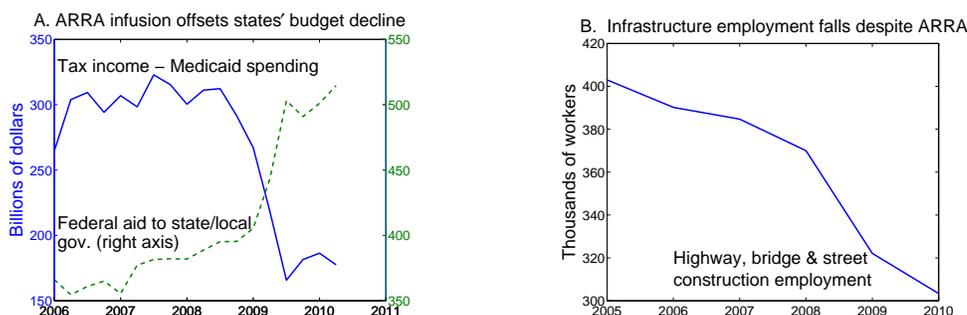# The American Recovery and Reinvestment Act: Public Sector Jobs Saved, Private Sector Jobs Forestalled[*]

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Updated May 17, 2011

Abstract

This paper uses variation across states to estimate the number of jobs created/saved as a result of the spending component of the American Recovery and Reinvestment Act (ARRA). The key sources of identification are ARRA highway funding and the intensity of state sales tax usage. Our benchmark point estimates suggest the Act created/saved 450 thousand government-sector jobs and destroyed/forestalled one million private sector jobs. The large majority of destroyed/forestalled jobs are in a subset of the private service sector comprised of health, (private) education, professional and business services, which we term HELP services. There is appreciable estimation uncertainty associated with these point estimates. Specifically, a 90% confidence interval for government jobs gained is between approximately zero and 900 thousand and the counterpart for private HELP services jobs lost is 160 to 1378 thousand. In the goods-producing sector and the services not in our HELP subset, our point estimate jobs effects are, respectively, negligible and negative, and not statistically different from zero. However, our estimates are precise enough to state that we find no evidence of large positive private-sector job effects. Searching across alternative model specifications, the best-case scenario for an effectual ARRA has the Act creating/saving a (point estimate) net 659 thousand jobs, mainly in government. It appears that state and local government jobs were saved because ARRA funds were largely used to offset state revenue shortfalls and Medicaid increases (Fig. A) rather than directly boost private sector employment (e.g. Fig. B).

A. ARRA infusion offsets states' budget decline

B. Infrastructure employment falls despite ARRA

1 Introduction

As a response to a recession that began in December of 2007, President Barack Obama signed into law The American Recovery and Reinvestment Act, hereafter ARRA, (Public Law 111-5) in February of 2009.[1] It authorized $288 billion for Federal tax cuts and $499 billion in Federal government spending. This paper seeks to understand the causal effect on employment of the government spending component of the ARRA.[2] We estimate how many jobs were created/saved by the American Recovery and Reinvestment Act.[3]

Our benchmark point estimates suggest that the ARRA created/saved approximately 450 thousand state and local government jobs and destroyed/forestalled roughly one million private sector jobs. State and local government jobs were saved because ARRA funds were largely used to off-set state revenue shortfalls and Medicaid increases rather than boost private sector employment. The majority of destroyed/forestalled jobs were in growth industries including health, education, professional and business services.

There is appreciable estimation uncertainty associated with these point estimates. Specifically, a 90% confidence interval for government jobs gained is between approximately zero and 900 thousand and the counterpart for private HELP services jobs lost is 160 to 1378 thousand. In the goods-producing sector and the services not in our HELP subset, our estimated jobs effects are, respectively, negligible and negative, and not statistically different from zero. However, our estimates are precise enough to state that we find no evidence of large positive private-sector job effects.

The finding of a negative jobs effect in the HELP services sector suggests the possibility that, in absence of the ARRA, many government workers (on average relatively well-educated) would have found private-sector employment had their jobs not been saved. Searching across alternative model specifications, the best-case scenario for an effectual ARRA has the Act creating/saving a net 659 thousand jobs, mainly in government.

A large fraction of the Federal ARRA dollars was channeled through and controlled by state and local governments.[4] This is important for two reasons. First, it opens the possibility that states might receive different ARRA allocations due in part to differing exogenous capacities to channel or attract Federal funding. Approximately two-thirds of all ARRA spending is formulary,

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[1] Useful background reading on the ARRA includes Auerbach, Gale and Harris (2010).

[2] We focus on employment rather than: (a) the unemployment rate because of well-known issues related to movements in and out of the labor force, and (b) GDP because it is only available annually for our unit of observation, a U.S. state, and it is subject to long data-collection lags. We focus on government spending because of the relative dearth of government spending research relative to research on tax change.

[3] Section 5 discusses other researchers' estimates of the jobs effects of the ARRA in the context of our findings. Also, several economists have written insightful pieces, in the popular press, on the macroeconomic effects of government stimulus spending, such as Barro (2010), Frank (2009), Krugman (2009), and Ohanian (2009).

[4] This included, for example, $86.6 billion to support states' Medicaid programs, a $53.6 billion 'State Fiscal Stabilization Fund' to aid local school districts, $48.1 billion for transportation infrastructure investment, $40 billion for states to pay unemployment benefits, $13 billion for programs supporting public schools with students from low income families, and $6 billion for clean water projects.

Table 1: State government contributed spending and ARRA spending, various categories and in billions of dollars

Spending category	ARRA	States-contributed spending
Medicaid	88.6	254.1
Elementary and secondary education	53.6	434.5
Highways	28.0	46.8

Notes: ARRA dollars are amounts authorized by the Act. State contributions are 2008 FY multiplied by the number of years that ARRA has spanned, 1.83. Elementary and secondary education of ARRA dollars refers to State Fiscal Stabilization Fund. State-contributed education spending does not include $557 billion 2008 spending by local governments. Sources are Public Law 111-5 (2009), National Association of State Budget Officers (2009) and U.S. Census Bureau (2009).

of which there is substantial exogenous state-level variation in formula 'parameters.'

Second, channeling through states creates an environment where Federal dollars might be used to replace state and local spending. The Act legislated ARRA funds to go to state and local governments for specific programs, such as schools in high poverty neighborhoods and highway construction. Importantly, as depicted in Table 1, states and local governments were already spending significant amounts of their own dollars on many of these programs before the ARRA. Often state spending was substantially higher than nominally targeted ARRA funding.

Upon acquisition of ARRA funds for a specific purpose, a state or local government could cut its own expenditure on that purpose. As a result, these governments could treat the ARRA dollars as general revenue, i.e. the dollars were effectively fungible.

Federal aid arrived when state and local governments were entering into budget crises. The solid line in Figure A in the abstract illustrates these budget woes. It plots the non-Federal sales and income tax revenue net of non-Federal government transfers.[5] These combined budgets experienced a sharp and then persistent decline beginning in 2008:Q4.[6] The reduction in consumer purchases and employment reduced the tax base for sales and income tax revenue. Second, non-Federal government transfer expenditures, most importantly from Medicaid[7], increased over this period. As the economy worsened, Medicaid participation rates and, thus, the states' burdens increased. Moreover, state and local governments are, with few exceptions, legally prohibited from borrowing to pay for non-capital expenditures.

The deterioration of the non-Federal government budget position occurred concurrently with an increase in Federal grants (the dashed-dotted line on Figure A), mainly due to the ARRA, of

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[5]These together constitutive the most cyclical component of non-Federal government finance. The main non-Federal government transfer is Medicaid.

[6]For timely background on the states' budget crisis between 2008 and 2010, see Boyd and Dadayan (2010), Inman (2010) and McNichol, Oliff and Johnson (2010).

[7]Medicaid is a U.S. health care program for low income individuals and households.

approximately the same amount.[8] In fact, a substantial component of the ARRA was authorized specifically to cover states' tax losses (through the State Fiscal Stabilization Fund) and the most dramatic cost increases (through support for state Medicaid programs).

States were able to re-purpose some ARRA dollars. For example, despite the fact that the ARRA gave states $22 billion, of the total $28 billion available, through September of 2010 to spend on infrastructure, the number of highway, bridge and street construction workers, nationwide, fell dramatically over the past several years (Figure B in the abstract).[9,10]

In our benchmark specifications, we exploit the effective fungibility of ARRA dollars along with an assumption that states spent ARRA dollars to offset lost revenue. Suppose California loses one dollar in sales tax revenue. If at the same time, California receives an additional ARRA dollar and that ARRA dollar is fungible, then we assume California spends the aid dollar for the same purpose it would have spent its just lost tax dollar. Under this scenario, the relevant treatment is ARRA funding net of state budget shortfalls. This presents the opportunity to use exogenous variation in budget shortfalls to identify the effect of ARRA spending.

We use three instruments capturing exogenous variation in capacity to attract/channel ARRA funds, all aimed at isolating variation in ARRA outlays. The first is the component allocated via the Department of Transportation for highway and bridge construction. $27.5 billion was allocated for highway improvements. These dollars were allocated by formulary rule to states, based on pre-defined factors, mainly highway-lane miles, highway usage, and each state's previous contribution to the Federal highway fund.[11] This formula was set several years prior to the ARRA's passage and was used to disperse previous highway funds. These outlays should be uncorrelated with each state's short-run budget, employment and general economic situation. Second, we instrument using each state's ratio of dollars spent by the Federal government in a state relative to the amount of Federal taxes paid by that state's residents in 2005. For example, New Jersey ranked last, receiving 61 cents from the Federal government for every Federal tax dollar paid by resident businesses and households. This spend-pay ratio reflects the general (and pre-recession) tendency of the Federal government to be more or less generous to a state. Third, we instrument using the political party of the governor. We intend for this to capture political considerations relevant for attracting ARRA dollars that are plausibly uncorrelated with a state's particular economic situation.

