12	18	42	215
WV	25	26	0	2	0	62	5	3	12	135
WI	8	43	2	0	93	207	17	9	34	413
WY	3	0	0	0	11	34	1	3	13	65
Total	475	580	49	145	528	6238	351	697	1129	**10192**

Table 4.5 Percentage Mix of Projects, by State

Project Breakdown by State By Project Type (incomplete info and projects not started removed)										
	Bridge Improvement	Bridge Replacement	New Bridge Construction	New Construction	Other	Pavement Improvement	Pavement Widening	Safety/Traffic Management	Transportation Enhancements	Total
AL	0.4%	2.1%	0.0%	0.8%	4.2%	82.2%	1.3%	3.8%	5.1%	100%
AK	7.4%	0.0%	0.0%	3.7%	0.0%	66.7%	3.7%	3.7%	14.8%	100%
AS	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100%
AZ										
AR	0.9%	3.4%	1.7%	5.2%	0.9%	55.2%	16.4%	13.8%	2.6%	100%
CA	0.9%	0.5%	0.0%	0.5%	2.6%	75.8%	2.2%	6.5%	11.1%	100%
CO	0.0%	4.3%	1.1%	3.2%	2.1%	33.0%	8.5%	13.8%	34.0%	100%
CT	9.2%	4.2%	0.0%	0.0%	3.3%	51.7%	0.8%	16.7%	14.2%	100%
DE	10.0%	3.3%	0.0%	3.3%	16.7%	36.7%	0.0%	10.0%	20.0%	100%
DC	14.3%	0.0%	0.0%	0.0%	0.0%	42.9%	7.1%	21.4%	14.3%	100%
FL	2.6%	0.0%	0.5%	1.3%	0.5%	52.4%	6.0%	9.2%	27.5%	100%
GA	0.0%	8.8%	0.0%	2.2%	0.6%	65.5%	3.4%	11.3%	8.2%	100%
GU	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	100%
HI	18.8%	6.3%	0.0%	6.3%	0.0%	62.5%	0.0%	6.3%	0.0%	100%
ID	10.3%	0.0%	2.6%	1.3%	5.1%	52.6%	9.0%	0.0%	19.2%	100%
IL	5.9%	3.8%	0.0%	1.0%	4.8%	73.3%	0.3%	6.6%	4.2%	100%
IN	7.4%	1.9%	1.6%	0.5%	1.1%	74.4%	1.3%	7.5%	4.5%	100%
IA	2.8%	10.6%	1.1%	3.4%	2.2%	67.0%	0.6%	2.8%	9.5%	100%
KS	1.5%	11.8%	0.7%	2.9%	2.9%	55.9%	8.1%	5.9%	10.3%	100%
KY	1.1%	0.0%	0.0%	6.3%	1.1%	33.7%	7.4%	5.3%	45.3%	100%
LA	0.0%	12.5%	0.0%	6.3%	0.0%	40.6%	9.4%	2.1%	29.2%	100%
ME	6.7%	4.0%	0.0%	0.0%	5.3%	76.0%	0.0%	5.3%	2.7%	100%
MD	4.5%	1.3%	0.0%	0.0%	0.0%	61.3%	2.6%	21.3%	9.0%	100%
MA	3.6%	2.4%	0.0%	0.0%	2.4%	75.9%	0.0%	8.4%	7.2%	100%
MI	3.8%	2.1%	0.0%	0.0%	4.2%	81.9%	1.3%	3.4%	3.4%	100%
MN	2.7%	14.1%	1.6%	0.5%	2.2%	46.2%	1.1%	19.6%	12.0%	100%
MS	3.7%	8.5%	0.0%	1.8%	0.6%	62.8%	1.8%	10.4%	10.4%	100%
MO	2.7%	1.3%	0.7%	4.3%	5.7%	57.3%	8.7%	2.0%	17.3%	100%
MT	3.6%	4.8%	0.0%	3.6%	4.8%	61.9%	4.8%	4.8%	11.9%	100%
NE	6.7%	16.3%	0.0%	3.8%	1.0%	60.6%	2.9%	3.8%	4.8%	100%
NV	0.0%	0.0%	1.8%	1.8%	0.0%	74.5%	1.8%	1.8%	18.2%	100%
NH	0.0%	0.0%	0.0%	5.9%	0.0%	61.8%	5.9%	0.0%	26.5%	100%
NJ	9.2%	5.3%	0.0%	1.3%	23.7%	47.4%	0.0%	6.6%	6.6%	100%
NM	0.0%	4.4%	0.0%	2.9%	0.0%	60.3%	8.8%	1.5%	22.1%	100%
NY	13.8%	12.0%	0.0%	0.3%	10.4%	52.1%	1.2%	5.5%	4.6%	100%
NC	5.0%	6.1%	0.3%	1.2%	6.4%	37.4%	6.7%	5.6%	31.3%	100%
ND	0.7%	2.8%	0.0%	0.0%	0.7%	91.0%	0.0%	0.0%	4.9%	100%
MP	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100%
OH	8.9%	8.0%	0.9%	3.0%	3.3%	57.6%	3.0%	9.5%	5.9%	100%
OK	2.4%	22.1%	1.6%	0.0%	0.0%	51.8%	2.8%	3.2%	16.2%	100%
OR	0.4%	0.0%	0.0%	0.4%	38.5%	41.0%	0.7%	9.9%	9.2%	100%
PA	26.5%	11.0%	0.0%	0.4%	0.7%	44.2%	0.7%	6.7%	9.9%	100%
PR	9.5%	0.0%	0.0%	0.0%	0.0%	81.0%	9.5%	0.0%	0.0%	100%
RI	9.7%	1.6%	0.0%	0.0%	4.8%	58.1%	0.0%	21.0%	4.8%	100%
SC	0.0%	4.8%	0.0%	1.2%	1.8%	52.4%	4.8%	13.1%	22.0%	100%
SD	0.0%	0.0%	0.0%	0.0%	0.0%	70.6%	2.0%	0.0%	27.5%	100%
TN	0.0%	22.3%	0.4%	1.7%	2.9%	55.8%	5.8%	2.5%	8.7%	100%
TX	0.0%	7.3%	1.3%	2.7%	2.7%	63.1%	10.3%	6.3%	6.3%	100%
UT	3.4%	2.5%	0.0%	2.5%	5.0%	46.2%	8.4%	10.9%	21.0%	100%
VT	12.3%	4.6%	0.0%	0.0%	1.5%	67.7%	3.1%	0.0%	10.8%	100%
VI	0.0%	0.0%	0.0%	66.7%	33.3%	0.0%	0.0%	0.0%	0.0%	100%
VA	0.0%	0.0%	1.0%	5.7%	28.6%	42.9%	10.5%	10.5%	1.0%	100%
WA	0.9%	3.3%	0.9%	3.3%	3.3%	54.9%	5.6%	8.4%	19.5%	100%
WV	18.5%	19.3%	0.0%	1.5%	0.0%	45.9%	3.7%	2.2%	8.9%	100%
WI	1.9%	10.4%	0.5%	0.0%	22.5%	50.1%	4.1%	2.2%	8.2%	100%
WY	4.6%	0.0%	0.0%	0.0%	16.9%	52.3%	1.5%	4.6%	20.0%	100%

