Did the Stimulus Stimulate? Effects of the American Recovery and Reinvestment Act

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We use state and county level variation to examine the impact of the American Recovery and Reinvestment Act on employment. A cross state analysis suggests that one additional job was created by each $107,000 in stimulus spending. Time series analysis at the state level suggests a smaller response with a per job cost of about $400,000. These results imply Keynesian multipliers between 0.5 and 1.0, somewhat lower than those assumed by the administration. However, the overall results mask considerable variation for different types of spending. Grants to states for education do not appear to have created any additional jobs. Support programs for low income households and infrastructure spending are found to be highly expansionary. Estimates excluding education spending suggest fiscal policy multipliers of about .67 with a per job cost of $267,000.

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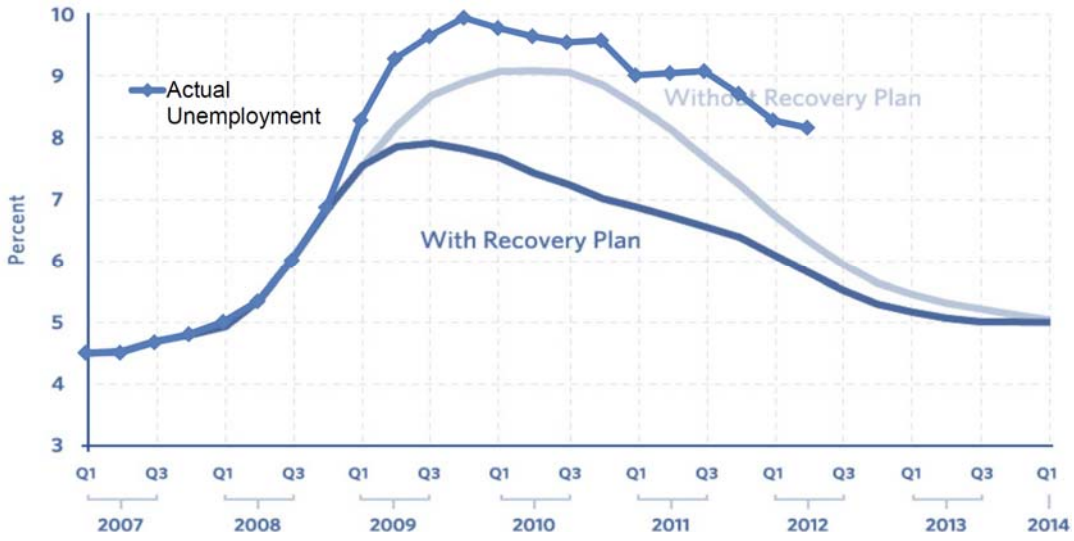
I. Introduction

On February 17, 2009, the U.S. Congress approved the the American Recovery and Reinvestment Act of 2009. Since then, the success or failure of the ARRA has been hotly debated. In arguing for the bill, supporters claimed that passage would increase output and decrease unemployment. The Chair of the Council of Economic Advisers, Christina Romer, presented the following graph to show the expected path of unemployment both with and without passage of the ARRA.

Figure 1: Estimates of the Impact of ARRA at the Time of Passage versus Reality



Added to the graph is a line showing the actual path of unemployment, which rose even faster than the scenario without the recovery plan. In fairness, it was impossible at the time to know exactly what the future path would be in either scenario. This graph was drawn starting with a baseline forecast without the ARRA and projecting the improvement that would occur if the ARRA were passed. It is possible that the stimulus was effective but that underlying conditions were much worse than predicted in January of 2009.

Unfortunately, direct evaluation of the impact of the bill has proven difficult. Most claims of success or failure have been based on the same models that were used to argue for or against the stimulus in the first place. To a first approximation, most evaluations of the stimulus take the difference between the simulated path of output from a scenario with and without the ARRA and substitute the actual path of unemployment for the scenario where the ARRA was implemented. The only new information that has been added is the actual timing of spending in the stimulus.

Typical of this approach is Alan Blinder and Mark Zandi's "How the Great Recession Was Brought to an End." They use a modified version of a large macroeconomic forecasting model to plot the path of the economy both with and without ARRA.[2] They conclude

> *...the effects of the fiscal stimulus alone appear very substantial, raising 2010 real GDP by about 3.4%, holding the unemployment rate about 1½ percentage points lower, and adding almost 2.7 million jobs to U.S. payrolls*

This conclusion, however, could have been written before the ARRA was implemented, knowing only the intended policy path. Their methodology does not take any account of the actual path of employment after the passage of the bill.

Many evaluations claiming failure of the ARRA suffer from similar problems. Other model based evaluations, such as Cogan, Cwik, Taylor, and Wieland (2009) conclude that the government spending multipliers are significantly smaller than those claimed by advocates. Again, their conclusions are based entirely from existing models and gain nothing from actual data on employment before and after the implementation of the ARRA.

In a post on the Congressional Budget Office's blog, CBO director Douglas Elmendorf is very forthright about the inability of these types of evaluations to evaluate actual results.

> *Although CBO has examined data on output and employment during the period since ARRA's enactment, those data are not as helpful in determining ARRA's economic effects as might be supposed because isolating the effects would require knowing what path the economy would have taken in the absence of the law. Because that path cannot be observed, the new data add only limited information about ARRA's impact.*[3]

The fundamental problem is the lack of a counterfactual. We do not know what the path of the economy would have been in the absence of the stimulus. Without a counterfactual, the best we can do is fall back on our models. Unsurprisingly, the models tell the same story today that they did when arguments for and against the stimulus were being made.

This paper aims to take a different approach to evaluating the efficacy of the ARRA by looking at state and local stimulus spending. We will use geographic and time series variation in stimulus spending to identify the effect of stimulus spending on employment. Did regions that received larger amounts of stimulus dollars have faster employment growth?

One potential difficulty with this approach is that regional variation in stimulus spending is not exogenous. Regions that have been harder hit by the recession may be receiving more transfers. In order to deal with this problem we turn to the political economy literature. Knight (2002)

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[2]Specifically, Moody's Analytics model of the U.S. economy

[3]"Estimated Impact of the Stimulus Package on Employment and Economic Output", CBO Director's Blog, Aug 24 2010, http://cboblog.cbo.gov/?p=1326.

and others have found that the composition of congressional delegations has a significant impact on government spending. States with higher seniority in Congress tend to receive more money per capita than those with lower seniority. If we take congressional seniority to be unrelated to underlying economic conditions this should provide an instrument for spending at the regional level.

We will also examine the time path of the spending at the state level to examine the dynamic effect of stimulus spending. This approach more closely maps to the traditional fiscal policy literature by looking at the impulse response from a shock to spending. The advantage of this approach is that the exact time path of the payments from stimulus is likely to have a significant random component once the aggregate level of state spending is accounted for.

We will also disaggregate the spending by federal agency. In examining the spending patterns we found that the agencies fell naturally into three groups. The first group includes agencies providing block grants to fund local government employment. A large proportion of spending by the Departments of Education and Justice were used to fund teachers and police at the local level. The second group consists of support to low income families. Spending by the Departments of Agriculture, Health Education and Welfare, and Housing and Urban Development had a large component of support to low income individuals (food stamps, Medicaid, and rental assistance). The spending of the third group largely consisted of paying for new infrastructure projects. This group includes the Departments of Transportation and Energy which funded building projects. The results for each of the individual agencies within a group are very similar.