Exploiting fungibility, we use two instruments to isolate a component of government finance

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[8]The spike in Federal aid is less than the authorized $499 billion because several spending categories (such as Department of Energy grants) had largely been unspent through the first quarter of 2010.

[9]No doubt part of the decline is due to a fall in local street construction due to a slowdown in home building during the recession. This component is unrelated to highway and bridge spending. Calculating the amount of the employment decline due to reduced street construction versus reduced highway funding (because of ARRA crowding out) will be possible with the 2010 Bureau of Labor Statistics Occupational Outlook, which should become publicly available in mid-2011.

[10]We present more evidence for fungibility in the next section. Also, in Section 5, we discuss economic theory, beginning with Bradford and Oates (1971a), and empirical work that followed on how local governments' spending changes with receipt of Federal grants.

[11]The Act specifies a small number of set asides, e.g. $60 million for forest highways on Federal land.

stress that is likely orthogonal to the state's short-run economic conditions. The first of these two instruments is the pre-recession fraction of each state's tax revenue from sales taxes. Sales tax revenue is more cyclical than other tax revenue sources; therefore, a state that relies mainly on sales taxes will experience greater fiscal stress during a recession than a state that relies on other (mainly income and property) taxes. The second instrument is a measure of the strength of the state's balanced budget laws.[12] Nearly every state government has a balanced budget law; however, the particular details of each rule vary across states. Weak-law states have some capacity to ease their fiscal stress through de facto borrowing, at least in the short-term.

The next section provides background necessary to understand the Act as well as our approach. Section 3 describes the data and the estimation equation and Section 4 presents our empirical results including the number of jobs created/saved because of the ARRA. Section 5 discusses other estimates of job creation due to the ARRA in the context of our findings. The final Section concludes.

2   Required Background on the Act

2.1   The Legislation

The American Recovery and Reinvestment Act of 2009 (Public Law 111-5) was enacted on February 17, 2009. The Act contains approximately 175,000 words and makes references to hundreds of existing U.S. codes and existing laws. As such, a comprehensive explication of the Act is beyond the scope of this paper.

One paramount feature of the Act is that a large fraction of the Federal dollars are channeled state and local governments. The Act specifies dollar amounts allocated for various categories and often formula for divvying each categories' dollars across states; however, local and state governments have much latitude regarding when and on what projects ARRA dollars are spent. Moreover, each state and local government maintained substantial control over how it spent its own non-Federal revenues. This is important because it created an environment where Federal ARRA dollars might be used to replace state and local spending.[13]

Let us consider a specific section of the Act: highway infrastructure improvement. Title XII of Division A of the Act specifies that $27.5 billion shall be allocated to "restoration, repair, construction and other eligible activities," where the eligible activities are spelled out in a particular U.S. pre-existing code.

These dollars are divvied up between states based on pre-defined factors, mainly highway-lane miles, highway usage, and each state's previous contribution to the Federal highway fund.[14] This

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[12]Clemens and Miran (2010) apply this instrument to study the effects of fiscal policy in a pre-ARRA period.

[13]As Inman (2010) writes, "States are important 'agents' for Federal macro-policy, but agents with their own needs and objectives."

[14]The Act specifies a small number of set asides, e.g. $60 million for forest highways on Federal land, $20 million

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formula was set several years prior to the Act's passage and was used to disperse previous highway funds. More generally, roughly two-third of all ARRA spending is formulary.

Each state selects highway projects on which to spend its dollars. While the FHA must approve each project, our reading is that the approval rate has been very high.[15] The Act does dictate that the FHA should give priority to "projects that are projected for completion within a 3-year time frame." The Act also gives a deadline for when grant applications are due, when dollars must be allocated and when the grant dollars must be spent. Agencies provide some guidelines for potential applicants beyond the language of the legislation, e.g. U.S. Federal Highway Administration (2009).

For some components, Federal agencies have additional discretion in allocating amounts. For example, the Act allocates $1.1 billion as grants-in-aid for airports. The Act states: "such funds shall not be subject to apportionment formulas, special apportionment categories or minimum percentages 2026 the Secretary shall distribute funds provided under this heading as discretionary grants to airports, with priority given to those projects that demonstrate to his satisfaction their ability to be completed within 2 years of enactment of this Act."

Each Federal agency, twenty-eight in total, charged with dispersing a fraction of ARRA dollars issues regular "Agency Funding Notification Reports" which summarize the agency's intention to communicate the availability and requirements an applicant must meet to receive funding. The agency posts the total dollar value of current and past notifications, by state when applicable. State governments, local governments, citizens and companies may apply for ARRA dollars. In this paper, these are referred to as announced dollars. These are compiled by the Recovery Accountability and Transparency Board, which was established by the Act, and posted at this Board's web site Recovery.gov.

Besides announcements, the Recovery Accountability and Transparency Board also tracks awards and outlays. These come from the "Weekly Financial and Activity Report" made by the participating Departments and Agencies. These reports are also posted on the Recovery.gov web site. Each agency provides a list of awards and the total outlays related to each project. Some awards have either territory codes, such as Puerto Rico, or no code at all. We drop these from the sample. In terms of the chain of events described above, the agency enters a new award once a specific grant has been issued, whether it is formulary or discretionary. Our benchmark specification uses outlaid dollars, and we use announced dollars as an alternative treatment measure.

Outlays are payments from the U.S. Treasury as directed by the managing Federal agency to the grant recipient. Most outlays are paid as reimbursements for expenses the grant recipient has made.

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for training as well as Federal Highway Administration overhead costs.

[15]The Act does specify that priority will go to "projects located in economically distressed areas." Often, a phrase that might be open to interpretation, such as "economically distressed," is followed by reference to a specific U.S. Code or Law which defines that phrase.

2.2 Evidence for Fungibility

As stated previously, states have substantial capacity to treat ARRA dollars as fungible. For example, if California receives $100 million ARRA dollars to improve its highways, it might cut its own contribution to the state highway budget by $100 million and use this money to finance pay increases of UC system faculty. Establishing this fungibility is important because it will allow us to use state-level variation in budget differences as one way to infer the effects of ARRA spending on employment—thus providing additional variation besides that from exogenous ARRA spending itself.

Texas provides a case in point. In Texas, ARRA dollars arrived and simultaneously the number of Texas highway, bridge and street construction workers declined. Employment in that sector fell from 34,600 workers in May of 2008 to 28,500 workers in May of 2010. Total capital outlay on highways in Texas (fiscal year ending on August 31) went from $3.38 billion in 2009 to $2.82 billion in 2010. This decrease in state expenditures occurred even though Texas spent $0.70 billion in ARRA highway funds during 2010.[16] The Texas government *responded* to its receipt of ARRA highway dollars by cutting Texas' own contribution to highway spending, which freed up state dollars to boost suffering state finances.

The State of New York provides a second example.[17] For the year ending in May 2009, which contains only three months of the ARRA period, the New York Department of Transportation capital project spending was $3.42 billion. For the year ending in May 2010, in which ARRA spending was in full swing, this spending was $3.47 billion (i.e. nearly unchanged). On the other hand, the US Department of Transportation reported that it outlaid $522 million in ARRA monies to New York by May of 2010. Interestingly, the reduction in state transportation dollars simultaneous with its spending of ARRA dollars may not have been planned in advance by the state government; the *planned* 2009-2010 budget allocated $3.95 billion towards transportation capital spending. This was nearly $500 million more than it *actually* spent.

Michigan provides another example. For the fiscal year ending on September 30, 2009, Michigan's revenue from Federal aid had increased by $189.2 million over the previous fiscal year;[18] however, over the same horizon, capital outlays had risen by only $17.4 million. What might explain this gap? Taxes and miscellaneous revenues received by the Department fell by $140.6 million relative to the previous fiscal year. The US DOT reported that it outlaid $110 million to Michigan through September 2009, $105 million of which was FHA money. As in Texas and New York, ARRA dollars were substituting for Michigan government dollars.[19]

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[16]Only $110 million in ARRA funds were spent in 2009. The budget amounts come from Texas Department of Transportation (2009, 2010)

[17]The following numbers are taken from the State of New York (2009, 2010) Enacted Financial Plan reports.

[18]See Michigan Department of Transportation (2010).

[19]More up-to-date data on how the ARRA highway dollars crowded out Michigan state spending can be seen looking at construction contract activity in Michigan Department of Transportation (2011). The total value of pre-ARRA Michigan DOT contract dollars was $1.26 billion in FY2008. In the following two years, contract dollars *not*

Poten and Poten, a private company that collects, analyzes and sells information about the asphalt industry, describes the situation clearly: "The lack of demand for asphalt is largely due to constrained public road funding and a weak private and commercial market for the product. Most state and local governments have major budget problems. Federal funds related to the transportation budget and Stimulus are a critical source of current road funding, but it hardly makes up for the declines from state and local public funding sources, as well as scant private and commercial demand."[20]

Ohio provides another example. Ohio Department of Transportation (2010) provides spending details for its 2009 fiscal year, which began on July 1, 2008. It reported $935 million in ARRA stimulus dollars for fiscal year 2009, which represented a 54 percent increase in Federal funding relative to 2008. However, capital outlays increased by only $183 million over the same period. On the other hand, the dollars carried into the next fiscal year increased by $1,040 million over the period. Since the ARRA was enacted in February 2009, one explanation for the small spending increase in Ohio may be that projects took time to get approval. In that case only a small fraction of ARRA dollars would actually be spent. To find out whether the carry forward will be used to fund capital improvements in 2010 or else be used to cover other state expenditures remains to be seen will require data not yet available.