■ 4.4 Other Factors Affecting Job Generation

Regression Design. A regression analysis is conducted to examine how much of the remaining variation in direct job creation between the states and project types can be explained through state-specific factors regarding labor and non-labor costs. The regression analysis is based on the conceptual framework shown in Figure 3.1. After deleting early stage projects (because the job reporting was too unreliable), the regressions included four sets of explanatory factors selected in accordance with the previously discussed conceptual framework:

- Project type;
- Expenditure level;
- Wage rate (per hour); and
- Project difficulty.

Initial research found that of all available predictors of project difficulty, topography, and volume/capacity ratio appear to have the greatest explanatory power. Both population density and urban setting variables were found to be highly correlated with a high volume/capacity ratio, though the latter appeared to be a better predictor of job impact.

Separate regression equations are estimated (calibrated) for each project type class, reflecting the impact of expenditures and the interaction of expenditures with wage rate, topography and volume/capacity ratio. Three project classes are defined to account for differences in the relative roles of impact factors:

Major Construction Projects: including bridges (new, replacement and improvement) and highways (new construction, widening and other). All had in the range of 11.5 to 12.7 jobs per million.

Pavement and Safety Projects: including pavement improvement and safety/traffic management projects. These represented smaller scale projects with lower rates of job generation (in the range of 9.0 to 10.3 jobs per million).

