



White Paper:

Job Impacts of Spending on Public Transportation: An Update

Prepared for:



American Public Transportation Association
Washington, DC

Prepared by:

Economic Development Research Group, Inc.
2 Oliver Street, 9th Floor, Boston, MA 02109

April 29, 2009

Table of Contents

Executive Summary	ii
Overview	1
1.1 Topics Covered	1
1.2 Background: What are Job Impacts?	1
1.3 The Need for Updates	2
Total Job Impacts	4
2.1 Earlier Studies and Reports	4
2.2 Updating the APTA Study	5
2.3 Blended Average Impact	6
2.4 Alternative Model Estimates	7
2.5 Federal Spending Impacts	8
Types of Jobs	10
3.1 Types of Occupations	10
3.2 Direct Effects	10
3.3 Total Effects	11
Improving Future Analysis	14
4.1 Future Research Needs	14

EXECUTIVE SUMMARY

Job Impacts of Spending on Public Transportation: An Update

*A white paper prepared by Economic Development Research Group, Inc.
for the American Public Transportation Association, February 13, 2009.*

This document reviews and updates estimates of the job impacts of public transportation spending and it examines broader issues concerning the definition and measurement of those job impacts. Key findings:

- The rate for federal funding of public transportation reflects a specific mix of capital investment and preventive maintenance funding as allowable by law. **Under current federal law, an estimated 30,000 jobs are supported per billion dollars of spending.**
- The national rate can vary from of 24,000 to 41,000 jobs per billion dollars of spending, depending on the spending mix. The lower figure holds for spending on capital investments (vehicles and facilities), while the higher figure holds for spending on transit system operations. In reality, it is not logical to spend money on vehicles and not use them, nor is it logical to operate vehicles forever without any purchases of new equipment. For these reasons, the average rate is a more meaningful number.
- Looking across the entire \$47 billion spent on public transportation in the US each year, there is an average rate of approximately 36,000 jobs per billion dollars of public transportation spending (i.e., 36 jobs per million dollars of spending). This figure is based on the national mix of public transportation spending as of 2007. It includes a direct effect of spending in transportation related manufacturing, construction and operations as well as orders to suppliers or by re-spending of worker income on consumer purchases.
- The rate of jobs supported per billion dollars of spending will continue to change every year, as prices change and technologies evolve.

1

OVERVIEW

1.1 Topics Covered

This memo provides a current update of the job impacts of public transportation spending in the US, and it examines broader issues concerning the definition and measurement of those job impacts. It has three parts:

- **Number of Jobs** -- First, we provide current updates concerning the numbers on job creation created by public transportation capital and operations spending. We also discuss the interpretation of the updated numbers as they compare to the figures put out by past studies.
- **Types of Jobs** – Second, we provide estimates of the types of jobs and income levels created by public transportation spending, and interpret them in light of current national trends.
- **Towards a Better Measures** – Third, we discuss gaps and missing elements in current and past analyses of job impacts associated with transportation spending, and we indicate directions needed for further research and analysis that may help improve future policy analysis.

1.2 Background: What are Job Impacts?

Investment in transportation infrastructure construction and transportation services has long been a favored policy option to aid economic recovery and accelerate employment growth. There are two general types of job impacts –

- (1) the impacts of spending money on public transportation, which creates and supports jobs in a wide variety of related industries, and
- (2) the impacts of having public transportation services available, which can potentially lead to cost savings or income benefits for households and businesses.

This white paper focuses only on the first type of job impact. The second category of impact has been addressed in a past APTA report and it will be further addressed in future TCRP reports.

The job impacts of spending on public transportation can be grouped into three key categories:

- “Direct” spending on public transportation – This can include spending on “capital Investments” such as building or constructing buses, trains, stations, tracks, maintenance shops, equipment, etc. It can also include spending on ongoing operations of public transportation systems – including bus and train operations, maintenance activities and administration.
- “Indirect” effects on supporting industries, i.e., those that supply goods and services to enable the direct spending – including workers in industries supplying engines, equipment, and the steel, concrete, wood and plastic materials that are needed for building vehicles, guideways and station facilities.
- “Induced” effects on the re-spending of worker income on consumer goods and services – including food, clothing, shelter, recreation and personal services.