The Medicaid component of the Act provides another channel for fungibility. A Council of Economic Advisors (2010, pg. 7) report states that ARRA Medicaid dollars were "intended to boost the level of discretionary funds available to states and not simply to relieve Medicaid burdens." The Act does reference the proper use of funds to support states' Medicaid program. For example, Section 5001(f)(3) of the Act reads "A State is not eligible for an increase [in Federal Medicaid funds] ... if any amounts attributable (directly or indirectly) to such increase are deposited or credited into any reserve or rainy day fund." The dire straits of the typical state's budget gave it little incentive to stockpile the aid; therefore, the above requirement was unlikely to bind.

For some components of the stimulus program, language in the Act does try explicitly to prohibit states from cutting state funding upon the receipt of ARRA dollars. U.S. General Accountability Office (2009) states that $101 billion of the spending, including funds for transportation, education and housing, have such restrictions in place. For example, each state governor was required to certify, by March 19, 2009, to the USDOT that the state would maintain a certain contribution to its spending in an area as a condition of accepting ARRA transportation funds. This is part of a "maintenance of effort" requirement of the Act.

However, the governors were not required maintain their pre-Act levels of spending. Rather, it was acceptable for a governor to promise to spend less than their expenditure in recent years if she

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funded by the ARRA fell to $0.88 billion and $0.93 billion.

[20]This quote appears in the August 16, 2010 issue of *Asphalt Weekly Monitor* in the article headlined "US Asphalt Prices Slide Despite It Being Peak Demand Season."

could justify the reduction based on other fiscal considerations, such as falling tax revenues.[21]

Moreover, the U.S. Department of Transportation (2010) reported that twenty-one states were failing to meet maintenance of effort requirements as of November 2010. The penalty for a state that fails certification or does not meet that certification's obligations is a prohibition from participation in redistribution of unobligated funds set to occur on August 1, 2011. Whether states have complied or not is an open question. FHWA officials state that they will not be able to make this assessment until after September 30, 2010.

The use of matching grants, a potential tool to discourage crowding-out, is almost entirely absent from the Act. The section on highway infrastructure investment in the Act states "the Federal share payable on account of any project or activity carried out shall be, at the option of the recipient, up to 100 percent of the total cost thereof."

Next, the section on grants to support schools with a high poverty population (i.e. Title I schools), states the funds shall serve to supplement and not supplant planned expenditures for such activities from other Federal, State, local and corporate sources.[22] This restriction, however, is unlikely to bind states that have seen declining tax revenues. A guide for local education agencies provided by U.S. Department of Education on ARRA funding states that the supplement not supplant restriction would not be violated if there was "a reduction in the amount of non-Federal funds available to pay for the activities previously supported by non-Federal funds."[23]

For a few components of the ARRA, the "effective fungibility" we will sometimes impose on the econometric model may be inappropriate. For example, the Act authorized $6 billion for clean-up of nuclear waste sites. Since states spent very little on nuclear clean up before the ARRA, those state governments could not free up state dollars by cutting their own spending in response to this $6 billion.

Prior to the Act, researchers had studied whether Federal grants crowd out state and local spending. Early analysis by Bradford and Oates (1971a) shows that crowding out occurs in a simple political economy model. Empirical work that followed, surveyed in Hines and Thaler (1995), finds evidence against crowding out, which has been termed the "flypaper effect." When a higher-level government issues grants for a particular purpose to a lower-level government, then this money sticks like flypaper towards its intended purpose, with little or no reduction in the lower-level government's contribution. Knight (2002) shows that, on the other hand, that after controlling for a particular form of endogenity, the flypaper effect is not present in Federal Highway Aid from 1983 through 1997. In the context of our paper, it is worth noting that we are unaware of any studies

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[21]The issue of maintenance of effort is complicated. The language of the Act and administrative guidances that followed appear to have interpretations that differ across Federal agencies.

[22]Similar language requiring that ARRA dollars 'supplement rather than supplant [non-Federal] funding' appears in six other sections of the Act, which deal with airports, Amtrak, public housing, child care assistance for low income families, community college and career training as well as community economic development. The total dollars subject to this qualification is very small as a fraction of the Act's total dollars.

[23]See page 29 of U.S. Department of Education (2009).

on the flypaper effect when state and local governments have been under the tremendous budget pressure witnessed during the most recent recession.

3 Statistical Specification

We use the Generalized Method of Moments on a panel of states to estimate a linear model of employment growth as a function of state budget loss, ARRA aid and ancillary variables. Table 2 contains summary statistics for all variables used. The dependent variable is $EMPLOY_j^i$, the eighteen-month growth rate of a state j employment in sector i ending in September 2010. Here i denotes sector and j denotes state. The beginning date is chosen to coincide with the passage of the ARRA. Our employment data is the number of seasonally-adjusted payroll employees and comes from the Bureau of Labor Statistics Establishment Survey.

　We apply our analysis to four distinct employment sectors rather than total employment because of the large differences in trends across the sectors over the past decade. Our first employment sector combines health and education, leisure and hospitality and business and professional services, which we refer to as HELP services. The remaining service employment is combined into Non-HELP service employment. The other two categories are goods-producing employment and the combined state and local government employment.[24]

　Differences in trends across the four sectors can be seen in Figure 2, which plots national totals where the initial point is normalized to 100 for each sector. Both government and HELP services employment have fared relatively well during the recession. Employment in the goods-producing sector has fallen most dramatically during the recession, which has been part of a continual decline over the preceding decade.

　Our first key regressor is $OFFSET_j$—the ratio of ARRA dollars actually spent relative to 2008 state government tax revenue for state j. We also estimate the model using announced ARRA dollars (see Section 2).[25] Our second key regressor is $LOSS_j$, measured as the twenty-month decrease in state tax revenues plus Medicaid increase ending in March 2010, relative to 2008 tax revenue for state j. Finally, when it does not cause confusion, we will sometimes omit subscript j and superscript i.

　We scale ARRA dollars by the size of state government rather than the state population because: (i) ARRA funds were channeled largely though the state and local governments that, in turn, used this aid to cover functions that otherwise may have been cut, (ii) the size of government varies substantially across states. Figure 1 shows substantial cross-state differences in both the size of governments and the number of government employees. Intuitively, even if two states have the same

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[24]Educators employed by state and local governments count toward the government sector. Federal workers count towards Non-HELP service employment.

[25]We try two different measures because macro analyses of the effects of fiscal policy (such as Mertens and Ravn (2009), Leeper, Walker and Yang (2009) and Ramey (2010)) often find that whether measured fiscal shocks in vector-autoregressions are unanticipated or anticipated has important implications for estimated impulse responses.

Table 2: Summary statistics

Variable	Mean	Stdev.	10th perc.	90th perc.
Economic and financial variables				
Outlay offset	0.161	0.035	0.120	0.210
Announced offset	0.189	0.048	0.138	0.234
Loss	0.070	0.030	0.034	0.095
Government employment growth (percent)	-0.011	0.018	-0.035	0.013
HELP employment growth (percent)	0.003	0.014	-0.014	0.021
Non-HELP employment growth (percent)	-0.028	0.012	-0.047	-0.013
Goods-producing employment growth (percent)	-0.100	0.048	-0.144	-0.055
2009 Government employment (millions)	0.396	0.418	0.065	0.718
2009 HELP employment (millions)	0.991	1.072	0.133	2.187
2009 Non-HELP employment (millions)	0.902	0.954	0.147	1.913
2009 Goods-producing employment (millions)	0.420	0.422	0.056	0.889
ARRA outlaid dollars (billions)	5.977	6.421	1.063	12.205
ARRA announced dollars (billions)	5.960	5.870	1.524	10.789
Instruments				
USDOT outlay offset	0.03	0.01	0.02	0.03
Spend-pay ratio	1.15	0.36	0.72	1.53
Intensity of sales tax usage	0	0	0	1
Strong budget rule (fraction)	0.83			
Democratic governor (fraction)	0.54			
Other variables				
Max monthly UI (dollars)	435.22	131.79	275.00	572.00
Northeast (fraction)	0.22			
West (fraction)	0.22			
Midwest (fraction)	0.22			
Observations	46			

Notes: Employment is measured as establishment survey non-farm employment. The four lowest population states (i.e. Alaska, North Dakota, Vermont and Wyoming) excluded from sample.