Transportation Enhancement Projects. These projects had the highest rates of job

Below is the form, specification, and summary table of each regression.

$$Jobs_{group\ 1} = \beta_1 * Expenditures + \beta_2 (Expenditures * Wage\ per\ worker) + \beta_3 (Expenditures*Distress) + \beta_4 (Expenditures * Topography)$$

$$Jobs_{group\ 2} = \beta_5 * Expenditures + \beta_6 (Expenditures * Wage\ per\ worker) + \beta_7 (Expenditures * Distress) + \beta_8 (Expenditures * Topography)$$

$$Jobs_{group\ 3} = \beta_9\ Expenditures + \beta_{10} (Expenditures * Wage\ per\ worker) + \beta_{11} (Expenditures * Topography)$$

Sources of Explanatory Data. The explanatory variables chosen include:

Wages per Person: (continuous variable) taken from Moody's as total payroll employee disbursements divided by employee count by Federal Information Processing Standard (FIPS) code. As wage per worker increase, holding budgets constant, we expect fewer jobs to be generated.

Volume to capacity ratio: (Binary variable) estimated as the State averaged (from HERS-ST: by urban/Rural) estimate of traffic congestion. We expect congested areas to tend to have higher job/expenditure ratio because of the need for more labor intensive work rerouting traffic.

Topography: a discrete variable which measured increasing gradient of FIPS coded regions in which the project was based. All things constant, we expect construction projects that a steeper gradient to require costlier materials, and that traffic enhancement projects require more labor to complete a project.

Results. Regression results are shown in Table 4.6. Results suggest that up to 90 percent of the variation in job generation impacts can be explained by the combination of project type and other explanatory factors. That is significantly more than the previously noted 81 percent of construction project impacts that was explainable by project type alone. In other words, of the 19 percent of state-to-state variance in job/expenditure ratio not already explained by the project mix, the regression incorporating measurements of labor cost, traffic congestion level, and topography explained up to 47 percent of that remaining variance.[24]

[24] This was based off of the group 1 R^2. A weighted average of the three R2 values by number of observations yields a combined explanatory power of approximately 87.7%, compared to what was explained by just project type (81%).

Table 4.6 Regression Coefficient Estimates: Results

Variables	Construction Projects	Pavement + Safety Projects	Traffic Enhancement Projects
Expenditure (millions)	12.439**	7.678**	14.148**
Exp * wages per worker (1000s)	-.073**	-.019**	-.108**
Exp * volume/capacity ratio	4.000**	2.942**	N.S.
Exp * Topography	-.041**	-.0863**	.198**
R^2	.903	.877	.822
N	1735	5736	880

* Significant at the 5 percent level.

** Significant at the 1 percent level.

The regression coefficients show that on average, low-wage areas tend to have a higher job/expenditure ratio, presumably because the money could be stretched to cover more construction activity and hence employ more total workers. The analysis also showed that congested areas also tend to have higher job/expenditure ratio, presumably because of the need for more labor intensive work rerouting traffic. It also shows that areas of high slope topography tend to have a lower job/expenditure ratio, presumably because of the greater need amount of structural support materials. The remaining unexplained variance may be due to differences in state processes for data collection and reporting, or other unexplained factors.

5.0 Analysis of Individual State-Level Data

5.1 Overview of State Collected Data

The public record includes, for each ARRA project, quarterly employment, and spending data. Employment is understood to represent current FTE, and spending is cumulative. In addition, four state databases were acquired from Florida, Kansas, Washington, and Wisconsin which include reported quarterly hours worked and payroll expenditure. Both of these are incremental, or in-period measures. By merging each of these databases with the public record, hours and payroll for each project could be appended to the existing public record of FTE and expenditure.

All projects are matched between databases based on their unique Federal project ID number. The major concern is consistency between databases. First, expenditures in the public dataset are differenced to produce incremental spending. In addition, there are some small chronographic differences between datasets, such as projects beginning or ending at different times. To ensure data consistency, each metric of interest was summed over quarters for which data was reported in both the public and state records. In a limited number of cases, a project is missing from one of the databases, and hence it is not included. Once the data are matched, four statistics are presented for each project: Hours, Payroll, FTE Jobs, and Expenditures. From these, four ratios are then calculated: Payroll/ Expenditures (representing labor's share of the project), Payroll/Hour (average hourly wage), Hours/FTE Job, and FTE Jobs/$1 Million Expenditure. For each state, these ratios are calculated both in the aggregate and by project type, as it was believed that the project category would be a significant determinant of labor input.