To preview the results, we find that the stimulus had modestly lower impacts than predicted by the administration, though their estimates are well within our confidence interval. The overall results mask significant heterogeneity by type of spending. Transfers to local governments and school districts to support teachers and police appear to have no positive effect on employment. Programs funding support for low income households generate the largest employment response. Building projects generate a smaller, but still substantial response. Excluding the transfers to local schools and governments, the cost of a job in the stimulus was roughly $267,000 per year. Including the transfers to local school districts, this cost increases by a factor of two. The implied Keynesian multipliers are between 0.5 and 1.0 in the aggregate and rise to 2.0 if one excludes education spending.

II. Literature Review

The impact of fiscal policy on output has been studied extensively. Empirical work in this field typically estimates Keynesian multipliers of the sort that underlie the Romer-Bernstein estimates of the impact of the ARRA. The size of these multipliers played a crucial role in evaluating the potential efficacy of the ARRA, with advocates arguing that multiplier are large and critics arguing that they are small. Unfortunately, unbiased estimates of fiscal multiplier effects are difficult to produce because fiscal policy is generally a response to economic conditions and therefore endogenous.

There have generally been three approaches used to solve the identification problem created by the endogeneity of spending. First, is the use of structural vector auto-regressions (SVAR) pioneered by Blanchard and Perotti (2002). They find spending multipliers in the vicinity of one. More recently, Auerbach and Gorodnichenko (2010) find that fiscal policy is more effective during recessions, finding multipliers as high as two, though they find that this is mostly concentrated in military spending.

The second approach is to search for episodes of fiscal policy innovations that were not motivated by current economic conditions. The most recent work by Romer and Romer (2010) on tax changes in the US uses this approach. They examine the narrative record to find episodes where congress changed tax laws for reasons that excluded current conditions. Some of the exogenous changes they identify are those related to budget deficit reduction or that are ideologically driven. They find multiplier in the range of about three for exogenous tax changes in the US.

Other papers using this general approach use changes in military spending as exogenous shocks. These papers include Barro (2009), Ramey and Shapiro (1998), and Ramey (2008). These papers tend to find multipliers that are less than one. Feyrer and Shambaugh (2009) exploit the Romer and Romer shocks to look at the impact of US fiscal shocks on the rest of the world. Their results suggest a significant proportion of tax shocks are absorbed abroad.

There has also been some work done using state level variation in spending. Shoag (2010) uses variation in state pension plan returns to instrument for state spending and finds a multiplier of about two. $35,000 in spending is associated with one additional job. Clemens and Miran (2010) exploit the variation in state level balanced budget rules to identify the effect of fiscal policy at the state level. They find that $25,000 in additional state spending results in one additional job. This suggests a rather large fiscal multiplier at the state level.

One potential problem with comparing previous work in fiscal policy to the current episode is external validity. The size of the ARRA is much larger than anything we have seen before, the output gap is much larger, and the Federal Reserve is at the zero bound. All three factors suggest that the response of the economy to the ARRA is likely to be different than the response to increased military spending and tax innovations that occurred during periods of small output gaps. The response of the economy to fiscal policy is also dependent on the Federal Reserve's response function. Woodford (2011) suggests that the multipliers will be higher when interest rates are at the lower bound.

There is also reason to believe that the type of spending matters significantly. Standard Keynesian theory suggests that direct government spending will have a larger impact than transfers. The impact of transfer payments will be higher for high marginal propensity to consume individuals. This makes it difficult to draw conclusions about the ARRA based on studies that are limited to military spending or tax changes taking place under non-recessionary conditions.

The fact that multipliers may vary greatly by type of spending, amount of spending and economic conditions suggests that a direct examination of the current episode may be useful. As discussed in the introduction, very little discussion of the ARRA has incorporated real time data. There are two notable exceptions to this. Wilson (2010) has written a state level analysis of jobs and stimulus spending that we draw on for our state level results. He finds that the ARRA had positive stimulus effects, but that the results are sensitive to the time frame over which the evaluation is taking place. We will go beyond his work by using time series variation in spending within state. Cogan and Taylor (2010) have looked at the impact of grants to the states in the ARRA and conclude that states did not alter spending significantly as a result of the stimulus.

III. Methodology

The fiscal policy literature generally expresses impacts in terms of fiscal multipliers. That is, how much additional GDP will be produced for each dollar of additional government spending? Like Wilson (2010), we will focus on change in the number of jobs rather than the level of output. The main reason for this is data constraints. We have good monthly measures of the number of people employed at the state level. We do not have similar real time numbers for state GDP. Employment and GDP are, of course, closely related and we will do some simple transformations using the Okun's law relationship between employment change and GDP growth.

We take two approaches. First, we examine the overall change in employment over the sample period against the overall quantity of stimulus spending at the state level. This is quite similar to work done by Wilson (2010) at the state level. Second, we examine month by month spending at the state level and generate impulse responses of employment to the state level spending changes.

These two approaches have very different sources of identification. The state level cross section gives the broadest picture with the most complete data. Because the identification is coming from state level variation, we can control for aggregate national shocks. The time series results allow us to control for the aggregate level of state spending and obtain identification though the idiosyncratic timing of the spending.

After examining the effects of overall stimulus spending on employment we further cut the data to look at different types of stimulus spending (do block grants for teachers have a different impact than expanding food stamp eligibility?) and different types of employment responses (did the stimulus create more education jobs than construction jobs?)

One disadvantage of moving to disaggregated data is that we miss any nationwide and global impacts from ARRA. The multiplier effects from stimulus spending at the local level will be reduced by the marginal propensity to import from outside the region being examined. This will potentially be more important for some kinds of spending than others. Road construction is a localized phenomenon in some regards (wages will be paid in the state where the road is built),

but national in others (new equipment and materials may be sourced out of state). Low income individuals may be more likely to spend locally than middle income individuals.
For this reason the positive effects on job growth and wages that we find will likely be lower bounds and possibly significant understatements of the total effects of ARRA. One goal of ARRA was to increase business and consumer confidence nationally. We do not capture these aggregate effects.

In the opposite direction, we do not capture the response of monetary policy to the ARRA. If we believe that the Fed is following a policy rule driven by forecasts of future output, the passing of fiscal stimulus should have resulted in less monetary stimulus by the Fed due to an upward revision of forecast growth. With non-zero policy interest rates, this would manifest itself in higher real interest rates. During the current recession, however, the discount rate has been at the zero bound since the end of 2008, potentially constraining the ability of the Fed to respond to the ARRA.

By performing the analysis at the state level, we are controlling for all national effects and examining only the within state impacts. Our estimates are therefore implicitly assuming that the net impact of the state spillovers and monetary responses is zero. The actual size of these effects is outside of the scope of this study.

IIIa Cross Sectional Analysis

We regress the change in employment per capita on stimulus spending per capita at the state level,

$$\Delta epop_i = \alpha + \beta * Stimulus\ per\ capita_i + \epsilon_i \quad (1)$$

where epop is the employment to population ratio.

Since we are regressing jobs per capita on stimulus per capita, our coefficients can be interpreted as jobs per hundred thousand dollars. This is a loose interpretation since in reality there is a flow of spending creating a flow of jobs. Since the time series results explicitly deals with the time path, this is less of an issue for these results.

One concern with our cross sectional approach is that stimulus spending is likely to be endogenous. States that were hardest hit by the recession may have received disproportionate amounts of stimulus spending. At the state level we deal with this concern by turning to the political science literature on the relationship between relatively idiosyncratic political power and spending. States with longer serving congressional delegations have higher seniority and more access to committee chairmanships and other leadership positions.

Higher seniority at the state level is therefore positively correlated with federal spending by state. We will exploit this variation to instrument for the level of stimulus spending. For each House and Senate member we collected current party, years of seniority, seniority rank relative to other House (Senate) members, and Chair of any committees or Caucus. We have tried

predicting stimulus spending per capita using mean ranks (seniority with 1 being the most senior) of a state's House and Senate delegations and with the number of committee chairs held by the House and Senate delegations.