Figure 1: Revenue-based and employment-based sizes of governments (state plus local governments)

(a) State + local government revenue, $1000s per capita

(b) Number of government workers per 100 persons
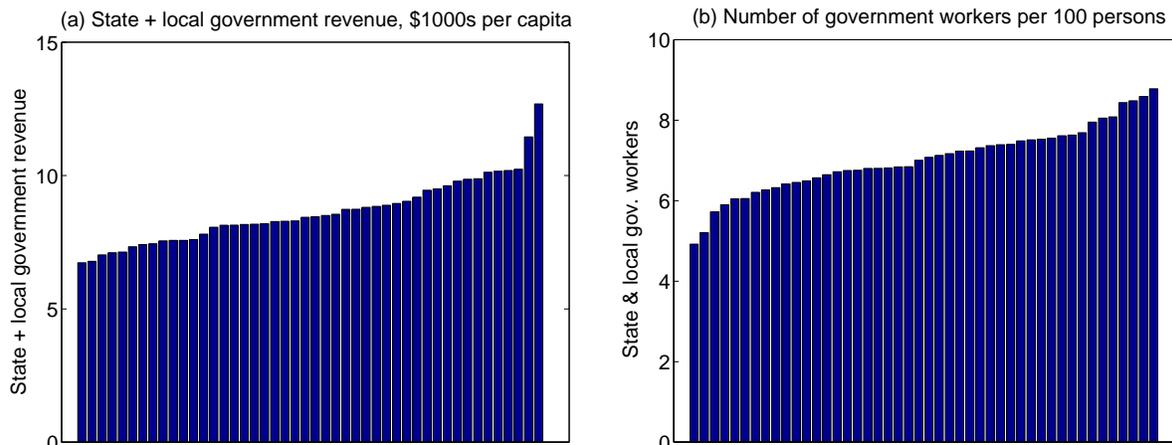
Notes: Excludes four smallest states. Revenue equals all state and local government revenues in 2008.

population, each dollar of aid is likely to have a greater impact on a state with a small government relative to a state with a large government.

Budget loss, $LOSS_j$, is measured as the twenty month change in the difference between state tax revenue and state Medicaid expenditures ending in March 2010 relative to total 2009 state government revenue.[26,27] A positive number for a state means its budget has deteriorated. State tax data is from the Census Bureau Quarterly Summary of State Tax Revenue. State-level Medicaid data (NASBO) is calendar-year annual. Details on this data series appear in the Appendix.

Our benchmark estimation equation exploits the fungibility of ARRA aid:

$$EMPLOY = a \times (OFFSET - LOSS) + c' \times ANC + e \qquad (3.1)$$

Here ANC is a column vector of state-specific ancillary regressors: two lags of employment growth, the maximum monthly unemployment insurance payment, region dummies, state population and a constant.

A state that is behaving optimally will, at the margin, spend an additional thousand dollars of ARRA aid in the same way it would spend an additional thousand dollars it received in state tax revenue. In turn, the result of ARRA outlays should have the same effects on state employment as a reduction in the budget loss that occurs when tax revenues are higher.

Figure 3 contains a scatter plot of each state's $LOSS$ and $OFFSET$. Note the substantial differences across states on both dimensions. South Dakota, a state that has fared well during the

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[26]The government revenue data is not ideal because: (*i*) other state revenue sources besides taxes, such as public university tuition, are not included because up-to-date data is not available; (*ii*) local government data is not included because up to data is not available.

[27]Local government and other state government expenditure data, besides Medicaid, are not available up-to-date.

Figure 2: Monthly employment (seasonally adjusted), January 2001 through September 2010, by sector
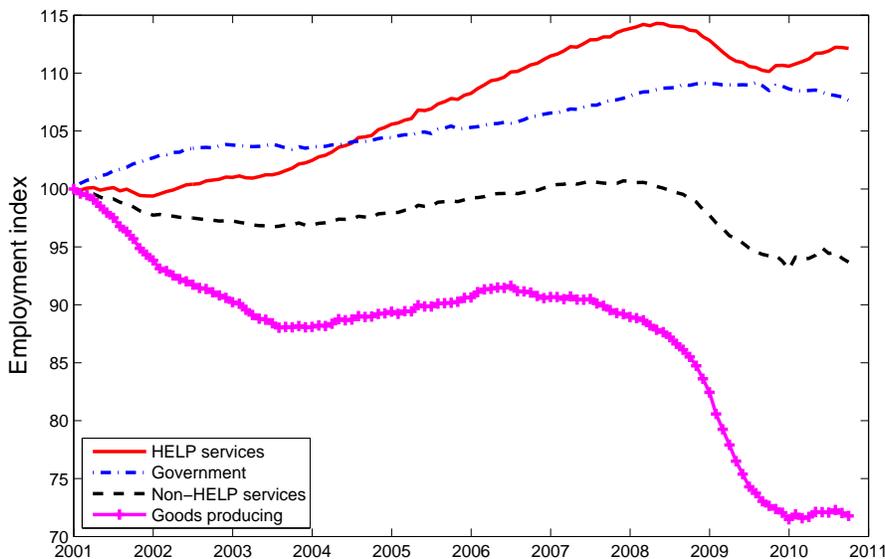
Note: Index = 100 in January 2001. HELP stands for Health, Education, Leisure and Professional and Business services.

recession, appears in the lower right corner. South Dakota has a $LOSS$ of 0.059, which means that it experienced only a 5.9% decline in its budget due to tax losses and Medicaid increases. It has an $OFFSET$ of 0.25, which means that the ARRA boosted the state's budget by 25% relative to its pre-recession size. In terms of resources for the government to operate, the ARRA dollars have more than compensated for the fiscal loss due to the recession in South Dakota. Its $OFFSET - LOSS$ equals 0.191 or 19.1%.

Other states have fared poorly. New Mexico appears in the upper left part of the figure. Its $LOSS$ and $OFFSET$ are 0.223 and 0.133, respectively. New Mexico saw a 22.4% budget decline, while ARRA outlays were only 13.3% of the pre-recession state budget.

In an alternative specification, we do not impose fungibility

$$EMPLOY = b \times OFFSET - d \times LOSS + k' \times ANC + e \qquad (3.2)$$

We will be able to assess whether the fungibility restriction, used in the benchmark specification, is rejected by the data using standard hypothesis test for whether $b = d$ from 3.2. We will find that the restriction is almost never rejected.

Figure 4 contains a scatter plot of non-Federal government employment growth against $OUTLAY - LOSS$ for each state. The correlation between these two variables equals 0.11. Also, note the upper

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Figure 3: $LOSS$ and $OFFSET$, each state's budget decline and ARRA dollars outlaid, relative to its pre-recession revenue
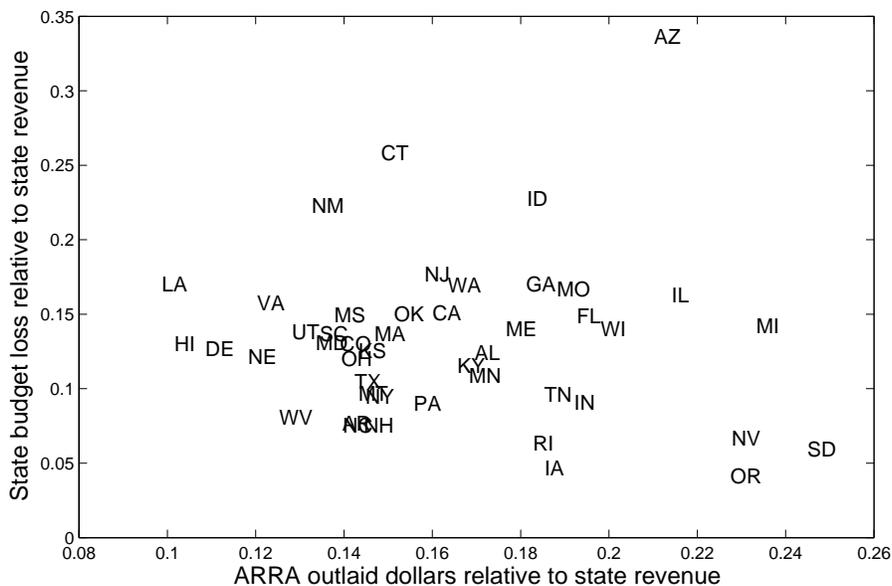
Notes: ARRA dollars are through September 2010 and plot excludes four smallest states.

left corner of the figure (specifically, positive employment growth and $OFFSET - LOSS < 0$) is nearly empty. As one might expect, governments have not hired new workers when their ARRA aid is insufficient to cover their deteriorated budget positions.[28] On the other hand, ten states with positive $OFFSET - LOSS$ values increased government employment over the period.

Figure 4 is not conclusive evidence that ARRA aid has increased government employment. In the next section, we will correct for the potential endogenity of the explanatory variables using instruments and also use state-level traits as control variables.

Whereas government employment growth is positively correlated with $OFFSET - LOSS$, HELP service sector employment growth is *negatively correlated* with $OFFSET - LOSS$. This correlation equals -0.35 and the corresponding scatter plot appears in Figure 5. Thus, states with relatively strong government budget positions (inclusive of ARRA aid) have lower employment growth in the sum of health, education, hospitality, leisure and business and professional services. Interestingly, HELP service employment is the only private sector employment category that has seen net growth during the past decade, as seen in Figure 2.

Next, we must address endogenity. The equation's error term, the shock to employment growth, could reasonably be conjectured to be correlated with $OFFSET$ and $LOSS$. For example, a negative shock to employment growth in a state might: (i) increase $OFFSET$ if that state received more

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[28]The sole exception is Utah, which lays extremely close to the $(0,0)$ point.