1.3 The Need for Updates

Investment in transportation infrastructure construction and transportation services has long been a favored policy option to aid economic recovery and accelerate employment growth. However, over time, a wide a variety of different studies have been conducted and have put forward very different numbers concerning the job impacts of transportation spending – particularly public transportation spending. This has, understandably, lead to confusion.

There are three basic reasons for the variation in numbers.:

- First, the ratio of job creation per dollar of investment continues to decline over time, as the buying power of the dollar is eroded by inflation in both wage levels and costs of materials. This same pattern of change holds for any kind of spending; it means that as salaries rise due to inflation, a million dollars will support fewer jobs. The result is that job impacts will differ depending on the year that the study is conducted.
- Second, the use of advanced technologies – which affecting the non-labor share of total costs –continues to rise over time. For instance, spending on automated fair collection and automated control systems continue to rise, while the need for workers to manually provide these services continues to fall over time. This trend further changes job

impact estimates, and also causes them to differ depending on the year that the analysis is conducted.

- Third, many different reports and articles address different categories of investment, though these distinctions are often not well discussed (or even noted) in the text of reports. It is not always clear whether the job impacts reported in some articles and papers refer to capital spending, operations spending, or a mix of the two. There can be additional differences assumed in the mix of spending, such as the combination of investments in right-of-way expansion, alternative vehicle types and alternative fuel or power systems.

This white paper is intended to address all three of these issues, so that readers can better identify and understand the nature of job generation associated with public transportation spending. However, this document should be interpreted as merely an interim update to past studies, as the Transit Cooperative Research Program has funded two new studies during 2009 that should shed further light on the full job and economic impacts of public transportation spending.¹

¹ This includes TCRP Project H-39 and TCRP Project J-11(07).

2

TOTAL JOB IMPACTS

2.1 Earlier Studies and Reports

The 1999 study entitled, “Public Transportation and the Nation’s Economy,” was sponsored by the American Public Transportation Association (APTA) and authored by Cambridge Systematics and Economic Development Research Group (EDRG).² That study examined the effects of various types of public transportation spending on jobs, household and business costs, and tax revenues. That study analysis utilized a hybrid of input-output and REMI simulation models to assess the direct, indirect and induced job impacts of public transportation spending.

Since then, a variety of organizations that have provided their own updated estimates of the job generation which range from as low as 19,795 jobs per \$billion of spending (in a study by the University of Massachusetts)³ to as high as 41,028 jobs per \$billion of spending (in a study by the Surface Transportation Policy Project).⁴ In general, these differences are attributable to the fact that they are covering different types of spending, different types of impacts and different analysis years. However, those differences are not always readily apparent to readers. Needless to say, this wide range of impact estimates has ultimately led to confusion over what is truly the relative job impact of public transportation investment.

² *Public Transportation and the Nation’s Economy*,” by Cambridge Systematics and Economic Development Research Group, prepared for the American Public Transportation Association, 1999. See <http://www.apta.com/research/info/online/documents/vary.pdf>

³ *Robert Pollin and Heidi Garrett-Peltier, The U.S. Employment Effects of Military and Domestic Spending Priorities*,” Department of Economics and Political Economy Research Institute, University of Massachusetts, Amherst, page 5. This figure is also quoted in *October 2007 Environmental Gristmill*. See <http://www.ips-dc.org/reports/071001-jobcreation.pdf> and <http://gristmill.grist.org/story/2008/3/11/155421/333>

⁴ *Surface Transportation Policy Project (STPP) updated estimate based on the original 1998 estimate; this figure is also quoted by the Sierra Club*. See http://www.transact.org/library/decoder/jobs_decoder.pdf and <http://www.sierraclub.org/sprawl/report04/transit.asp>

2.2 Updating the APTA Study

To update the 1998 estimates of jobs created by public transportation capital and operating expenditures, we applied changes in the applicable Producer Price Indexes (PPI) over the 1998-2007 period. (Note that final PPI numbers for 2008 are not yet available). As wage and price inflation occurs over time, a billion dollar buys fewer workers and less materials. So it is natural that the job creation numbers should decline over time.