Empirically ARRA spending per capita across states is not particularly correlated with committee chairs or with the seniority of a state's senators. However, the mean seniority of a state's House delegation is strongly correlated with the stimulus dollars per capita received by a state. Our finding in this regard is consistent with the existing political economy literature which also uses mean seniority at the state level to predict spending. As a result we confine ourselves to using mean seniority of the House delegation as our single instrument for stimulus spending per capita.

Another predictor of stimulus per capita is the population of the State. Small states such as Montana and Wyoming received many more dollars per capita than more populous states. This could be a result of the structure of the Senate (ie two Senators per state regardless of population) or it could be in part a reflection of the fact that less populous states have many more miles of highways and bridges per capita than densely populated states. However we are naturally concerned that population size may be directly correlated with employment and wage growth during the recession and we therefore we report robustness checks that include the log of population as a control on the right hand side rather than using as it an instrument.

IIIb. Dynamic Responses

We also look at the impact of the stimulus spending in a state level panel. By using a monthly panel we can control for the overall level of stimulus spending at the state level, getting identifying variation from the changes in spending on a month to month basis. For these regressions we do not have the luxury of an instrument for spending. However the time series allows us estimate the impacts in differences, effectively controlling for state level difference in the size of the initial shock. Our identification is coming from idiosyncratic differences in the timing of spending at the state level.

There are clearly some types of spending for which relying on the timing of spending is more problematic than others. In particular, spending on unemployment insurance is directly tied to the level of unemployment. For this reason we will exclude unemployment insurance in some specifications. It should be noted that the bias from programs tied to economic performance is against finding an effect of the stimulus.

The analysis follows the approach of Romer and Romer's paper examining tax changes. We regress the change in the employment to population ratio on a set of leads and lags of the change in spending. By summing these coefficients we generate the response over time to a permanent change in spending. The basic regression is:

$$\Delta epop_{it} = \gamma_t + \sum_{j=-leads}^{lags} \beta_j * \Delta(stimulus\ per\ capita_{i,t-j}) \quad (2)$$

The summation of the lag coefficients,

$$response_t = \sum_{j=0}^{lags} \beta_j \quad (3)$$

gives the response to a permanent change in spending per capita at various time horizons. These responses functions will be presented as graphs. All results use 2 leads and 18 lags, though the results are not sensitive to different lead and lag structures.

IV. Data

Data on stimulus spending comes from the website www.recovery.gov which is maintained by the US federal government.[4] We use two different measures of stimulus spending. We use what are called "Agency Reported" data at the state level. These data are reported by roughly 25 major federal agencies and detail what dollars were allocated to which states. The agencies include all of the cabinet level departments such as Department of Transportation and Department of Education as well as the Social Security Administration, the National Endowment for the Arts, the National Science Foundation etc. We will use both the aggregate spending across all agencies and the individual agency spending for the larger agencies. For the panel data, we use monthly outlays to each state as reported as reported by each Agency. Table 1 lists agencies with over $100 million in spending through September 2010 followed by categories that received over one billion dollars.

Means for the state level data are shown in Table 2. Spending is reported in two different ways, obligations and outlays. Obligations represent projects that have been approved, but may not have received funding. Outlays represent money that has actually been disbursed to projects. In both of our analyses (cross section and time series) we obtain similar results with either series. The tables below are based on the use of obligations under the theory that agencies and private contractors are likely to begin hiring and spending in advance of the actual cash arriving in a bank account.

Stimulus per capita averages around $1100. The state level (Agency Reported) data on funds announced account for about $280 billion worth of spending. We expect the total to be significantly less than the $765b ARRA since $288b of that total was allocated to tax relief and much of the spending beyond tax relief was allocated to entitlement programs including extensions of unemployment insurance.[5] Of the total ARRA money, $452 billion is part of agency spending that is captured in the agency reports as funds *available*. Only $347 billion of the $452 has actually been announced as part of specific grants, loans and contracts. Of the $347 billion that has been announced, only $284 billion is allocated to specific states with the other $63 billion being federal spending not allocated by the agencies to a state.

[4] Specifically we pull data from this location: http://www.recovery.gov/FAQ/Pages/DownloadCenter.aspx

[5] See http://www.recovery.gov/About/Pages/The_Act.aspx. We are still surprised that the Agency reported data do not add up to a larger figure given that

Our data on employment and earnings come from the Bureau of Labor Statistics.[6] At the state level we pull monthly employment and earnings data from the Current Employment Statistics (CES) survey. To collect these data, state agencies assemble data for a large sample of establishments. Roughly 140,000 businesses and governments are sampled and this represents 410,000 individual worksites.

For our cross state analysis we consider the difference in employment per capita across two different months. For the cross sectional results we calculate the effect of ARRA based on the change in log employment to population between February 2009 and October 2010. Our baseline results are for total employment. In earlier drafts of this paper (Feyrer and Sacerdote 2010) we show the effect of ARRA on all government employment, federal, state, local government employment and private sector employment.

Our data on the seniority of members of Congress comes from the list maintained by Wikipedia.[7] We spot checked it and found it to be accurate.

V. Results

In Table 3 we present our baseline results at the state level. In column (1) we regress the change in employment per capita (from 2/09 to 10/10) on stimulus spending per capita in hundreds of thousands of dollars. We find a coefficient of 0.93 which suggests that each $100,000 spent created 0.93 jobs. If we eliminate education spending from the calculation of stimulus per capita, the coefficient rises modestly to 1.0. If we control for the log of population, the coefficient rises to 1.08 (column 3).

The basic state level cross sectional result can be seen in Figure 2 in which we show a scatter plot of changes in the employment to population ratio over the period against stimulus spending per capita. There is a clear positive relationship between employment outcomes and spending per capita. Alaska is a clear outlier having received more than $2,500 per capita. If we drop Alaska, the slope changes from .87. If we instead eliminate North Dakota the slope falls to .63. The sensitivity of the cross state results to inclusion of these small population states suggests that one should place only modest weight on this cross state evidence.

We are concerned about the possible endogeneity of spending and in particular more money may have been sent to states that were hardest hit by the recession. To control for this selection we instrument for stimulus spending per capita using the mean seniority in a state's delegation to the House of Representatives. We measure seniority as the rank (1 to 435) with 435 being the least senior.