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Figure 4: Growth in government employment versus ARRA outlays net of budget loss, by state
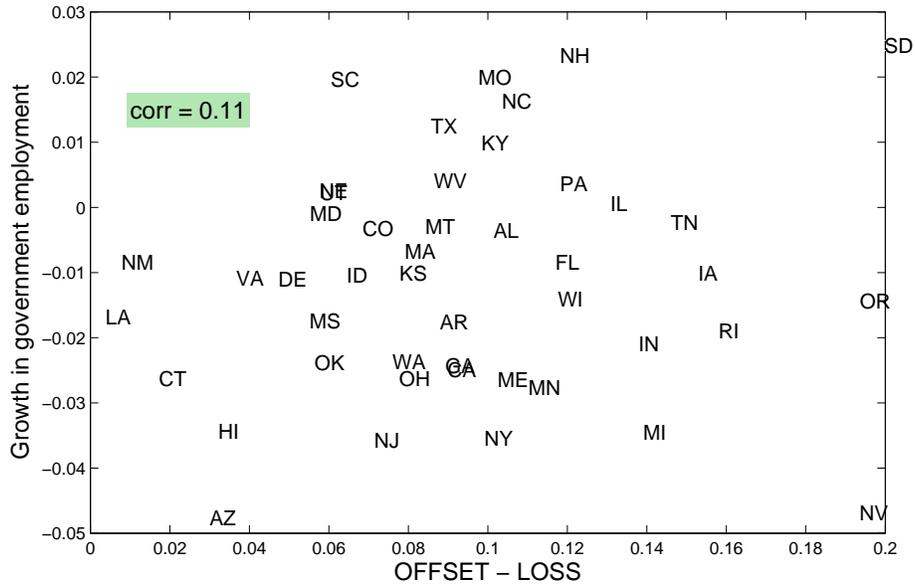
Notes: Plot excludes four smallest states; employment includes public teachers and excludes Federal workers; employment and ARRA outlays are through September 2010; 'corr' denotes correlation.

Figure 5: Growth in HELP services employment versus ARRA outlays net of budget loss, by state
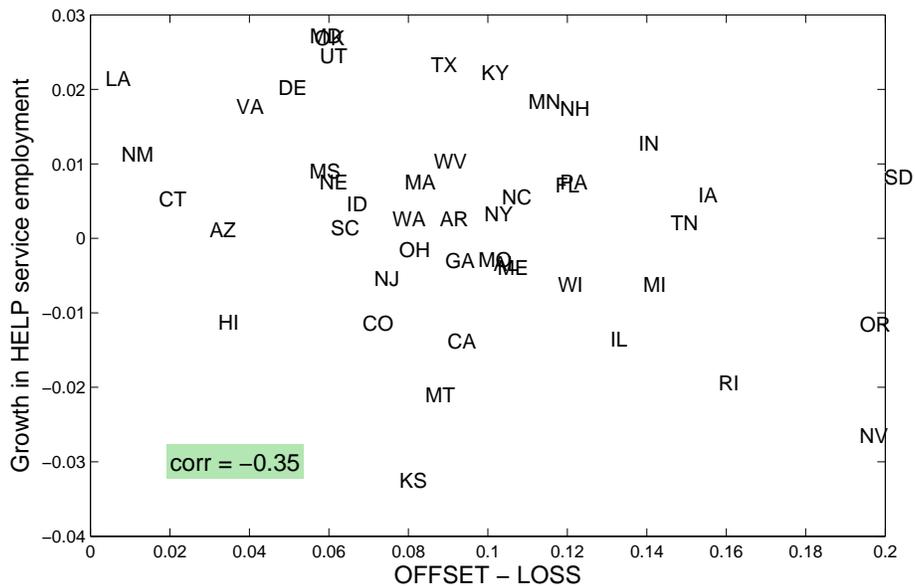
Notes: Plot excludes four smallest states; HELP stands for health, education, leisure, hospitality and business and professional; employment and ARRA outlays are through Sep 2010; 'corr' denotes correlation.

ARRA dollars because its economy was in worse shape; (ii) increase $LOSS$ if a worse employment situation resulted in lower state tax receipts.

We use five instruments: Federal Highway Administration ARRA dollars, the percentage of tax revenue collected from sales taxes, the ratio of a state's federal taxes paid relative to the state revenue from the Federal government as well as dummy variables for the governor's political party and whether the state has weak or strong balanced budget laws.

3.1 Instruments

To achieve identification, we first exploit the ARRA's purpose, apart from stimulating a weak economy, of improving the nation's infrastructure. Our first instrument is based on dollars allocated by the Federal Department of Transportation. Roughly $48 billion of ARRA funds were allocated for improving transportation infrastructure, with the largest share going to highway, bridge and intercity rail construction. Much of this was allocated by formula. For example, the Federal Highway Administration, an agency within the Department of Transportation, was authorized by the ARRA to apportion $27.5 billion. Criteria of the FHA formula for appropriation to the states include: each state's share of total eligible highway lane miles (which counts for 13%); each state's share of total vehicle miles traveled on eligible highways (20%); each's states share of dollar contributed to the Highway Trust Fund paid by highway users (17%).
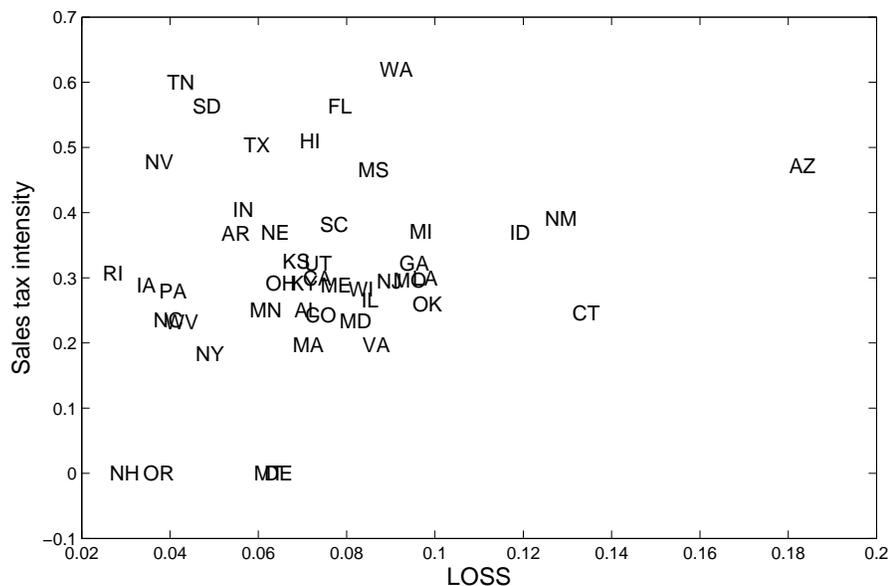
The contribution of DOT dollars to cross-state variation in $OFFSET$ is not due to particular economic conditions of any state during the great recession. As such, endogenity that may be present between the error term and the $OFFSET$ is likely to be orthogonal to the component for transportation infrastructure.

Specifically, our instrument is each state's ARRA dollars available from the Federal DOT divided by that state's tax revenue. We call this the highway instrument. Figure 6 contains a scatter plot of $OFFSET$ versus the highway instrument. It demonstrates a strong positive correlation, 0.49, between these two variables. Note that South Dakota is a substantial outlier. The numerator in the highway instrument for South Dakota is large because there are two Federal interstate highways (I-90 East/West and I-29 North/South) that each run from one side of the state to another as well as many state highways. The denominator in the highway instrument is low mainly because of that state's low population. Even excluding South Dakota, the correlation is still large at 0.39.

Table 3 reports statistics from least-squares regressions of endogenous variables on instruments as well as the ancillary variables.[29] We alternatively use $OFFSET$, $-LOSS$ and $OFFSET-LOSS$ as the dependent variable because we will estimate both (3.1) and (3.2). As our logic above suggests, the t-statistic on the highway interest is positive (and greater than four) when $OFFSET$ is the dependent variable.

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[29]This would be the first-stage from a two-stage least squares regression. We use GMM rather than two-stage least squares to allow for conditional heteroskedasticity.

Figure 6: $OFFSET$ versus the highway instrument, by state

Notes: The highway instrument is announced Federal DOT dollars from ARRA relative to state tax revenue; excludes four smallest states.

The second instrument is sales tax, specifically the general sales tax, intensity. Specifically, we use the ratio of general sales tax revenue relative to all tax revenue in each state, averaged from 2007 through 2008. There is variation across states in the degree to which states use general sales taxes relative other taxes as a revenue source.[30] The sales tax intensity is determined by historical, legislative decisions that are likely to be uncorrelated with the state-level variation over the most recent business cycle. Thus, a part of the variation in $LOSS$ is due to the historical evolution of each state's tax system. This instrument is correlated with $LOSS$ because, during the most recent recession, states that rely heavily on sales taxes *ceteris paribus* see overall revenues decline by more than states that rely on other taxes. The correlation between the two variables is 0.20 and the corresponding scatter plot appears in Figure 6.

In Table 3, we see that sales tax intensity is positively correlated with $LOSS$ even after accounting for the contribution of the controls and the other instrument. The t-statistic is -1.77 when $-LOSS$ is the endogenous variable and -1.34 when $OFFSET - LOSS$ is the endogenous variable.[31]

Our third instrument is each state's "spend-pay ratio." It is collected by The Tax Foundation. We expect it to be positively correlated with $OFFSET$ but orthogonal to that variable's endoge-

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[30]To a lesser extent, some states use other taxes, such as property and mineral extraction

[31]In the table, the coefficients are negative because the dependent variable is the *negative* of $LOSS$.

Figure 7: *LOSS* versus sales tax intensity instrument, by state

Notes: Sales tax intensity is the ratio of state sales tax revenue to all state tax revenue; excludes four smallest states.

Table 3: T- and partial F-statistics for instrument relevance

	Offset - loss	Offset	- Loss
Highway dollar and percent sales tax instruments			
Highway instrument	4.48	4.45	1.68
Sales tax intensity	-1.34	0.11	-1.77
Partial F-statistic	427.48	933.13	154.87
All five instruments			
Highway instrument	5.11	5.24	1.59
Sales tax intensity	-2.28	-2.48	-0.60
Spent-pay ratio	-0.25	1.12	-1.20
Strong budget rule	0.58	-0.75	1.27
Democratic governor	2.27	2.01	0.97
Partial F-statistic	858.04	1760.13	250.75

Notes: Above t-statistics are from the single-equation least-squares estimation of alternative endogenous variables on instruments and all control variables. Partial F-statistic reflects joint test against the null that coefficient on every instrument equals zero.

nous component.[32] As seen in Table 3, the t-statistic for spend-pay ratio is 1.12 in the $OFFSET$ regression, indicating a positive (as expected) but weak relationship.