To derive appropriate PPI adjustments for public transportation capital spending, we calculated a weighted average of the applicable cost elements, as shown in Exhibit 1:

*Exhibit 1. Mix of Public Transportation Spending, 2007*⁵

	% of Capital Spending	% of Total Spending
Purchase of Buses	16%	5%
Purchase of Rail Vehicles	11%	3%
Purchase of Supporting Equipment	12%	4%
Construction of Guideways (rail lines or busways)	33%	10%
<u>Construction of Buildings and Related Facilities</u>	<u>28%</u>	<u>8%</u>
Subtotal: Capital Spending	100%	29%
Operations and Maintenance Spending		71%
Total Public Transportation Spending		100%

For each spending element, we used the closest available Producer Price Index series for the period of 1998-2007, and then developed blended averages for the overall adjustment in public transportation capital and operating costs. The matching series for each element is listed in the footnote at the bottom of this page.⁶ The results are shown in Exhibit 2, on the next page. In each case, the

⁵ Breakdown of the current mix of cost elements of public transportation spending was provided by APTA, and is based on the most recent data reported in the National Transit Database.

⁶ For buses we used the PPI index for heavy truck and bus manufacturing. For rail equipment, we used the PPI for railroad rolling stock manufacturing. For supporting control equipment, we used the PPI for electrical equipment. For guideways, we used the closest available PPI, which is for highway and street construction. For buildings, we used the PPI commercial building construction. For transit operations, we used the

1998 values were drawn from the earlier APTA study, and the values for subsequent years were calculated on the basis of applicable PPI adjustments.

Exhibit 2. Summary of Estimated Public Transportation Spending Impact on US Job Creation, updated from the 1999 APTA Study

Year	PPI Adjust.	Capital Inv. Jobs per \$1B	PPI Adjust.	Operations Jobs per \$1B
	Public Trans Capital		Public Trans Operations	
1998	129.7	31,400	101.7	57,000
2005	151.5	26,885	125.2	46,304
2007	171.3	23,788	140.9	41,140

→ Average of all spending (as of 2007) is 36,108 jobs per \$ billion; corresponding average for federal spending mix is 30,107 (see section 2.3)

These results indicate that the job creation per billion dollars of expenditure is now approximately 24,000 for public transportation capital spending and 41,000 for public transportation operations spending (with all values rounded to the nearest thousand). However, it is often not useful to make the distinction between capital and operations spending, as discussed next.

2.3 Blended Average Impact

It is impractical to consider either public transportation capital spending or operations spending in isolation. After all, it is not practical to buy buses and trains and then not operate them. And it is not possible to operate public transportation systems indefinitely without some equipment replacement. Thus, in reality, the two categories of spending must both occur with some level of synchronization.

In the context of funding decisions, the distinction is further blurred. For instance, FTA capital funds can be used for preventive maintenance (an element of operations). In addition, a local public transportation agency can effectively trade off funding sources so that, for instance, a shortfall in capital funding can be offset by shifting some operating funds to purchase of badly needed buses. Conversely, a local transportation agency can offset a shortfall in operations funding by shifting some local revenue funds that might otherwise have helped purchase buses.

closest available PPI, which is for the broad category of rail transportation services. (Note: a separate PPI series for bus and truck transportation did not start until 2004).

To assess the job impact of all national spending on public transportation, we need to consider the current national mix of that spending. According to APTA, the national total is 71% for operations spending and 29% for capital spending. That yields a blended average of 36,108 jobs within the United States that are supported per billion dollars of public transportation spending.

Exhibit 3 shows a breakdown of these jobs, distinguishing categories of direct effects (public transportation manufacturing /construction and operations jobs), indirect effects (jobs at suppliers of parts and services) and induced jobs (jobs supported by workers re-spending their wages).

