MEASURING THE EFFECTIVENESS OF FISCAL POLICY DURING THE GREAT RECESSION

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By

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Abstract

We study the effectiveness of the ARRA fiscal stimulus package on raising GDP and lowering unemployment during the Great Recession. We collect data on Total GDP and unemployment rate for each U.S state and the District of Columbia between 2001-2015 from the Federal Reserve Economic Data (FRED) and the Bureau of Economic Analysis (BEA). Each area is given a stimulus intensity value as a percentage of their received funds of the area's total GDP. A difference in difference regression is used to ascertain the impact of the stimulus package between two time periods: before and after the stimulus was enacted. Furthermore, an event study is used to show the yearly changes in GDP and unemployment rate for each area between 2001-2015. We find evidence that the stimulus package had no statistical impact on GDP, and had a minute effect on unemployment rate.

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Introduction

Between 2007-2009, the U.S economy experienced arguably the biggest economic downturn since the Great Depression. During the "The Great Recession," an estimated 8.7 million jobs were lost, with unemployment rate rising up to 10% and GDP levels decreasing by 2.7% in 2009 (Center on Budget and Policy Priorities). To prevent further economic deterioration, the U.S Congress introduced the American Recovery and Reinvestment Act (ARRA) in February of 2009, totaling $787 billion in the form of government spending into different sectors of the economy such as infrastructure, energy, education and transport. The increase the government spending is a form of fiscal policy, one of the major government policy options used to influence the level of output and employment. The other option is through monetary policy, the use of changes in interest rates and money supply to affect overall demand. It can be argued that expansionary fiscal policy is more effective during a recession because the lowering of interest rates in monetary policy might cause demand to stay at low levels due to low consumer confidence. The ARRA stimulus package is a good example of the usage of fiscal policy during a recession. In theory, the stimulus package should increase GDP levels and employment by providing demand and encouraging firms to turn from stagnant to active. This paper attempts to ascertain whether fiscal policy was effective in raising GDP levels and lowering the unemployment rate during the Great Recession.

To answer this, we collected data for GDP and unemployment rate for every U.S state and the District of Columbia from 2001-2015 from the U.S Bureau of Economic Analysis and Federal Reserve Economic Data. Each area received a different amount of money and an unequal share of their GDP. As every area received funding from the ARRA, the funds were then tracked and

given a percentage value of their overall GDP, named Stimulus Intensity. Matching the GDP levels and unemployment rate with Stimulus Intensity, a difference-in-difference regression was used to show the effect of the stimulus package before and after the stimulus was enacted by how much money each area received from the federal government. In the first regression, which focuses on GDP, the effect of the stimulus is statistically insignificant and economically small. In the second regression, which focuses on unemployment rate, a 1% increase in stimulus intensity caused the average employment rate to decrease by 0.0028 percentage points after the policy was enacted. Next, we shift to an event study, which measures the changes in GDP and unemployment rate on a yearly interaction. Again, the stimulus package did not affect GDP levels between 2001-2015. However, there was a slight decrease in unemployment rate immediately after the stimulus package was enacted, with its effect gradually diminishing until 2013. Overall, with the stimulus package not impacting GDP levels and having a very minute effect on unemployment rate, fiscal policy was not particularly effective in lifting the U.S economy out of the Great Recession.

Data

The data set includes total GDP and unemployment rate for the 50 US States and the District of Columbia from 2001-2015. Statistics of each area's total GDP is from the Federal Reserve Economic Data (FRED), which was gathered from the Bureau of Economic Analysis (BEA). Similarly, unemployment rate is also collected from the Bureau of Economic Analysis, which had their data derived from the Bureau of Labor Statistics (BLS). Total GDP by area is measured as the factor incomes earned minus the costs of production. The incomes from the factors of production are split into two categories: labor and capital. Labor income consists of wages,

salaries and worker benefits. Capital income includes income earned by individuals or corporations. This also includes depreciation and other income from capital. After the incomes from factors of production are summed together, the costs of production are subtracted from this number. This usually includes business taxes, property taxes, sales tax, and other business expenses. The sum total of income earned minus cost of production then gives us the total GDP by area. To compute the unemployment rate, the BLS conducts a monthly survey called the Current Populations Survey (CPS). Within this survey, the sample size is about 60,000 households, which equates to approximately 110,000 individuals. The entire U.S is then split into 2000 geographic areas, with the survey sampling 800 of these areas that represent every state and the District of Columbia. The sample also represents all types of industries and reflects both rural and urban areas. The survey asks the sample population different questions regarding their employment status, type of work, and other personal characteristics. The sample population is then used to represent the entire country due to the sufficient information on the sample populations. To calculate the Stimulus Intensity for our 51 areas, we divide the total number of funds allocated by the total GDP for each area in 2008, for which data was found through government databases such as recovery.gov and FRED, respectively.

The summary statistics of GDP, unemployment rate and Stimulus Intensity are represented in Table 1.

Table 1

Variable	Observations	Mean	Standard Deviation	Minimum value	Maximum Value
GDP	765	$279117.7 Million	348130.6	$18660.7 Million	$2557132 Million
Log GDP	765	11.9989	1.040335	9.834175	14.7544
Unemployment rate	765	6.0128%	2.02	2.4%	14.367%
Stimulus Intensity	765	2.333%	0.9680	1.06%	5.94%

For GDP, there are 765 observations (51 areas multiplied by 15 years), with the mean GDP being $279,117.7 million. The area with the lowest GDP in 2009 is Wyoming with a national output of $18660.7 million. The area with the highest GDP is California with output being $2,557,131.9 million. However, instead of using GDP as our dependent variable, log GDP is used for an easier representation of the percent changes. For log GDP, the mean was 12.0, with a standard deviation of 1.04. The minimum log GDP is 9.83, and the maximum value is 14.75.