All four states exhibit a potential definitional issue, which concerns the Hours/Job metric. An annual FTE job should equal approximately 2,080 hours, given 40 hours per week and 52 weeks in the year. In this case, three of the states' provided quarterly reports that appeared to show Hours/Job averaging in the 628 to 701 range, which is somewhat higher than the 510 hours/quarter that would normally be expected. The fourth state provided monthly reports for Hours/Job averaging in the 225 range, which is slightly above the 173 hours/month that would normally be expected. The reason may be due to differences in accounting of part-time workers. Another issue is that all of the states appeared to report a number of jobs that differed from the U.S. DOT public dataset. The reason may be that contractors are actually reporting hours to the states, which then gets reported in the RADS system. U.S. DOT then converts the hours to FTE on a per quarter basis and it is this FTE number that is available in the public dataset, not the number of hours as originally reported.

The major findings from this exercise provide insight into labor's share of ARRA expenditure, average wages, and direct job creation associated with stimulus spending. The fact that these findings are relatively consistent across states provides an additional level of confidence in the results. Additionally, there are evident trends with project types across states. Below is a summary of the results from these four cases:

- The number of projects in each state varies widely, ranging from 150 to just over 1,000;
- The mix of projects varies slightly between states, but Pavement Improvement held by far the greatest share in each state, ranging from 32 percent to 55 percent of total project share;
- In three of the four states, payroll is 20.9 percent to 25.3 percent of total expenditure; in the fourth, this ratio is 6.7 percent;
- Average hourly wages for ARRA jobs ranges between $21 and $40, with three of the states being in the $21 to $28 range; and
- Jobs per one million of expenditure ranges from 9.0 to 16.8; this figure varied widely by project type; Transportation Enhancements and New Construction produces by far the most jobs, with figures consistently close to 20 and in one case above 32.

5.2 Florida Data

Table 5.1 presents the results for data provided by the State of Florida. The data reveal a Payroll/Expenditure ratio of 0.22, and average wage of $20.95, Hours/Job of 628, and 16.8 jobs per one million dollars. These results largely mirror those for the Pavement Improvement category, which makes up the largest share across project types. It should be noted that 38 percent of the Florida projects which were matched between the two databases did not have a designated project type.

Table 5.1 Florida ARRA Data – Based on Quarterly Reports

	Count	Share	Hours	Payroll	FTE	Expenditures	Payroll/ Expenditure	Payroll/Hour	Hours/Job	Jobs/$1MM Exp
Bridge Improvement	19	2%	291,118	5,277,650	504.9	12,222,207	0.4318	18.13	576.56	41.31
Bridge Replacement	6	1%	24,369	509,945	40.1	2,553,922	0.1997	20.93	607.56	15.71
New Bridge Construction	2	0%	191,012	6,416,264	364.1	38,233,844	0.1678	33.59	524.64	9.52
Other	4	0%	1,088,927	26,250,353	1017.5	100,419,458	0.2614	24.11	1,070.22	10.13
Pavement Improvement	352	32%	2,095,506	40,431,329	3372.9	178,762,166	0.2262	19.29	621.27	18.87
Pavement Widening	29	3%	2,672,467	56,464,906	4733.5	293,084,628	0.1927	21.13	564.59	16.15
Safety/Traffic Management	103	9%	278,729	5,488,896	461.7	21,219,094	0.2587	19.69	603.70	21.76
Transportation Enhancements	160	15%	543,107	9,667,598	943.4	34,519,433	0.2801	17.80	575.67	27.33
(Unknown)	422	38%								
All	**1,097**		**7,185,234**	**150,506,942**	**11438.2**	**681,014,751**	**0.2210**	**20.95**	**628.18**	**16.80**

5.3 Kansas ARRA Data

Table 5.2 presents the results of analyzing the ARRA submitted by the State of Kansas. The results for Kansas are similar to Florida, although wages are higher at $25.19, and direct FTE jobs per one million spent equal 13. Transportation Enhancements are the most labor intensive project type and also exhibit the highest wages. New Bridge and Bridge Replacement projects perform particularly well in creating direct FTE jobs.