Exhibit 3. Jobs Generated in the US per Billion Dollars of Spending on Public Transportation (National Spending Mix, 2007)

Jobs per Billion Dollars of Spending	Capital Spending	Operations Spending	Blended Average Spending
Direct Effect	8,202	21,227	17,450
Indirect Effect	7,875	2,934	4,367
Induced Effect	7,711	16,979	14,291
Total Jobs	23,788	41,140	36,108

2.4 Alternative Model Estimates

The estimates of job impact used for this study utilized a composite methodology that attempts to parallel the FHWA method used for highway related job creation, in that it tracks the pattern and mix of direct expenditures, and traces their indirect and induced impacts utilizing a national economic model. To verify its values, we also developed alternative job creation impact calculations using two economic modeling systems that offer simplified inputs to represent fixed, preset spending profiles for bus and train construction and public transportation system operations. Both IMPLAN and REMI are built upon the US national input-output (I-O) table, reflecting 2004 inter-industry purchasing and import patterns, with 2007 prices. Exhibit 4 compares findings from these alternative calculation methods.

Exhibit 4. Summary of Estimated Public Transportation Spending Impact on Job Creation, using three alternative economic models with 2007 prices

Job Creation per \$ Billion	IMPLAN model	REMI model	EDRG Composite
Public Trans. Capital Spending	18,465	28,984	23,788
Public Trans. Operations Spending	31,291	43,952	41,140
Public Trans. Overall Spending	27,571	39,611	36,108

Together, the IMPLAN and REMI models show a range of low and high impact estimates that encompass our estimates. The differences between these various estimates are also understandable. For instance, the IMPLAN estimates can be interpreted as representing a low end of the range because they do not automatically account for: (a) additional transportation spending impacts on wages and tax revenues, leading to further growth of government jobs over time, or (b) jobs associated with equipment that is assembled outside the US, but with parts that originated in the US. On the other hand, the REMI model estimates can represent a high end of the range because they incorporate forecasts of growth in technological productivity and real wages, which can include changes in US-based assembly and fuels.

Ultimately, none of these model estimates account for the potential that there can be even more jobs generated if there is a change in policies regarding “made in America” purchasing or incentives for further switching to biodiesel and natural gas vehicles (which rely primarily on US-processed fuels). As a result, all of these estimates could understate job impacts. However, for purposes of public discussion, it is most useful to avoid assuming that changes in other policies will take place. For that reason, we adopt the composite calculation of approximately 36,000 jobs per billion dollars for all public transportation spending in the US.

2.5 Federal Spending Impacts

Federal Spending Impact on Jobs. The preceding estimates reflect jobs supported per billion dollars of transit spending in the US, including spending funded by rider-paid fares, local/state revenue sources, federal funding and other sources. In order to assess the number of jobs supported by federal spending on public transportation, we have to recalculate the job figures using the specific spending mix that is applicable for federal funding. Basically, federal authorization law focuses federal funding on capital expenditures and preventive maintenance, though the latter would actually be described as operations in the federally required standard accounting system.

In federal fiscal year 2007, 31.4% of federal assistance for public transportation was for operating expenses as defined by the standard accounting system and 68.6% was for capital expenses. That mix of uses supports an estimated 29,236 jobs per billion dollars of federal spending on public transportation. If expenditures on right-of-way are excluded from the analysis, then the figure rises to an estimated 29,833.⁷

It is notable that this latter figure for historical expenditure on federal funding of public transportation is statically comparable to the range of jobs per billion of federal spending on highway investment that was found by FHWA.⁸

Exhibit 5 summarizes these findings. Of course, it is important to remember that the actual value of these job generation numbers will vary from year-to-year, depending on both the mix of spending elements and price inflation rates. Changes in the mix may include not only shifts in shares of capital and operating spending, but also shifts in technologies used. For instance, the growth of alternative motor fuels such as biodiesel and natural gas can increase US job creation because these alternative fuels come from US-based sources which support additional jobs for their collection and processing. Finally, it should be noted that bus operations also depend in part on spending to build and adequately maintain road systems, though that job impact is not addressed in this paper.