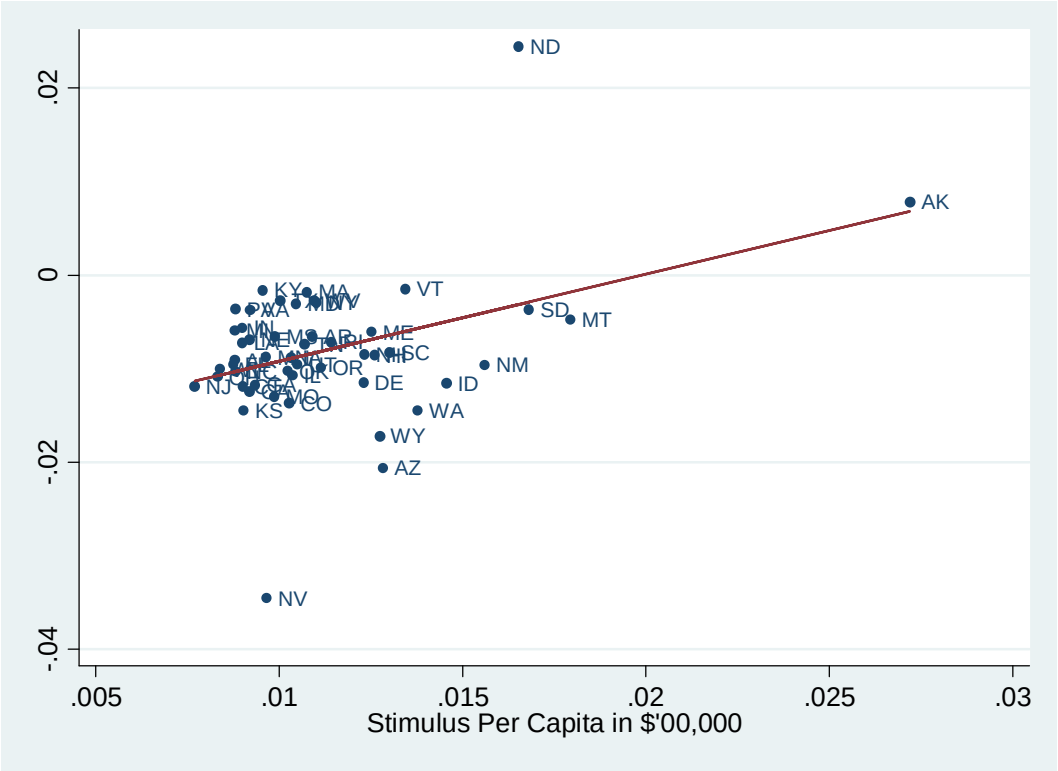
As expected, states with less senior delegations receive fewer stimulus dollars per capita. This first stage is shown in column (4). Mean seniority rank has a standard deviation of 50. A one

[6] See http://www.bls.gov/data/#employment
[7] See http://en.wikipedia.org/wiki/List_of_current_members_of_the_United_States_House_of_Representatives_by_seniority

standard deviation decrease in seniority (i.e. mean rank increases by 50) is associated with a decrease of $165 per capita of spending. Economically this is meaningful and represents a 0.48 standard deviation drop in stimulus per capita.

Figure 2: Long Change in Employment versus Stimulus Spending Per Capita

spending per capita is in hundreds of thousands of dollars per capita. Change in employment is difference in employment per capita from Feb 2009 to October 2010



The second stage of the instrumental variables regression is shown in column (3). The result implies that a $100,000 increase in stimulus creates two additional jobs. The t statistic on this coefficient is 3.0.

To put these numbers in perspective we attempt to translate them into dollars spent per job year and we compare our results to White House assumptions. The OLS coefficient in column (1) implies that $100,000 created .93 jobs. Since this takes place over roughly 20 months (Feb 09 to August 10) we could think of this as 0.93*(20/12) job years which implies roughly $64,500 per job year. The White house anticipated that during 2010, ARRA spending would create 3.0 million jobs from $787 billion of spending. (See the Jobs Report issued in May 2009).[8] If we assume that these three million jobs existed over the entire 20 month period, that would imply $157,000 per job year.

[8] See http://www.recovery.gov/About/Documents/Jobs_Report_Final.pdf.

Table 4 looks at the change in the state level employment to population ratio in the 16 months after stimulus spending peaks. We regress the change for the post-period (October 2010 to January 2012) on the same stimulus per capita measure used in Table 3. One might expect a negative effect on employment to population from the ramp down in stimulus spending. On the other hand, the speed of the ramp down was modest. And as the economy moved (at least slightly) closer to full employment, reductions in government spending may have had smaller impacts on employment than the initial increases in ARRA spending which occurred in the deepest part of the recession.

Interestingly we do not see negative effects of stimulus withdrawal on employment in the post period. In column (1) The coefficient on stimulus per capita is .023 which implies that an additional $100,000 in stimulus spending is associated with .02 more jobs, even though the spending is being decreased not added. However the standard errors are large and we cannot reject negative effects as large as -.58 jobs (during the post period) for each 100,000 in stimulus per capita received.

Table 5 breaks down the stimulus spending by federal agency that disbursed the funds. The point estimates are noisy but suggest that the effects of the stimulus on job creation vary greatly by type of expenditure. For example each 100,000 per capita in Department of Transportation spending is associated with 2.8 jobs and each 100,000 per capita in Department of Health and Human Services (HHS) spending is associated with 2.5 jobs. HHS spending is largely Medicaid spending.[9] In contrast spending by the Department of Education actually has an insignificant negative association with growth in employment per population. It may be that infrastructure spending and low income supports are more effective at creating jobs than broad fiscal relief (eg education block grants) to states.

In Table 6 we switch the dependent variable to be growth in construction jobs per population and growth in local education jobs per population. The notion is to see how strongly Department of Transportation and Department of Education spending is associated with employment growth in those two sectors. The results are similar to those in Table 5 which used overall employment to population. An additional 100,000 per capita in DOT spending is associated with an additional 2.4 jobs whereas an additional 100,000 in Dept of Education spending is not associated with increased jobs in education.

VI. Time Series Results

The time series results are presented as impulse response functions. The sums of the coefficients presented in the impulse response graphs are the cumulative change in the employment to population ratio over time after a spending shock scaled to $100,000 per capita. Because both the spending and jobs counts are scaled to population, the coefficients can be interpreted as the number of jobs per $100,000 per month increase in spending. On a yearly

[9] Of the 125 billion in ARRA money allocated by HHS, as much as 105 billion may be Medicaid spending. See http://www.hhs.gov/recovery/.

basis it is the number of jobs for each $1.2 million in spending. All response functions are surrounded by a band indicating the 90-10 percent confidence interval. Figure 3 shows the overall impact of the ARRA.

The overall response is modest, with an increase of 2-3 jobs per $100,000 increase in monthly spending. It takes about 10 months for the full impact to take place, after which the impact is relatively constant. This is consistent with the existing literature which finds that fiscal policy shocks take 3-4 quarters to have their full impact. In terms of yearly spending the cost is about $400,000 per job. The standard errors are large and we cannot reject that the impact is nearly twice as large.

Examining the impact by type of spending reveals interesting differences. Figure 4 shows the impact of spending at the agency level for agencies spending over one billion dollars by September, 2010. Grouping agencies with similar patterns reveals three major groups.

First are agencies that are engaged in grants for building projects. Department of Transportation ARRA money largely is being spent on highways, ports, and airport projects. Department of Energy and Environmental Protection Agency projects similarly are funding energy and environmental projects. In both cases, the money appears to be funding projects that were unlikely to take place in the absence of the funding.