Table 5.2 Kansas ARRA Data – Based on Quarterly Reports

	Count	Share	Hours	Payroll	FTE	Expenditures	Payroll/ Expenditure	Payroll/Hour	Hours/Job	Jobs/$1MM Exp
Bridge Improvement	2	1%	3,128	62,844	6.6	377,580	0.1664	20.09	473.22	17.51
Bridge Replacement	16	11%	103,755	2,094,635	179.2	7,274,783	0.2879	20.19	579.05	24.63
New Bridge Construction	1	1%	3,690	47,208	7.1	289,158	0.1633	12.79	521.92	24.45
Other	4	3%	48,329	3,789,755	75.1	17,166,795	0.2208	78.42	643.53	4.37
Pavement Improvement	82	55%	400,174	9,547,207	609.6	45,062,196	0.2119	23.86	656.46	13.53
Pavement Widening	11	7%	1,136,340	27,142,833	1781.8	149,249,558	0.1819	23.89	637.76	11.94
Safety/Traffic Management	9	6%	57,800	1,285,424	87.6	6,098,213	0.2108	22.24	659.82	14.36
Transportation Enhancements	21	14%	91,082	3,634,584	165.1	7,447,611	0.4880	39.90	551.58	22.17
New Construction	4	3%	134,471	2,238,073	195.0	6,000,560	0.3730	16.64	689.74	32.49
All	**150**		**1,978,769**	**49,842,563**	**3107.0**	**238,966,453**	**0.2086**	**25.19**	**636.87**	**13.00**

5.4 Washington ARRA Data

Table 5.3 displays the findings from the State of Washington ARRA data. Of the four states, projects in Washington have by far the highest average wages at $40.41, and as a result the highest labor cost share of expenditures. ARRA-funded projects in WA also exhibit the lowest impact on direct FTE jobs (8.95) per $ million spent compared to the other three states. This may be due to two factors in combination: i) higher wages imply fewer jobs per expenditure, and (ii)Washington also has a high share of Pavement Improvement projects, which are less labor intensive.

Table 5.3 State of Washington ARRA Data – Based on Quarterly Reports

	Count	Share	Hours	Payroll	FTE	Expenditures	Payroll/ Expenditure	Payroll/Hour	Hours/Job	Jobs/$1MM Exp
Bridge Improvement	2	1%	24,084	794,189	11	12,792,322	0.0621	32.98	2,287.18	0.82
Bridge Replacement	7	3%	457,778	18,270,749	510	69,482,979	0.2630	39.91	897.01	7.34
New Bridge Construction	2	1%	233,790	8,351,097	213	16,710,972	0.4997	35.72	1,098.90	12.73
Other	7	3%	157,664	7,233,731	218	14,328,700	0.5048	45.88	723.66	15.21
Pavement Improvement	118	53%	1,063,589	44,508,271	2,144	265,986,811	0.1673	41.85	496.07	8.06
Pavement Widening	12	5%	491,021	20,370,183	503	54,192,579	0.3759	41.49	976.61	9.28
Safety/Traffic Management	20	9%	117,313	4,428,190	118	13,535,771	0.3271	37.75	990.65	8.75
Transportation Enhancements	43	19%	159,312	6,107,722	380	20,700,378	0.2951	38.34	419.75	18.33
New Construction	7	3%	184,579	6,919,396	123	9,772,489	0.7080	37.49	1,501.62	12.58
(Unknown)	4	2%	133,993	5,195,301	91	4,106,244	1.2652	38.77	1,479.93	22.05
All	**222**		**3,023,123**	**122,178,829**	**4,310**	**481,609,244**	**0.2537**	**40.41**	**701.47**	**8.95**

5.5 Wisconsin ARRA Data

Tables 5.4 and 5.5 display the findings from examining ARRA data provided by the State of Wisconsin. For the other states examined in this section, we used the Federally reported expenditures. For Wisconsin, we used the Federally reported expenditures in Table 4 and state reported expenditures in Table 5. Notable is the fact that state reported expenditures are about 55 percent of the total Federally reported expenditures.

Wisconsin has the second highest average wage and produces 10.83 jobs per one million spent. However, it has by far the lowest payroll to expenditure ratio, likely due in part to its high propensity for pavement projects. Nonetheless, the overall ratio of.07 is quite low. The aforementioned problem of Hours/Job is highlighted in Wisconsin where it is about nine times lower than one would expect for a FTE position.