Exhibit 5. Jobs Generated in the US per Billion Dollars of Spending on Public Transportation, for Alternative Spending Mixes (2007)

Spending Category	(Capital / Operating) Mix	Model Calculation	Recommended Use: Rounded Value
Capital Spending Only	(100 / 0)	23,788	24,000
Operations Spending Only	(0 / 100)	41,140	41,000
Total National Spending Mix	(29 / 71)	36,108	36,000
Federal-Aid Spending Mix	(69 / 31)	29,833	30,000

⁷ The purchase of land for busways and rail lines does not generate jobs, so the exclusion of those costs leads to slightly higher estimates of job generation per billion dollars of spending. The portion of federal public transportation expenditures spent on land acquisition is not precisely known, though it is likely to be significantly lower than the 7% portion which applies for federal highway expenditures. For this study, a figure of 2% was adopted as a reasonable estimate of the applicable portion of federal public transportation funding.

⁸ FHWA analysis for 2007 indicates that each \$ billion of federal highway expenditure, in historical proportions of use, supports 27,800 jobs (allowing for inclusion of right-of-way expenses) or 30,000 jobs exclusive of right-of-way acquisition costs. Source: www.fhwa.dot.gov/policy/otps/pubs/impacts/index.htm (updated 2/12/09)

3

TYPES OF JOBS

3.1 Types of Occupations

In a time of economic stagnation and decline, the job generation impacts of public transportation investment are particularly valuable. However, the public need is not just for any type of job, but rather those in industries particularly hard hit by the economic downturn. In a time of declining blue-collar employment within the US, there is a particular need for quality skilled and semi-skilled blue-collar jobs.

Thus, it is also useful to examine the types of jobs that are generated directly or indirectly by spending on public transportation capital and operations. In general, the job impacts can be examined in two distinct ways:

- (1) *direct effects* -- in terms of the mix of jobs that are directly generated by the processes of capital investment (acquiring vehicles and constructing guideways and building facilities) and operations (running bus, train and paratransit systems); and
- (2) *total effects* – counting the mix of directly-generated transportation-related jobs, *plus* additional jobs that are generated throughout the broad economy as a result of increased supplier orders (indirect effects) and re-spending of worker wages (induced effects).

3.2 Direct Effects

Direct-effects refer to jobs building public transportation systems (vehicles, facilities and right of way), as well as jobs operating and maintaining them. Jobs associated with these direct effects can be considered “green jobs.”⁹

These “direct effects” jobs are classified into four categories:

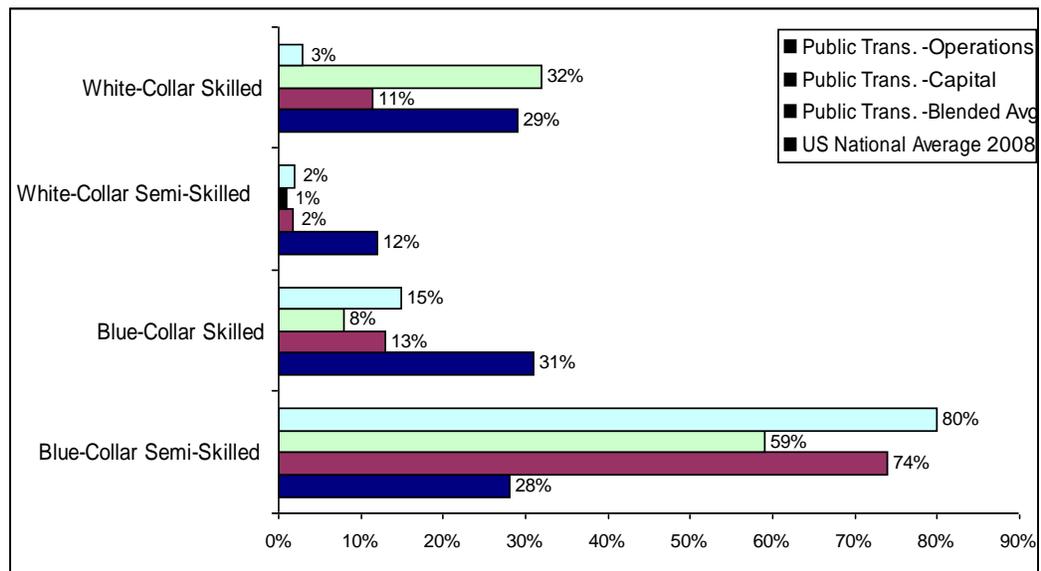
- *Blue collar semi-skilled jobs* –drivers, crew, ticket agents, construction;
- *Blue collar skilled jobs* – manufacturing, service and repair workers;