Our fourth instrument is "strong budget rule." Strong budget rule is a dummy variable equal to one if a state's balanced budget laws are relatively strict. Of the forty-six states, twenty three had strong rules. Examining Table 3, both relevant t-statistics are negative and statistically significant. This instrument is likely to be linked to $LOSS$ because a strong rule state is likely to adopt at tax system that is generally more robust to recessions than a weak rule state. A weak rule state can engage in greater *de facto* borrowing allowing it to buffer tax revenue swings. Whether a state has strong or weak budget rules is due to political and historical experiences which justifies the exogeneity restriction.

Our final instrument is an indicator equal to one if a state's governor is a Democrat. Examining the penultimate row of Table 3, there is a positive and statistically significant relationship with either $OFFSET$ or $OFFSET - LOSS$. Why might Democratic governors be more likely to have larger offsets? The rate of spending of ARRA dollars by a state, and therefore the amount of outlays, may be larger when Democrats are in charge. There are several well-publicized instances where Republican governors, including Jindal of Louisiana, Perry of Texas and Sanford of South Carolina, initially refused to accept parts of ARRA aid.[33]

The third and ninth rows of Table 3 investigate instrument strength. We present partial F-statistics for the joint hypotheses of all instrument coefficients being zero in the two and five instrument cases, respectively. The values of these F-statistics are sufficiently large for us not to be concerned about weak instrument problems with a single endogenous regressor. For our specifications with two endogenous variables, the first-stage coefficients corresponding to OFFSET and LOSS across instruments, reported in the Appendix, appear sufficiently different that we are confident in using strong instrument approximations in this case as well.

4 The Act's Impact: More Government Jobs, Fewer Private-Sector Jobs

4.1 Benchmark Estimates

Table 4 reports the jobs effect of ARRA aid for the four employment categories, both with and without the fungibility restriction imposed. Each estimate uses the outlaid amount, includes the same forty-six states, twelve control variables and all five instruments. The table reports estimates of the thousands of jobs that existed in September of 2010 that would have not existed (i.e. jobs saved or created) had the Act not been implemented.[34] A negative number implies that the ARRA

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[32]We do not present scatter plots for the final three instruments.

[33]See "They're Saying No to the Cash, but Talk is Cheap" in the Washington Post (2009).

[34]To calculate the number of jobs created/saved, for each state we compute the product of the state's offset times the state's pre-recession employment level times the point estimate from either (3.1), with fungibility, or (3.2), without

destroyed or prevented employment growth in that sector over the period. The bracketed pair of numbers beneath each estimate correspond to its 90% confidence interval.

First, our point estimate states that government employment (non-Federal) was 443 thousand persons greater than it would have been in absence of the Act, as seen in Table 4. This is the only sector where we see a strong positive employment effect of ARRA aid. The estimate is consistent with the raw data represented visually in Figure 4. This figure shows that states with weak budget positions, after including ARRA aid, saw falling government employment. Intuitively, state and local governments with declining tax revenue (that was not replaced with ARRA aid) either cut or else did not increase government hiring.

In our counterfactual world without the Act, all states would have been forced to take the same action of firing and not filling job openings—resulting in significant government jobs lost.

On the other hand, employment in HELP services is 772 thousand persons *lower* because of the Act. This is consistent with the raw data represented visually in Figure 5. States with weak budget positions, after including ARRA aid, tended to have greater employment growth in the HELP service sector.

The employment effects for the other two sectors are smaller. Non-HELP services employment was 92,000 persons greater because of the Act; however, the lower bound of the confidence interval is -347 thousand. Next, goods-producing employment was reduced by 362 thousand workers. The upper bound of its confidence interval was positive 218 thousand.

A second way to report the jobs effect is directly as the elasticity of employment growth with respect to ARRA aid (specifically, $OFFSET$). This coefficient, for each of the sectors, appears in Table 5 in two cases: fungibility is imposed, a from equation (3.1) and fungibility is not imposed, b from equation (3.2). This elasticity equals 0.139 for the government employment sector when fungibility is imposed. *In words, this means that a one-percent increase in ARRA outlays relative to the state's pre-recession revenue results in employment that is 13.9% greater in September 2010.* The corresponding elasticity for the HELP service sector is negative -0.096.

Table 5 also tells us that the data does not reject the fungibility restriction. Under the heading "fungibility restriction not imposed," we see the elasticity estimates when b is not required to equal d. Examining the government column, the elasticity for the ARRA outlay-based offset equals 0.149 and the elasticity for $-LOSS$ equals 0.206. Taking into account the standard errors of the estimates, these two values are very close. Formally, the Chi-squared statistic for the test is sufficiently low that we fail to reject fungibility at all conventional significance levels. This failure to reject fungibility also holds for the other sectors. Moreover, our finding of jobs forestalled for the three private sectors is maintained even when the fungibility restriction is not imposed (although the precision of the estimates fall).

What can explain our two findings that (a) the ARRA has created/saved government jobs, (b)

fungibility. Then, we sum across all states to find the total jobs effect reported in the table.

Table 4: Response of employment growth through September 2010 to state government losses and outlaid ARRA money, reported as thousands of jobs

	Government	HELP Services	Goods-producing	Non-HELP services
Fungibility imposed	443	-772	-362	92
	[-35 , 920]	[-1378 , -166]	[-942 , 218]	[-347 , 531]
Fungibility not imposed	473	-880	-832	-433
	[-531 , 1477]	[-1912 , 152]	[-2172 , 507]	[-1515 , 649]

Notes: Bracketed numbers report corresponding 90 percent confidence interval. Using all five instruments, ARRA outlay-based offset.

Table 5: Response of employment growth through September 2010 to state government losses and outlaid ARRA money, reported as elasticities

	Government	HELP services	Goods-producing	Non-HELP services
	Fungibility restriction imposed			
Aid offset - loss	0.139	-0.096	-0.106	0.013
	(0.088)	(0.044)	(0.100)	(0.035)
	Fungibility restriction not imposed			
Aid offset	0.149	-0.109	-0.244	-0.059
	(0.186)	(0.075)	(0.231)	(0.087)
- Loss	0.206	-0.076	0.160	0.190
	(0.242)	(0.112)	(0.383)	(0.187)
Test of fungibility restricton (Chi-squared)	3.570	3.558	0.112	0.969

Notes: Using all five instruments, ARRA outlay-based offset.

the ARRA has may have forestalled at least some private sector jobs (in particular those in the HELP service sector)?

Finding (a) has a straightforward explanation. First, a significant part of the ARRA is aimed directly at saving government jobs and services, e.g. the \$53.6 billion State Fiscal Stabilization Fund. Second, states have found ways to use ARRA dollars (not directly intended for government salaries) to free up state funds for other uses. Several examples based on U.S. Dept. of Transportation programs are presented in Section 2. Freed-up state monies can in turn be used for government hiring and retention.

Finding (b) might be partially explained by a 'crowding out' effect. In the absence of the ARRA, many government employees would have found jobs in the private sector. Governement workers tend to be well educated. In 2006, the most recent available data, 49% of state and 47% percent of local government workers had at least a bachelor's degree,[35] for private sector workers this proportion is only 25%. The labor market for well-educated individuals was relatively strong during and after the recession. In September of 2010, the unemployment rate among persons with at least a bachelor's degree was only 4.5%; on the other hand, versus 10% for high school graduates with no college. The spread in unemployment rates across different educational attainment categories was fairly constant during and after the recession. The HELP services sector employs much more educated workers than our other two private sectors[36], is thus relatively strong as seen in Figure 2, and could plausibly have absorbed large numbers of these counter-factually unemployed workers.

However, a crowding out story would not be a full explanation if, as our point estimates suggest, the ARRA destroyed/forestalled more jobs in HELP services than it created/saved in the government. It is important to note that we do not have enough precision in our estimates to conclude that number of jobs lost/destroyed was (probably) greater than the number created/saved. Our estimates are consistent with there being a net positive (but not large) number of jobs saved/created. We leave completing an evaluation of crowding explanations for future research.

Prima facie evidence for a crowding out scenario can be seen beginning in late 2010. At that time, most of the Act's state stabilization funds, Medicaid aid and highway dollars had been spent. No new Federal aid has been authorized and state tax revenues have remained below normal. As such, state and local governments have had to cut employment. Between July 2010 and February 2011, non-Federal government employment fell by 179 thousand nationwide.

4.2 Estimates using alternative specifications

Tables 7 and 8 report the jobs effects when employment growth is measured ending in May rather than our benchmark of September. We use this alternative date in case the main employment responses to the Act came earlier rather than later in time. The May estimates are very similar to our

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[35]Greenfield (2010).

[36]For example, the percentage of workers in HELP services with a college education is 43.6% in pooled March CPS data from 2003 to 2009 versus 17.4% and 23.4% for goods-producing and non-HELP services, respectively.