Figure 3: The Overall Impact of the ARRA

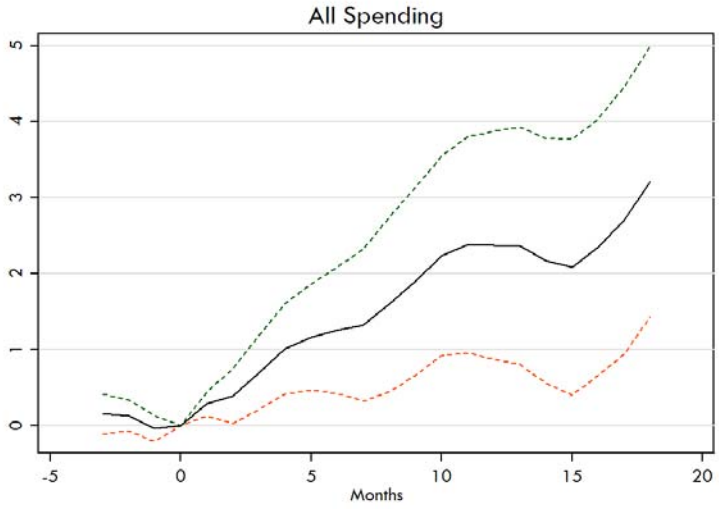
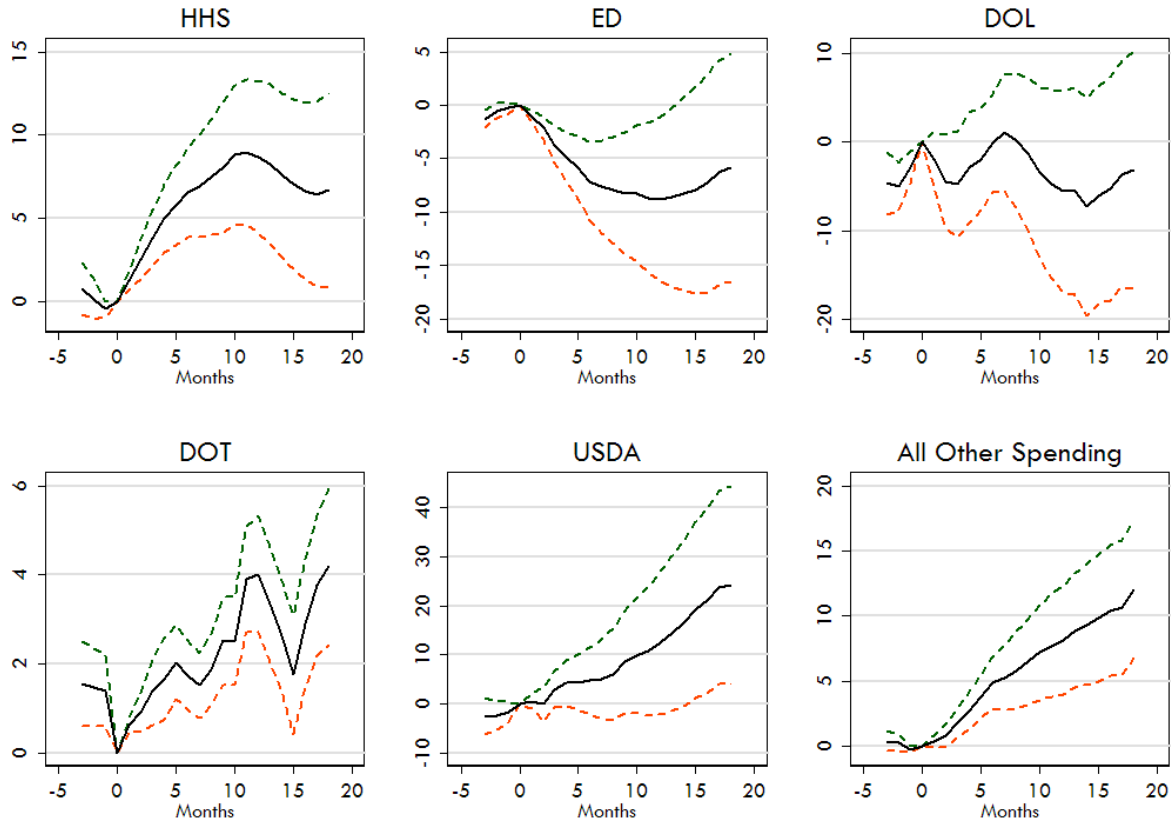


Figure 4: Agency level impacts of the ARRA (agencies over $10 billion)



The second major grouping is support programs for low income households. The majority of USDA spending went to an expansion of food stamps. HUD spending was spent on rental assistance and public housing projects. HHS spending went to Medicaid. A substantial part of the money for low income support came in the form of matching funds to the states, particularly Medicaid. We therefore may worry that this money was essentially a fungible transfer to the states despite the nominal targeting of low income individuals. This concern is mitigated by the fact that the money was only available if states agreed to leave existing eligibility rules in place. In other words, states were obligated to cover the additional individuals that became eligible due to the recession and could not simply use the money to cover imbalances elsewhere. This money was also in the form of an increase in the rate of matching funds, so decreases in state level support reduce the level of federal transfers.

The third major grouping was in the form of grants to local governments to support teachers and police from the Departments of Education and Justice (Homeland Security also spent some money supporting first responders, but this was a relatively small amount). As far as we can tell, this money came with far fewer structural restrictions compared to the state level transfers for low income support. Municipalities had more flexibility to use this money to offset other budget categories.

The only major funding agency that does not fit neatly into these three categories is the Department of Labor, whose spending largely went to extensions of unemployment insurance. This spending is obviously problematic for our analysis because the distribution of these funds is directly related to the employment rate. Extension of unemployment insurance also benefits a much more diverse income group than the low income support programs (though clearly beneficiaries are experiencing a temporary shock). Interestingly, this is the only agency that shows a statistically significant pre trend in the effects of the stimulus.

Figure 5 shows the impulse response functions by each of these major groupings. The differences become more obvious in this view. Support for low income households have the largest positive impact, followed by transportation and energy projects. Transfers to municipalities to fund teachers and police have if anything a negative impact.

Figures 6 and 7 zoom in on the components of the two larger spending categories. All three low income support programs have a positive impact, but the effect is larger for the two programs that directly give cash, food stamps and rental assistance. The transfers to municipalities are negative in all three cases.

Figure 8 shows the results of including everything but education and unemployment extension spending in the analysis. Non education stimulus has a significant positive impact on employment. An increase in spending of $100,000 dollars per month will generate a bit over 4 jobs after about 10 months. Assuming that these coefficients remain at this level indefinitely (which is likely a generous assumption) this indicates a cost of about $300,000 per job over the course of a year for this subset of spending.