⁹ *Jobs in mass transit development and operations are considered “green jobs” as defined by the report, Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy” by Robert Pollin, Heidi Garrett-Peltier, James Heintz, and Helen Scharber, University of Massachusetts-Amherst, commission by the Center for American Progress.*

- *White collar semi-skilled jobs* – clerical jobs; and
- *White collar skilled jobs* – managerial workers and technical engineers

Exhibit 6 shows the percentage of directly-generated jobs that fall within each of these categories. It distinguishes jobs associated with capital investment and operations of public transportation facilities, and it compares that mix to the national US average of all jobs. Altogether, it shows that both capital investment *and* public transportation operations spending are particularly successful at generating blue-collar, semi-skilled jobs. It also shows that capital investment in buses, trains and related equipment generates a higher-than-average portion of white collar skilled jobs, including engineering and technical professions.

Exhibit 6. Direct Effects Occupation Mix
(Percent of Jobs Generated by Public Transportation Spending)



3.3 Total Effects

Total effects on jobs encompass a wider range of occupations generated by suppliers of goods and services and firms benefiting from workers re-spending their wages. These jobs can include:

- *Blue collar semi-skilled jobs* –restaurant, grounds keeping and personal care workers, as well as construction workers and transport workers;
- *Blue collar skilled jobs* – health care and protective services, as well as manufacturing, service and repair workers;
- *White collar semi-skilled jobs* – retail and wholesale stocking workers, as well as clerical workers; and
- *White collar skilled jobs* – legal, banking, technical, managerial workers.

Exhibit 7 shows the percentage of total-effects jobs that fall within each of these categories. It also keeps the distinction between jobs associated with capital investment and operations-related jobs, and the comparison to national US average of all jobs. Altogether, it shows that both capital and operations spending generates a very broad range of jobs spanning all basic job categories, with significant shares of both white- and blue-collared jobs in skilled occupations, as well as the blue-collar semi-skilled category. Spending on transit operations, though, is most notably dominant in its concentration of blue collar, semi-skilled jobs. That difference is illustrated by Exhibit 8 on the next page.

Exhibit 7. Total Effects Occupation Mix:
(Percent of Jobs Supported by Public Transportation Spending)