Table 5.4 Wisconsin ARRA Data (Using Federally Provided Expenditure Data) – Based on Monthly Reports

	Count	Share	Hours	Payroll	FTE	Expenditures	Payroll/ Expenditure	Payroll/Hour	Hours/Job	Jobs/$1MM Exp
Bridge Improvement	9	2%	49,567	1,400,590	84.4	6,703,011	0.2089	28.26	587.29	12.59
Bridge Replacement	43	10%	136,666	3,924,817	245.9	22,510,428	0.1744	28.72	555.80	10.92
New Bridge Construction	2	0%	993	27,471	397.2	26,796,850	0.0010	27.67	2.50	14.82
Other	94	22%	33,247	909,928	253.2	11,481,207	0.0793	27.37	131.31	22.05
Pavement Improvement	214	51%	1,172,564	31,955,402	4646.3	367,202,042	0.0870	27.25	252.36	12.65
Pavement Widening	17	4%	499,883	14,037,231	2989.5	380,912,832	0.0369	28.08	167.21	7.85
Safety/Traffic Management	9	2%	150,556	4,032,500	286.3	38,466,942	0.1048	26.78	525.79	7.44
Transportation Enhancements	34	8%	166,276	4,604,774	902.4	50,943,685	0.0904	27.69	184.27	17.71
All	**422**		**2,209,752**	**60,892,714**	**9805.2**	**905,016,997**	**0.0673**	**27.56**	**225.37**	**10.83**

Table 5.5 Wisconsin ARRA Data (Using State Provided Expenditure Data) – Based on Monthly Reports

	Count	Share	Hours	Payroll	FTE	Expenditures	Payroll/ Expenditure	Payroll/Hour	Hours/Job	Jobs/$1MM Exp
Bridge Improvement	9	2%	49,567	1,400,590	84.4	8,575,187	0.1633	28.26	587.29	9.84
Bridge Replacement	43	10%	136,666	3,924,817	245.9	25,096,593	0.1564	28.72	555.80	9.80
New Bridge Construction	2	0%	993	27,471	397.2	441,174	0.0623	27.67	2.50	900.35
Other	94	22%	33,247	909,928	253.2	6,168,188	0.1475	27.37	131.31	41.05
Pavement Improvement	214	51%	1,172,564	31,955,402	4646.3	278,542,974	0.1147	27.25	252.36	16.68
Pavement Widening	17	4%	499,883	14,037,231	2989.5	110,797,444	0.1267	28.08	167.21	26.98
Safety/Traffic Management	9	2%	150,556	4,032,500	286.3	39,011,470	0.1034	26.78	525.79	7.34
Transportation Enhancements	34	8%	166,276	4,604,774	902.4	30,180,012	0.1526	27.69	184.27	29.90
All	**422**		**2,209,752**	**60,892,714**	**9805.2**	**498,813,043**	**0.1221**	**27.56**	**225.37**	**19.66**

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6.0 Conclusions

Direct job impact verification related to 'shovel-ready' state-specific highway and bridge projects (to date) funded through ARRA relies upon quarterly public data. The dataset is comprised of 14527 records containing ARRA projects with associated jobs (by project type and status) and expenditures levels for the time period ranging from third quarter 2009 to first quarter 2011. The data covered a range of projects in all of the 50 states as well as the U.S. territories of American Samoa, District of Columbia, Guam, Northern Mariana, Puerto Rico, and the Virgin Islands. The project records contain the following project types: Bridge Improvement, Bridge Replacement, New Bridge Construction, New Construction, Other, Pavement Improvement, Pavement Widening, Safety/ Traffic Management and Transportation Enhancements. Table 6.1 displays the percentage of jobs and expenditures by project type and Table 6.2 displays the national average jobs per million dollars in expenditures by project type.

Table 6.1 Percentage of Recovery Act Reported Jobs and Expenditures by Project Type, 2009Q3 to 2011Q1

Arra Reported Percentage Allotment		
Project Type	Reported Jobs	Reported Expenditures
Bridge Improvement	6%	5%
Bridge Replacement	5%	5%
New Bridge Construction	2%	1%
New Construction	6%	5%
Other	3%	3%
Pavement Improvement	46%	55%
Pavement Widening	17%	14%
Safety/Traffic Management	5%	5%
Transportation Enhancements	7%	4%

Source: CS and EDR Group analysis of data available at:

Table 6.2 Average Direct Jobs per Million Dollars in Expenditures, National ARRA Database, 2009Q3 to 2011Q1[25]

Avg Jobs Per Million By Project Type(Post Screening)	
Project Type	Jobs Per Million
0	16.57
Bridge Improvement	12.12
Bridge Replacement	11.53
New Bridge Construction	11.74
New Construction	12.52
Other	12.05
Pavement Improvement	9.01
Pavement Widening	12.69
Safety/Traffic Management	10.32
Transportation Enhancements	17.03
All	**10.55**

Source: CS and EDR Group analysis of data available at http://www.Recovery.gov.