Figure 5: Responses by Types of Spending

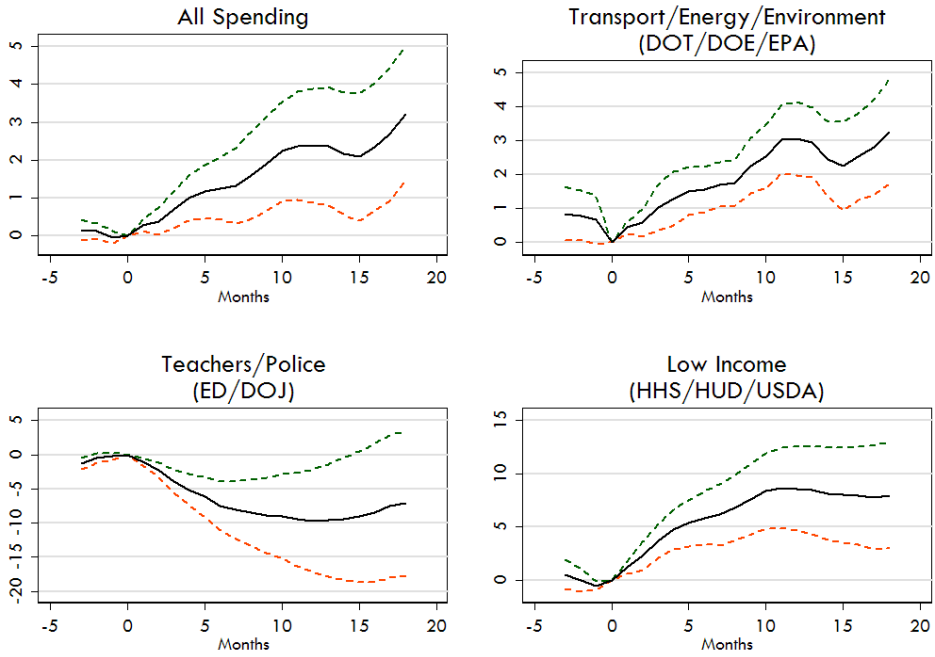


Figure 6: Support for Low Income Households

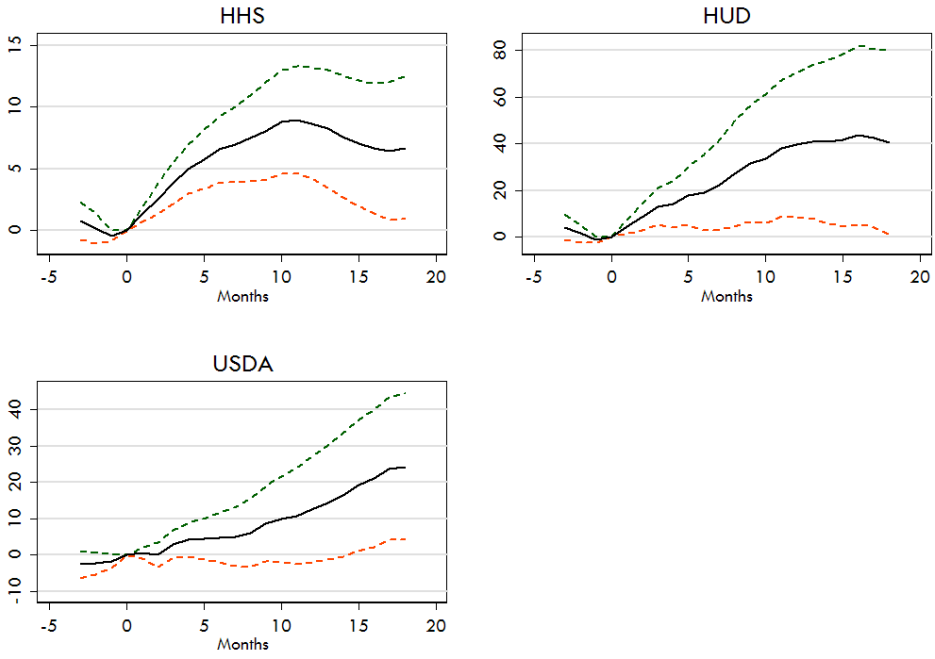


Figure 7: Teachers and Police, Building Projects

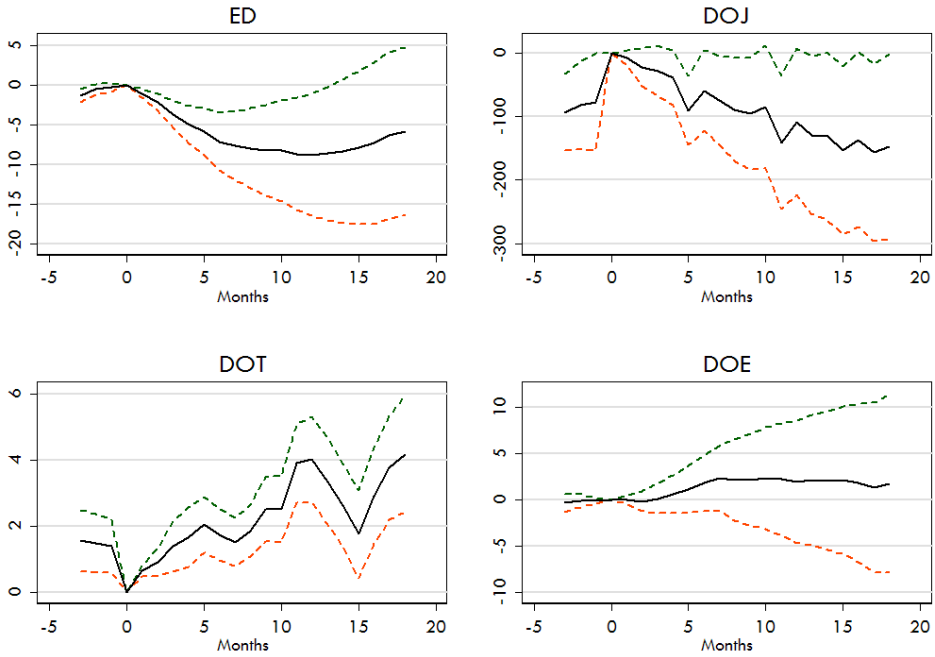
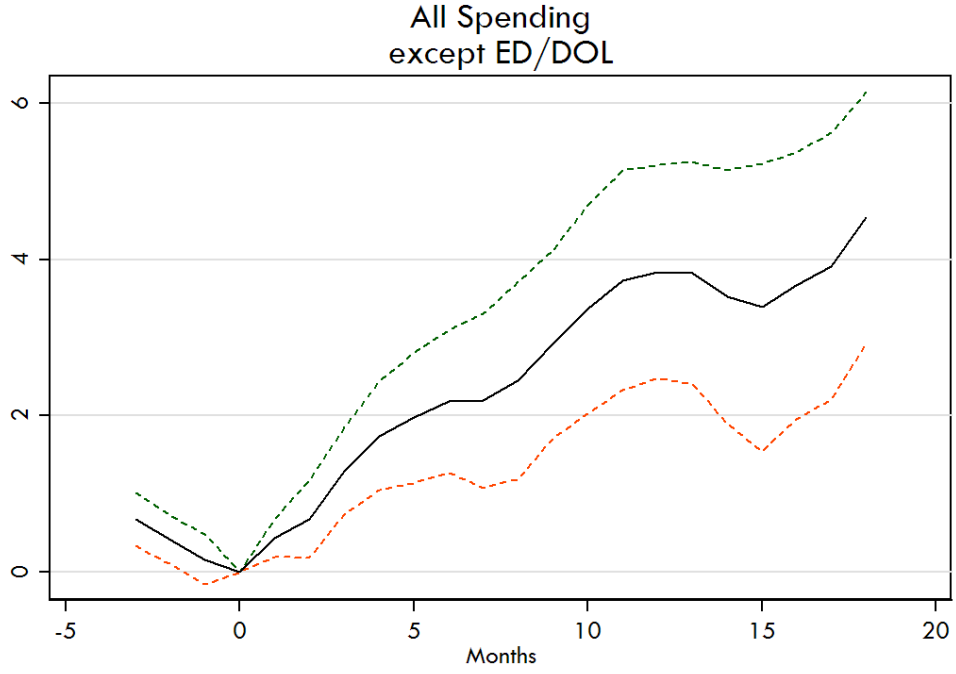


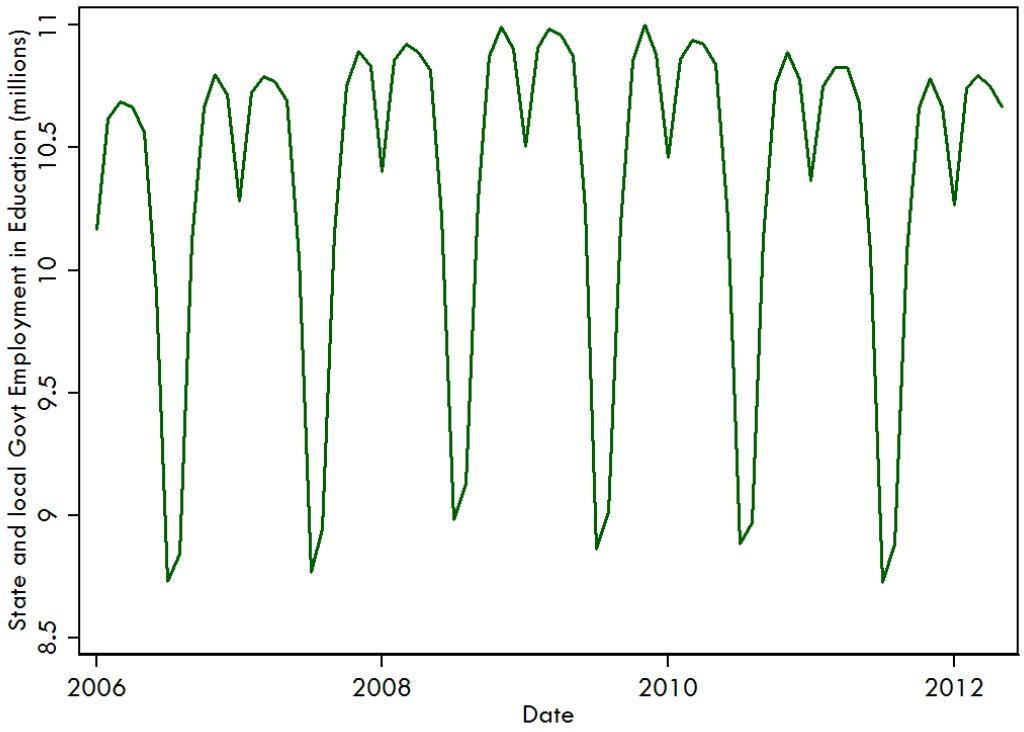
Figure 8: All Spending but Department of Education and Department of Labor