Table 6: Response of employment growth to state government losses and outlaid ARRA money, least squares estimates

	Government	HELP services	Goods-producing	Non-HELP services
		Fungibility restriciton imposed		
Aid offset - loss	0.075	-0.071	-0.140	0.015
	(0.058)	(0.030)	(0.206)	(0.043)
		Fungibility restriction not imposed		
Aid offset	-0.015	-0.067	-0.234	-0.039
	(0.081)	(0.044)	(0.241)	(0.055)
- Loss	0.184	-0.075	-0.047	0.073
	(0.100)	(0.037)	(0.217)	(0.065)

Notes: Ordinary least squares, ARRA outlay-based offset and employment through September 2010.

Table 7: Response of employment growth through May 2010 to state government losses and outlaid ARRA money, reported as thousands of jobs

	Government	HELP Services	Goods-producing	Non-HELP services
Fungibility imposed	565	-1054	-368	-295
	[285 , 844]	[-1756 , -352]	[-853 , 118]	[-798 , 208]
Fungibility not imposed	210	-14	-208	-968
	[-794 , 1214]	[-1046 , 1018]	[-1548 , 1131]	[-2050 , 114]

Notes: Bracketed numbers report corresponding 90 percent confidence interval. Using all five instruments, ARRA outlay-based offset.

benchmark ones. The only substantial difference is in the Non-HELP service sector. Employment fell by 295,000 using the May date rather than increase by 92,000 in September. Thus, using an earlier end date suggests an even stronger overall negative jobs effect of the ARRA.

An alternative way to measure ARRA spending is in terms of dollars that the Federal government has committed to spend, even if a fraction has not yet been spent. This may be appropriate if businesses, local governments and state governments make current economic decisions in response to changes in expected future Federal spending. Table 9 reports our estimates when we replace outlaid dollars with announced dollars. For each of the four sectors, the numbers of jobs created when $OFFSET$ is measured using announced ARRA dollars are nearly identical to those using the benchmark outlaid ARRA dollars.

Next, Table 10 reports estimates when we change the generalized method of moments criteria

Table 8: Response of employment growth to state government losses and outlaid ARRA money, reported as elasticities

	Government	HELP services	Goods-producing	Non-HELP services
		Fungibility restriciton imposed		
Aid offset - loss	0.178	-0.131	-0.108	-0.040
	(0.052)	(0.051)	(0.084)	(0.040)
		Fungibility restriction not imposed		
Aid offset	0.066	-0.002	-0.061	-0.132
	(0.102)	(0.085)	(0.224)	(0.090)
- Loss	0.466	-0.279	-0.130	0.143
	(0.192)	(0.130)	(0.380)	(0.165)
Test of fungibility restriciton (Chi-squared)	11.742	7.009	0.720	0.007

Notes: Using all five instruments, outlay-based offset and employment through May 2010.

Table 9: Response of employment growth to state government losses and announced ARRA money, reported as thousands of jobs

	Government	HELP services	Goods-producing	Non-HELP services
Fungibility imposed	551	-734	-25	78
	[415 , 687]	[-1430 , -38]	[-318 , 268]	[-227 , 383]
Fungibility not imposed	551	-603	126	-192
	[359 , 743]	[-1604 , 398]	[-571 , 823]	[-872 , 489]

Notes: Bracketed numbers report corresponding 90 percent confidence interval. Using all five instruments, announcement-based offset and employment through September 2010.

Table 10: Population-weighted results: Response of employment growth to state government losses and outlaid ARRA money, reported as elasticities

	Government	HELP services	Goods-producing	Non-HELP services
	Fungibility restriciton imposed			
Aid offset - loss	-0.054	-0.135	-0.332	-0.036
	(0.061)	(0.039)	(0.101)	(0.028)
	Fungibility restriction not imposed			
Aid offset	-0.086	-0.199	-0.583	-0.086
	(0.094)	(0.067)	(0.162)	(0.052)
- Loss	0.130	-0.065	0.051	0.074
	(0.136)	(0.065)	(0.281)	(0.101)

Notes: Using all five instruments, ARRA outlay-based offset and employment through September 2010.

to give more weight to high population states. The error term for each state is multiplied by the square root of that state's population.

Why do this? Certainly, our statistical model assumes that the regression coefficients are the same across states. Thus, strictly speaking there is no reason to give different weights to different states' error terms depending on the population of that state. Rather, our weighting scheme is an expedient way to allow larger states to have a greater influence over coefficient estimates in case there is some heterogeneity across states in the magnitude of the treatment effect. Alternatively, policy makers may wish to assign greater relevance to a high population relative to a low population state, e.g. California versus Rhode Island.

This change in the specification changes the estimates for the two service sectors very little relatively to the benchmark. For the government sector, the employment effect becomes negative rather than positive. For the goods-producing sector, the effect is negative as in the benchmark but is much stronger. Using the population weights, all four sectors have a negative employment effect.

Table 11 reports elasticities for ten alternative specifications. The pattern is clear. For all but one specification, government employment is greater because of the Act. For all but one specification, HELP services employment is lower because of the Act. Non-HELP services is close to zero for each specification. The widest range of employment estimates occurs in the goods-producing sector; however, in cases where it is positive, it is not statistically different from zero.

One natural question is: searching across all specifications in Table 11, what is the best-case scenario for an effectual ARRA in terms of job creation? This is seen in row (*vi*), which impose fungibility, use the benchmark specification except only use the sales tax intensity and highway dollars instruments. In this case, the Act created a net 659 thousand jobs—the majority of which

Table 11: Response of employment growth to state government losses and ARRA money, miscellaneous specifications, reported as elasticities

	Government	HELP Services	Goods producing	Non-HELP Services
	Plausible alternative specifications			
(i) Benchmark (from table 2)	0.139	-0.096	-0.106	0.013
	(0.088)	(0.044)	(0.100)	(0.035)
(ii) Drop six smallest	0.053	0.166	-0.181	-0.033
	(0.088)	(0.108)	(0.133)	(0.067)
(iii) Drop six largest	0.033	-0.121	-0.303	-0.024
	(0.077)	(0.055)	(0.099)	(0.028)
(iv) Only primary instruments	0.297	-0.126	0.024	0.032
	(0.099)	(0.083)	(0.102)	(0.044)
(v) Keep all states	0.020	-0.103	-0.192	0.004
	(0.080)	(0.051)	(0.091)	(0.028)
(vi) Drop small four and NV	0.240	-0.096	-0.024	0.021
	(0.091)	(0.047)	(0.062)	(0.039)
	Implausible specifications (for comparison)			
(vii) Drop loss regressor	0.160	-0.136	-0.203	0.001
	(0.125)	(0.064)	(0.168)	(0.046)
(vii) Drop offset regressor	0.365	-0.219	-0.092	0.105
	(0.203)	(0.123)	(0.197)	(0.130)
(ix) Exclude region control	0.074	-0.137	0.053	-0.024
	(0.071)	(0.053)	(0.060)	(0.027)
(x) Exclude population control	0.119	-0.097	-0.143	0.017
	(0.090)	(0.045)	(0.129)	(0.034)

Notes: Employment through September 2010. In benchmark specification, the four lowest population states (i.e. Alaska, North Dakota, Vermont and Wyoming) were excluded. The two primary instruments are the highway instrument and sales tax intensity.

were in the government sector.

5   Other Researchers' Estimates of Job Creation

Even before the legislation was passed, Bernstein and Romer (2009) reported that 3.6 million jobs would be created or saved by the then envisioned legislation, relative to a no stimulus act baseline. This was based on existing estimates of fiscal policy multipliers. Their estimates included both the tax and spending components of the ARRA.

Congressional Budget Office (2010) estimates that the employment increase "attributable to the ARRA" was in the range of 500 to 900 thousand in 2009 and is in the range of 1.3 to 3.3 million for 2010. Their ranges are computed based on both government spending as well as tax cut incentives in the Act. To construct these numbers (in their Table 1), they divide the total spending of the ARRA into its components and then apply low and high output multipliers. These multipliers were delivered from previous studies.

The Council of Economic Advisors (2010) measures the employment increase due to the Act in two different ways. First, using a multiplier approach similar to the Congressional Budget Office, the CEA estimates that the Act had the effect of increasing employment by 2.5 million workers (Table 4). Second, the CEA estimates a vector autoregression which includes employment from 1990:Q1 to 2007:Q4. Based on those parameter estimates, they forecast gross domestic product for the period after the Act's implementation. They then interpret the vector autoregression's forecast error for employment from 2009:Q2 to 2010:Q2 as being due to the policy. According to these estimates (Table 5), at the end of 2010:Q2, the Act had increased employment by 3.6 million workers.

Blinder and Zandi (2010) find that the employment increase due to the ARRA (including both spending and tax cuts) was 2.7 million jobs. Their estimate is based on the Moody Analytics model of the U.S. economy, which is a statistical model that includes restrictions based upon standard Keynesian assumptions.

Wilson (2011) estimates the job effects of the Recovery Act using state-level variation in a manner similar to ours. He instruments for endogenity using two cost estimates for the ARRA that existed prior to the Act's passage. He considers the effect on employment at different horizons following the ARRA's implementation. For employment through October 2010, he find that there were 800 thousand additional jobs because of the stimulus. This is close to our "best case" scenario for the ARRA described in the previous section.

While Wilson's above number is relatively small compared to other studies, he does find larger employment effects at a more short-run horizon. When evaluating the employment growth through February rather than October of 2010, Wilson finds that the Act saved/created 2.3 million jobs.