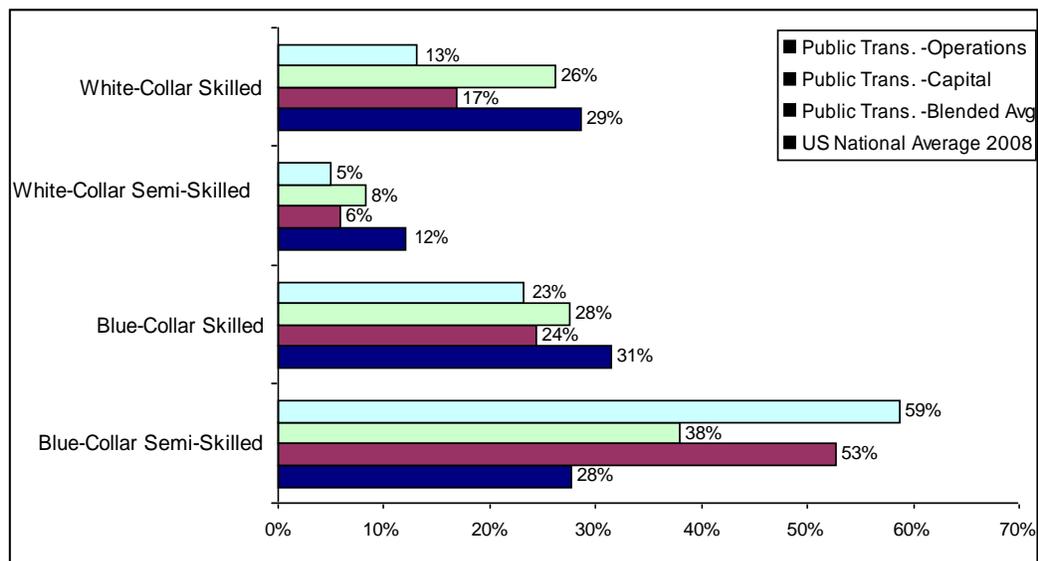
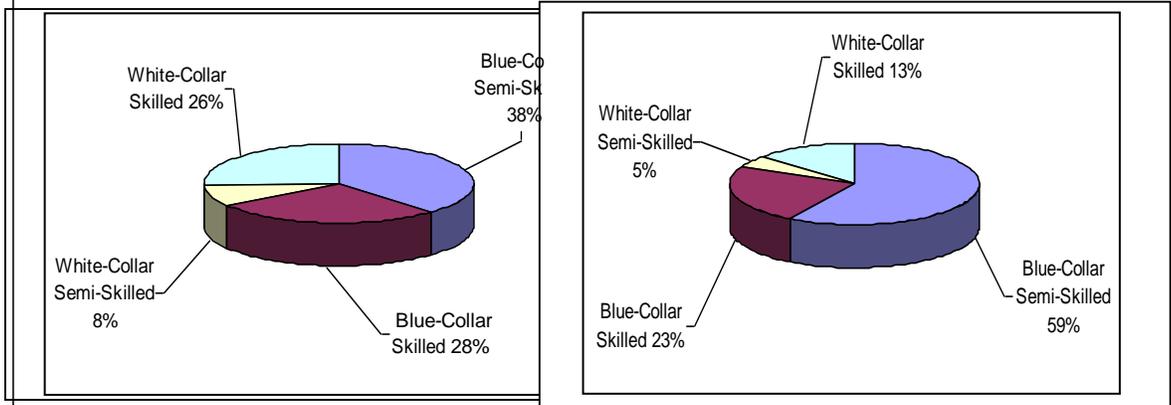


Exhibit 8. Comparison of the Total Effects Occupation Mix: All Jobs Generated as a Result of Public Transportation Capital & Operating Spending

(A) All Jobs Generated by Public Transportation Capital Spending

(B) All Jobs Generated by Public Transportation Operations Spending



4

IMPROVING FUTURE ANALYSIS

4.1 Future Research Needs

To make a more balanced comparison of the *relative impact of investing in alternative transportation modes*, it may be useful to consider how transportation spending affects jobs by considering all relevant spending -- regardless of whether the spending is initiated by federal agencies, state agencies, private business spending or household spending. After all, most federal and state funds originates as tax and fee revenues collected from households and businesses, so ultimately the money for all of these various types of spending come from the nation's workers and residents. This recalculation can be done by considering the average number of jobs supported per dollar of spending on each mode, where that average covers all forms of public and private spending.

If this approach is taken, then we can recognize that road building also supports public transportation by enabling better bus services and train station access. We can recognize that car and truck fuel purchasing patterns also affect total job impacts from road building. We can further recognize the potential for expanded public transportation to shift needs and household savings associated with car purchases, and redirect those savings into other forms of purchases. However, these additional sources of job impacts relate more to the long-term impact and benefit of enhancing available public transportation services, rather than the short-term impact of spending. These additional issues are to be addressed in later research studies.