VII. Education Spending and Employment

Block grants to support local education agencies have very small (and statistically insignificant) impacts on employment. At first blush this may seem surprising given that the money was described as support to avoid layoffs of needed public employees. But Figure 9 may help convince readers that ARRA's effects on education hiring were in fact small relative to the total dollars spent. We graph total employment in education month by month from 2007 through January 2012. These data are from the Current Employment Survey data used in the paper. We include state and local government employees working in education.

Figure 9: Education Employment ('000) Over Time



Data are from the BLS monthly Survey of Employment, series CEU9093161101 and CEU9092161101
Graph shows the total number of people in the US with state and local government employment in the education sector.

In 2009, educational employment halted its traditional growth path and fell from a peak of 10.8 million jobs in November of 2009 to 10.6 million jobs as of March 2012, a loss of 200 thousand jobs. These job losses are roughly equally distributed over the 2010-2011 and 2011-2012 school years. Perhaps one could attribute the 200,000 job loss to the withdrawal of the $68 billion in education stimulus funding. That would imply about $340,000 per job.[10] But that is likely an optimistic view of the number of teaching jobs created by stimulus spending.

[10] We have in mind 200,000 job years being lost due to the elimination of $68 billion in funding.

What is a plausible counterfactual for the decline of education employment in the absence of the stimulus? The decline in education employment didn't really begin until after the ARRA was passed. The second half of the 2009-2010 school year shows the first discernible drops in employment. The pace of the decline has been relatively constant since then despite the decline in funding for the 2011-2012 school year. If the stimulus was having a dramatic impact on hiring we might expect to see an acceleration in layoffs as the stimulus expires.

This suggests that local government hiring patterns were at most modestly affected by these block grants. Our interviews and research indicate that State Departments of Education advised local education agencies to avoid making permanent hires since the money was explicitly temporary. Our results may imply that the block grants allowed schools to maintain their staffing patterns without increasing taxes or having states incur additional debt in order to support the schools in their state. In other words block grants for education may have funded staffing that would have occurred anyway but would have been financed through increased taxation and state and municipal debt as opposed to Federal debt. This echoes the conclusions of a recent paper by Cogan and Taylor (2010) which finds that state spending was largely unaffected by stimulus spending. If the money were spend on avoiding tax increases this may have had a stimulus effect. Cogan and Taylor suggest that much of the transfers to states were used to reduce borrowing which is likely to have limited stimulus effects. Our results are consistent with this hypothesis.

VIII. Keynesian Multipliers

How do our results compare to traditional Keynesian multipliers? Our results are in terms of jobs created for each dollar spent. By using Okun's law we can transform job creation into GDP growth. The coefficients in the cross sectional regressions are in terms of β jobs per capita created by spending $100,000 per capita. Diving by 100,

$$\$1{,}000\ per\ capita => \beta * \frac{jobs}{pop} * 100$$
$$\$1{,}000\ per\ capita => \beta\%\ increase\ in\ epop$$

Since the population is twice as large as the labor force (310 million/154 million), a one percent move in epop translates into a two percent move in the employment rate and a negative two percent move in the unemployment rate.

$$\$1{,}000\ per\ capita => 2 * \beta\ \%\ decrease\ in\ UR$$

According to Okun's law, a one percent fall in unemployment is associated with two percent higher gdp (or GDP per capita) over the course of a year.

$$\$1{,}000\ per\ capita => 4 * \beta\ \%\ increase\ in\ GDP\ per\ capita$$

GDP per capita is about $45,000 and hence a 1 % increase in GDP per capita is $450. $1000 per capita spending should generate a 4*450* β percent increase in GDP per capita.

$$\$1{,}000\ per\ capita => \beta * \$1800\ increase\ in\ GDP\ per\ capita$$

To translate our jobs per $100,000 in monthly spending into a Keynesian spending multiplier, you therefore multiply the coefficient β by 1.8. The coefficients in the time series regressions are in terms of jobs created by spending $100,000 per month, so the coefficients from these regressions need to be divided by 12. The implied Keynesian multiplier is therefore the coefficient β multiplied by 0.15. Table 11 summarizes the implied multipliers.

Our point estimates for the stimulus as a whole suggest multipliers that are lower than the 1.6 used in the Romer-Bernstein estimates, though standard errors are large enough that we cannot reject the higher figure. Also, by performing the analysis at the state level we rule out national effects which suggest that we are understating the impact. We are more confident that the stimulus had at least some positive effect, so perfect crowding out did not occur. Excluding the transfers to the states for education, we find modestly higher multipliers.

Table 7: Implied Keynesian Multipliers

Cross Sectional Regressions

Category of Spending	*Jobs per $100,000*	*Implied Multiplier*
All	0.93	1.67
Low Income Support	2.21	3.97
Teachers/Police	-1.96	-3.53
DOT/DOE/EPA	0.948	1.71

Time Series Regressions

Category of Spending	*Jobs per $100,000 per month (peak)*	*Implied Multiplier*
All	3.2	0.48
Low Income Support	8.7	1.31
Teachers/Police	-9.6	-1.44
DOT/DOE	2.8	0.42
All but Education	4.5	0.68

VIII. Discussion and Conclusion

We have presented one of the first detailed analyses of employment and earnings effects from the stimulus package that uses actual employment outcomes.[11] This is important because the debate about the efficacy of fiscal policy has remained mired in the same arguments that were being made in January 2010. We hope that our analysis helps to move the discussion forward. This is important because the ARRA represents the largest exercise of countercyclical fiscal policy in the post war period. Analyses of the efficacy of the ARRA are likely to set the baseline for discretionary fiscal policy going forward.

Our results are somewhat mixed, but generally support the effectiveness of the ARRA. Our point estimates for the stimulus as a whole suggest that it was somewhat less effective than anticipated by the administration, but that their estimates are well within our confidence intervals. Overall we find a cost per job between $100,000 and $400,000 depending on our specification. This implies overall Keynesian multipliers between 0.5 and 2.0. By performing a state level analysis, we are excluding impacts that cross state lines, which is likely biasing our estimates of the effectiveness down.

Perhaps most intriguing is our analysis of how the impacts on employment appear to differ by type of spending. Transfers to the states to support education and law enforcement appear to have little effect. This is consistent with a model where the states consider the grants to be temporary and therefore avoid making permanent changes based on the transfer. States may

[11] As far as we know, Wilson (2010) was the first paper to attempt a real time analysis of the stimulus. Our cross sectional results are broadly consistent with his.

have used the money to lower borrowing or limit tax increases. Cogan and Taylor (2010) find that this is the case.