Feyrer and Sacerdote (2011) conduct both a cross-sectional and time series analysis to estimate the employment effects of the ARRA. Based on state-level data, their cross-section estimate implies

that the Act created/saved 1.9 million jobs, while their time series estimate implies that the Act created/saved approximately 845 thousand jobs.[37]

The most crucial difference between their analysis and ours may be aggregation. In their regressions, the jobs effect is restricted to be identical across employment sectors. Our modest disaggregation into four sectors demonstrates that different sectors responded differently to ARRA aid. First, we are able to reject statistically the hypothesis of identical sector responses. Second, these differences are also quantitatively important. Third, the different trend behavior, over the last decade, across sectors suggests different employment processes are at work. Finally, the practical consideration that much aid flowed through state and local governments suggests that government employment should be treated differently than private-sector employment. Also, differences between our results and theirs might be explained by the differences in instruments; Feyrer and Sacerdote (2011) use the average seniority of members of the U.S. House of Representations to control for endogenity.

Cogan and Taylor (2010a) look at Bureau of Economic Analysis data on government purchases of goods and services.[38] They find that most government purchases occurred at the Federal rather than state and local level and that these purchases account for only 2% of ARRA aid. They argue that state and local governments did not make purchases of goods and services, but rather increased transfer payments and reduced borrowing. As such, there was only a negligible impact of the Act on aggregate output and employment. While our analysis confirms the fact that much funding went through states, it is not clear whether wages and salaries of government workers are fully or even partially captured by the National Income and Product Account measures of government purchases.

6   Conclusion

Much work on the effects of the ARRA remains to be done. We found, surprisingly, either negligible or negative effects of the Act on total employment; thus, it is important to explore whether alternative empirical specifications, besides the historical 'Keynesian multiplier' approach of Section 5 used by other researchers, are capable of finding a significant positive jobs effect.

The most promising avenue in this regard is to allow for cross-state positive spillovers. This might result in estimates of a large positive jobs effect. Suppose, for example, that Georgia received relatively more ARRA aid, which in turn stimulated that state's economy. If, as a result, Georgia residents' vacation spending in Florida increased, then the increased vacationing might generate jobs in Florida. Our methodology cannot pick up this effect.

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[37]Feyrer and Sacerdote (2011) do not report results in units of employment; however, we can calculate this figure based upon numbers they report: per capita stimulus is $1100, one job per $170,000 of stimulus (cross-section), one job per $400,000 (time series). These statistics together with a U.S. population of 307 million imply the job totals reported in the text.

[38]See also Cogan and Taylor (2010b).

If this type of spillover from interstate trade is widespread nationally, then the economy-wide jobs effect of the ARRA may be actually larger than what we find. To address this, we are planning to redo our analysis by adding time series variation to the current cross-state variation. Given data collection lags and the fact that ARRA spending did not begin in earnest until mid-2009, we did not have a sufficiently long time series to use this approach in the present paper.

Next, research on the ARRA, and in particular our empirical findings, demands greater structural economic modeling. In this study, we deliberately chose the relatively 'model-free' approach for one of the first studies on this new government program and data set. The drawback is that, at this point, we can only conjecture on the underlying, economic mechanisms that give rise to our findings.

Equilibrium modeling, with specification of preferences, endowments and technologies, should allow us to pinpoint these mechanisms. We predict that an accurate economic model of the ARRA experience will have three essential features. First, the Great Recession and the Act's implementation happened partway through a sectoral shift from goods-producing to a service (of a particular type) sector economy as evidenced in Figure 2.[39] Second, as explained in the paper, relatively less educated people faced, and continue to face, a much worse job market than more educated people. The way that state and local governments channeled ARRA funding into different sectors is likely to have consequences for the effects of the Act. For this reason, an accurate model should differentiate between high and low education workers along with their respective labor markets. Third, we have provided substantial evidence that state and local governments have used part of ARRA aid in a way not explicitly intended by Congress and the President. As such, an accurate model of this period will include a hierarchal intergovernmental component in the spirit of Bradford and Oates (1971a).

Acknowledgements

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[39]Existing economic modeling of sectoral shifts include Davis and Haltiwanger (2001) and Phelan and Trejos (2000).

Appendix

Data Construction

ARRA outlaid dollars data are taken from the 13 August 2010 Federal agencies' "Weekly Financial and Activity Reports," which are cumulative over time and available on the recovery.gov web site.[40] The Social Security Administration dollars are excluded entirely because these are direct transfers paid by the Federal government to citizens. We also exclude the following agencies from our data: General Services Administration, National Science Foundation, Small Business Administration, Department of Interior, Federal Communication Commission, Department of State, Retirement Railroad Board, Department of Veterans Administration, NASA. Each of these exclusions is due to one of the following reasons: data was not reported in a useful manner, none of that agencies' funding was reported as going through the states. The total funding outlays from excluded agencies (expect for the SSA) make up less than 2% of total ARRA outlays. Call this $OUTLAY$. Every variable, unless otherwise noted, is indexed by state which we suppress for simplicity.

ARRA announced dollars are taken from the recovery.gov web site on 13 September 2010. On the web site, these are reported as data summed across agencies for each state. The web site states that some agencies' data are not included here because these agencies did not report announced dollars as broken down by state. Call this $ANNOUNCE$.

Next, we use the total tax revenue collected by state. This is collected by the U.S. Census in the "Quarterly Summary of State and Local Government Tax Revenue," which is available on the Census web site.[41] We construct annual total state tax collections from the quarterly data. Call this $STATETAX_t$, where t represents one year ending in June.[42]

Next, we need a measure of the pre-recession size of state revenue. Because we do not need data since the recession's beginning, we are able to use a more accurate measure of the size of state government–one that includes non-tax state revenue sources. $STATEREVALL_t$ is the calendar-year state revenue from all sources, which is reported in the "Census of Governments."

In addition to state revenue, we will use state Medicaid outlays (independent of the funding source). Medicaid data is available in National Association of State Budget Officers (2009). There are two issues. First, unlike the quarterly census-collected tax revenue data, the state-level NASBO Medicaid data is reported in annual, calendar amounts. Therefore, we are unable to match Medicaid cost to the growth rate timing of state tax revenue ex-

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[40]Documentation for the web site data is contained in Recovery Accountability and Transportation Board (2009)

[41]Although the word 'Local' is in the title of the data series, in actuality the data does not report local tax information.

[42]Note that state tax is less than actual state government income. This is because we do not have up-to-date data on the two main others sources of state income: earnings from other sources, e.g. university tuition, and non-ARRA Federal aid.

actly. Second, NASBO reports the 2009 Medicaid expenditures as an estimate only. Let $MEDICAID_t$ equal the annual spending in a state on Medicaid.

Using the above variables, we compute our outlay-based measure of ARRA aid relative to the size of state government. Let

$$OFFSET = \frac{OUTLAY}{1.75 \times STATEREVALL_{2008}}$$

In our robustness analysis, we estimate the model using $OFFSET$ computed using the ARRA announced rather than outlaid dollars.

$$OFFSET_{announced} = \frac{ANNOUNCE}{1.75 \times STATEREVALL_{2008}}$$

Next, we compute a measure of fiscal stress faced by each state because of the recession. We use the annualized decline in state tax revenue plus the increase in Medicaid costs. We do so over seven quarters with the final quarter being 2010:Q3.

$$LOSS = -\frac{\Delta T - \Delta M}{1.75 \times STATREVALL_{2008}}$$

where

$$\Delta T = 0.5 \times STATETAX_{2009} + STATETAX2010 + STATETAX_{2009}^{AUTUMN} - 1.75 \times STATETAX_{2008}$$

$$\Delta M = 1.75 \times MEDICAID_{2009} - 1.75 \times MEDICAID_{2008}$$

Employment is the non-farm payroll series, de-seasonalized, from the Bureau of Labor Statistics Establishment Survey. This gives the number of workers in each state by month. We use measures from four different sectors: government, HELP services, non-HELP services and goods-producing. Each series has been deseasonalized either by us, using the Census' X12 algorithm, or by the Census itself. Further details on the employment data appear in the body of the paper.

We have five instruments. Our first is the ARRA dollars announced by the Federal Highway Administration relative to state government revenue from all sources in 2008. Second, "strong budget rules" is a dummy variable taking on one for a state that has relatively stringent balanced budget requirements. This classification is taken from Table 2 of Clemens and Miran (2010). Third, Democratic governor is a dummy variable constructed using the Wikipedia entry "List of Current U.S. Governor" (extracted in July 2010). Fourth, the

spend-pay ratio gives the number of dollars spent by the Federal government in that state relative to the Federal taxes paid by that state in 2005. It is from the Tax Foundation, a private nonpartisan research group organization, and available at its web site taxfoundation.org. Fifth, the intensity of sales tax usage is from the "Quarterly Summary of State and Local Government Tax Revenue." It measures the ratio of sales tax revenue relative to all tax revenue in each state, averaged over 2007 through 2008.

The remaining data are exogenous variables used in estimation. Northeast, West and Midwest are dummy variables based on the U.S. Census Bureau's region definitions. Finally, UI generosity reports the maximum weekly benefits amount from the 2010 U.S. Department of Labor's "Comparison of State UI Laws." In the case that a maximum is reported as a range in the report, we use the maximum from that range.

Partial Correlations

Table 12: Partial correlations of instruments on $OFFSET$ and $-LOSS$

	Offset	- Loss
Highway dollar and percent sales tax instruments		
Highway instrument	2.497	1.073
Sales tax intensity	0.003	-0.063
All five instruments		
Highway instrument	2.774	1.043
Sales tax intensity	-0.036	-0.011
Spent-pay ratio	0.036	-0.047
Strong budget rule	-0.009	0.020
Democratic governor	0.017	0.010

Notes: Above are regression coefficients from the single-equation least-squares estimation of alternative endogenous variables on instruments and all control variables.

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