General observations may be made through different combinations of the data. At the highest level, one can look by various project types with respect to their share of funding (outflow), and share of reported jobs (inflow). Projects of the type 'Pavement Improvement' received the highest percentage of funds, but comparatively had the lowest ratio of jobs to expenditures (followed by safety/traffic management). On the contrary, Transportation enhancements yield the highest reported jobs to expenditures ratio, followed by New Bridge Construction. Qualitatively a trend is becoming apparent where job creation can be expected to be some function of a given level of expenditure, however the relative success (in terms of creating direct jobs) of such a project can also be dependent on the type of project. This is not surprising, as it takes far fewer workers to repave a road, than to erect a bridge.

Analysis of the raw data results in significant variation in level of jobs reported. To try and capture more of the variation in state by state job creation (reported versus predicted), a simple multivariate linear regression is chosen to test the explanatory power of variables representing labor and non-labor project expense factors. Initial research based on the conceptual model finds that of all available predictors of project difficulty, topography, and volume/capacity ratio appear to have the greatest explanatory power. The

[25] For completeness the project type '0' was included – which was a designator for lacking project type. For regression analysis, this category was automatically dropped. The decision was made on the grounds of lack of adequate information and representativeness, and by the fact that it only made up 27 observations (after screening for project status).

Areas for Additional Research

- Detailed analysis of payroll and hours data for a more comprehensive set of states.
- Impact of sources of wage rate differentials (i.e., lower skill levels, labor unions, etc.) on direct job impact.
- Examination of short-term indirect and induced impacts of transportation investments.
- Reconciliation of time lag between hours and payroll data in the state level data and the expenditure data in the Federal database.

regressions indicate that up to 90 percent of the variation in job generation impacts can be explained by the combination of project type and other explanatory factors noted above.

Despite the variation and shortcomings in the ARRA data, this research suggests that investment in transportation infrastructure has a positive and significant impact on job creation and retention. However, the ARRA data reporting requirements are not designed to capture or to allow for the analysis of long-term economic impact of transportation investments without significant modifications and potentially overly burdensome reporting requirements.

In summary, the use of the ARRA data to analyze the economic impact of transportation investments is currently limited to short-term construction-related impacts. In addition, the usefulness of the data for this purpose is limited due to the fact that not all data reported is publicly available. Despite numerous attempts for this effort, the more detailed hours and payroll data were only obtainable on a state-by-state basis. To maximize the analytical usefulness of the data, all data complete with a reporting requirements over time are needed. The release of this more detail data would make another investigation into the explanatory nature of the data desirable.

Glossary of Terms

Direct Job: refers to jobs created by the actual project funded with ARRA funding.

Full-Time Equivalent (FTE): refers to a full-time worker. An FTE is calculated as the total of hours worked in one year divided by the maximum number of compensable hours (e.g., if total hours worked is 5,000, and the maximum compensable hours is 2,080, the FTEs is calculated at 5,000/2,080 = 2.4 FTEs). ARRA recipients were instructed to calculate the number of FTE jobs funded through ARRA by counting the total number of hours worked that were funded by ARRA during any given quarter, divided by the number of hours in a full-time schedule for a quarter.

Indirect Job: refers jobs created at suppliers who make the materials used in the project.

Induced Job: refers to jobs created elsewhere in the economy as increases in income from direct government spending lead to additional increases in spending by workers and firms.

Job-Years: Refers to the number of jobs created in one year. The 1512 database reports jobs by quarter. To avoid double counting of jobs from one quarter to another, the formula to estimate job years from quarterly reports is:

$$\frac{\sum \ Jobs\ by\ quarter}{\#\ of\ quarters}$$

Appropriations: A legal provision authorizing the spending of funds for a specific purpose.

Allocations: An administrative distribution of funds for programs that do not have statutory distribution formulas.

Status of ARRA Funding

Obligated: Funds that have been set aside by the Federal government for a specific purpose, but not necessarily expended or outlayed.

Expended (Expenditures): Funds that have already being spent in a project.

Reimbursed: Funds that have already being reimbursed by the Federal government to the grantee.

Outlays: Payments made by the government.