On the other hand, support for low income households appear to have been extremely effective with Keynesian multipliers of over 2 and a cost per job of under $150,000. This is consistent with low income individuals having a high marginal propensity to consume. Infrastructure spending such as highway projects had impacts that were nearly a large. This all suggests that a stimulus package that did not include state level grants for local services would have been more effective per dollar than the actual stimulus package.

All of these conclusions are necessarily preliminary and incomplete. The empirical fiscal policy literature suggests that the effects of fiscal policy shocks can persist for years. It will be some time before we can put together a full picture of the impacts of the ARRA but we think this preliminary analysis is valuable. We hope that this paper will help to set the stage for further analysis and move the ongoing debate in a new direction that is more directly informed by the data.

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Table 1: Aggregate ARRA Spending By Agency and By Function

	Outlays as of 9/2010 (millions)
Health and Human Services	**102,707**
Grants to States for Medicaid	83,982
Emergency Fund for State Temporary Assistance for Needy Families	4,105
Children and Families Services Programs	2,403
Payments to States for the Child Care and Development Block Grant	1,821
Payments to States for Child Support Enforcement and Family Support	1,710
Health Resources and Services	1,497
Department of Education	**78,886**
State Fiscal Stabilization Fund	44,715
Student Financial Assistance	15,820
Special Education	9,479
Compensatory Education for the Disadvantaged	7,857
Department of Labor	**63,564**
Payments to the Unemployment Trust Fund - Recovery Act	37,097
Federal Addtl Unemployment Compensation Program	13,928
Unemployment Trust Fund	8,629
Training and Employment Services	3,002
Department of Transportation	**28,118**
Highway Infrastructure Investment	19,643
Transit Capital Assistance	4,572
Capital Grants to National Railway Passenger Corporation	1,297
Grants-in-Aid for Airports	1,036
Department of Agriculture	**25,824**
Food Stamp Program	22,886
Housing and Urban Development	**9,688**
Public Housing Capital Fund - Recovery Act	3,078
Project-Based Rental Assistance	1,977
Home Investment Partnership Program - Recovery Act	1,964
Community Development Fund	1,051
Department of Energy	**8,803**
Energy Efficiency and Renewable Energy - Recovery Act	7,009
Electricity Delivery and Energy Reliability	1,302
Environmental Protection Agency	**5,258**
State and Tribal Assistance Grants	5,108
Department of Justice	**2,616**
State and Local Law Enforcement Assistance	2,145
National Science Foundation	**1,047**

Table 2
Summary Statistics at the State Level

Employment data are from the Bureau of Labor Statistics Current Employment Statistics data. (http://www.bls.gov/sae/#tables). State level stimulus spending data are from recovery.gov agency level reports. (http://www.recovery.gov/FAQ/Pages/DownloadCenter.aspx). Seniority of congressional delegation is average seniority rank from 1 to 435 with 1 being the most senior.

VARIABLE	OBS	MEAN	STD. DEV.	MIN	MAX
Change Emp to Pop 2/09 to 10/10	50	-0.0080	0.0076	-0.0346	0.0244
Change Emp to Pop 10/10 to 1/12	50	0.0077	0.0082	-0.0017	0.0533
Stimulus Capita in $00,000	50	0.0113	0.0033	0.0077	0.0272
Dept Transportation Stimulus Capita in $00,000	50	0.0016	0.0008	0.0009	0.0048
Dept Educ Stimulus Capita in $00,000	50	0.0032	0.0004	0.0026	0.0051
HHS Stimulus Capita in $00,000	50	0.0020	0.0009	0.0011	0.0069
Dept Energy Stimulus Capita in $00,000	50	0.0009	0.0010	0.0003	0.0044
Mean Seniority Rank of Congressional Delegation	50	174.1191	50.6248	50.6667	280.2222
Log Population in 2000	50	15.0599	1.0200	13.1099	17.3381

Table 3
State Level Regressions of Employment Changes on Stimulus

Cols (1)-(3) are the long difference in employment to population ratio (employment per capita) regressed on stimulus per capita. Col (2) excludes education spending from the stimulus measure. Col (3) includes log (population in the regression. Stimulus per capita is expressed in hundreds of thousands of dollars per person. Column (4) instruments for stimulus per capita with the seniority (average rank) of the states' congressional (US House) delegations. Column (5) shows the first stage regression.

VARIABLES	(1) Change Emp/Pop Jan 09 to Oct 10 Baseline	(2) Change Emp/Pop Jan 09 to Oct 10 Exclude Education Spending	(3) Change Emp/Pop Jan 09 to Oct 10 Control for Log Pop	(4) Instrument for Stimulus/ Cap With Congressional Seniority	(5) First Stage
Stimulus Per Capita	0.930**		1.083**	2.163**	
in $'00,000	(0.307)		(0.394)	(0.711)	
Stimulus Per Capita		1.004**			
Excluding Education		(0.308)			
Log of Population			0.000792		
			(0.001)		
Mean Seniority House Reps* After Feb 2009					-3.24e-05**
					(0.000)
Constant	-0.0185**	-0.0162**	-0.0322	-0.0324**	0.0169**
	(0.004)	(0.003)	(0.022)	(0.008)	(0.001)
Observations	50	50	50	50	50
R-squared	0.161	0.181	0.168		0.249

Standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 4
State Level Regressions For the Post Stimulus Period

Regressions are similar to those in Table 3 but the change in employment to population is calculated from the month of peak stimulus spending (October 2010) to January 2012. Columns are (1) and (2) are OLS and use state level long differences. Column (3) instruments for stimulus spending per capita with Congressional Seniority.

	(1) Change Emp/Pop Oct 2010 to Jan 2012	(2) Change Emp/Pop Oct 2010 to Jan 2012 Control Log Pop	(3) Instrument for Stimulus/ Cap With Congressional Seniority
Stimulus Per Capita in $'00,000	0.0233	0.178	0.382
	(0.286)	(0.367)	(0.583)
Log of Population		0.000802	
		(0.001)	
Constant	0.00577+	-0.00805	0.00173
	(0.003)	(0.021)	(0.007)
Observations	50	50	50
R-squared	0.000	0.010	

Standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1

Table 5
State Level Regressions of Employment By Type of Stimulus Spending

State Level Long Diff in Employment Per Capita Regressed on various categories of stimulus spending per capita.
Change Emp/Pop Oct 2010 to Jan 2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Transportation	2.757+						
	(1.372)						
Education		-2.932					
		(2.767)					
Health Human Services			2.517*				
			(1.161)				
Energy				-0.413			
				(1.118)			
DOT/DOE/EPA					0.948		
					(0.755)		
ED/DOJ						-1.963	
						(2.523)	
HHD/HUD/USDA							2.211**
							(0.757)
Constant	-0.0124**	0.00123	-0.0131**	-0.00768**	-0.0106	-0.00150	-0.0144**
	(0.002)	(0.009)	(0.003)	(0.001)	(0.002)	(0.008)	(0.002)
Observations	50	50	50	50	50	50	50
R-squared	0.078	0.023	0.089	0.003	0.032	0.012	0.151

Standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 6
State Level Regressions of Construction and Education Employment Per Capita
On Dept of Transportation and Department of Education Stimulus Spending Per Capita

	(1) Change Construction Emp/Pop Oct 2010 to Jan 2012	(2) Change Local Education Emp/Pop Oct 2010 to Jan 2012
Transportation Spending $00,000 Per Capita	2.424**	
	(0.266)	
Education Spending $00,000 Per Capita		-0.174
		(0.426)
Constant	-0.00251**	0.000238
	(0.000)	(0.001)
Observations	32	36
R-squared	0.735	0.005

Standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1