The unemployment rate is the percentage of unemployed workers as a share of the total labor force. In this investigation, the yearly unemployment rate is the average unemployment rate over the course of the year. The average unemployment rate is 6.01%, with a standard deviation of 2.02. The area with lowest unemployment rate between 2001-2015 was Utah at 2.4% in 2007, with the highest being Michigan at 14.37% in 2009.

Stimulus intensity is the total number of funds allocated to the area divided by the area's total GDP. The higher the stimulus intensity, the higher the proportion of the funds allocated in terms of their GDP. The average proportion of the funding in terms of their overall GDP was at 2.33%. Connecticut had the lowest stimulus intensity at 1.06%, whilst D.C had the highest at 5.94%.

Method

We begin the analysis by only looking at two time periods: pre and post 2009. We are also looking at two separate independent variables, in log GDP and the unemployment rate. Firstly, we examine the effect of the stimulus package on log GDP using a difference-in-difference analysis. Regression equation (1) is

$loggdp_{st}=b0+b1(StimulusIntensity_s)+b2(Post_t)+b3(StimulusIntensity.Post_{st})$.

Using a statistical software called STATA, we see the effect of a 1% increase in stimulus intensity on log GDP after the stimulus was enacted. We use log of GDP because the existence of a logarithm on our dependent variable allows us to see percentage changes easier. In summary, b0 is the average level of log GDP before 2009 in a hypothetical state that did not receive any funding from the stimulus. The coefficient on b1 is the average percentage change in GDP when stimulus intensity increases by 100% before 2009. The coefficient on b2 is the average percentage change in GDP when there is no stimulus during the post period (2009-2015). In order to find the overall effect of the stimulus package on GDP between the two time periods, we simply look at the value of b3, the average percentage change in GDP when stimulus intensity equals 1 during the post period.

Secondly, we do the exact same process with our other dependent variable: unemployment rate. Regression equation (2) is

$ue_{st}=b0+b1(StimulusIntensity_s)+b2(Post_t)+b3(StimulusIntensity.Post_{st})$

We don't use the logarithm on unemployment rate as the unemployment rate is already measured in percentage points. Thus, b0 is the average level of unemployment rate before 2009 in a hypothetical state that did not receive any funding from the stimulus. The coefficient on b1 and b2 are now measuring the average percent change in unemployment rate when StimulusIntensity and Post increases their value from 0 to 1. Similarly, the value of b3 gives us the average change in unemployment rate when the stimulus intensity increases by 100% between the two time periods. By dividing that value by 100, we see the average change in unemployment rate when stimulus intensity increases by 1% after the stimulus was enacted.

Our second analysis is an event study, rather than a difference-in-difference analysis. An event study examines the effect of an event in or around the time of the event. In our study, we measure the effect of the stimulus package on GDP and unemployment rate for every year between 2001-2015. Instead of having two time periods, there is a continuous interaction to see the changes of GDP and unemployment rate for every year. Similar with Regression (1) and Regression (2), we are looking at the changes in log GDP in unemployment rate when stimulus intensity increases by 1%.

Regression equation (3) is

$$loggdp_{st}=b0+ b1(2001.StimulusIntensity_{st})+b2(2002.StimulusIntensity_{st})\ldots+ b15(2015.StimulusIntensity_{st}).$$

Regression equation (4) is then given by

$$ue_{st}=b0+ b1(2001.StimulusIntensity_{st})+b2(2002.StimulusIntensity_{st})\ldots+ b15(2015.StimulusIntensity_{st}).$$

Assumptions

The main assumption is that the changes in total GDP and unemployment rate for a low stimulus areas is the same as for a high stimulus area if they received the same funding, and vice versa Thus, we assume that the changes for every area's total GDP and unemployment rate would be the same if they all received the same amount of funds. There may be a number of other factors outside the stimulus package that might affect GDP and unemployment rate differently across the areas. For example, the enactment of the stimulus package may have caused the real interest rate or price levels to change. If the stimulus package affected price levels in California to differ from Montana, then GDP and unemployment rate might have been caused by the chain effects of price levels rather than from the fiscal policy. Thus, we must assume these outside factors impacted all the areas equally between 2001-2015.

Results and interpretation

We begin our findings with regression equation (1). Findings for regression equation (1) and (2) are shown below in Table 2.

Table 2

VARIABLES	(1) loggdp	(2) ue
StimulusIntensity	-0.56***	2.868***
	(0.046)	(0.160)
Post	0.24	0.114***
	(0.17)	(0.0431)
Post*StimulusIntensity	0.011	-0.280***
	(0.067)	(0.0631)
Constant	13.2***	4.712***
	(0.11)	(0.109)
Observations	765	3,060
R-squared	0.276	0.303

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Regression (1) is $loggdp_{st}=b0+b1(StimulusIntensity_s)+b2(Post_t)+b3(StimulusIntensity.Post_{st})$. The most important value here is the coefficient for b3. Interaction coefficient b3 tells us how the GDP changes in the post period when stimulus spending increases by 100 percentage points. However, we must scale down the percentage points as the values for stimulus intensity ranged from 1 to 6 percentage points. If stimulus intensity of the average area increases by 1 percentage point after 2009, there is a 0.00011% increase in their GDP. To put this in context, the average annual change in U.S GDP ranged from 1% to 4% from 2001-2015. The absence of asterisks around the coefficient of b3 shown in Table 2 tells us that the p value doesn't fall within the 90%

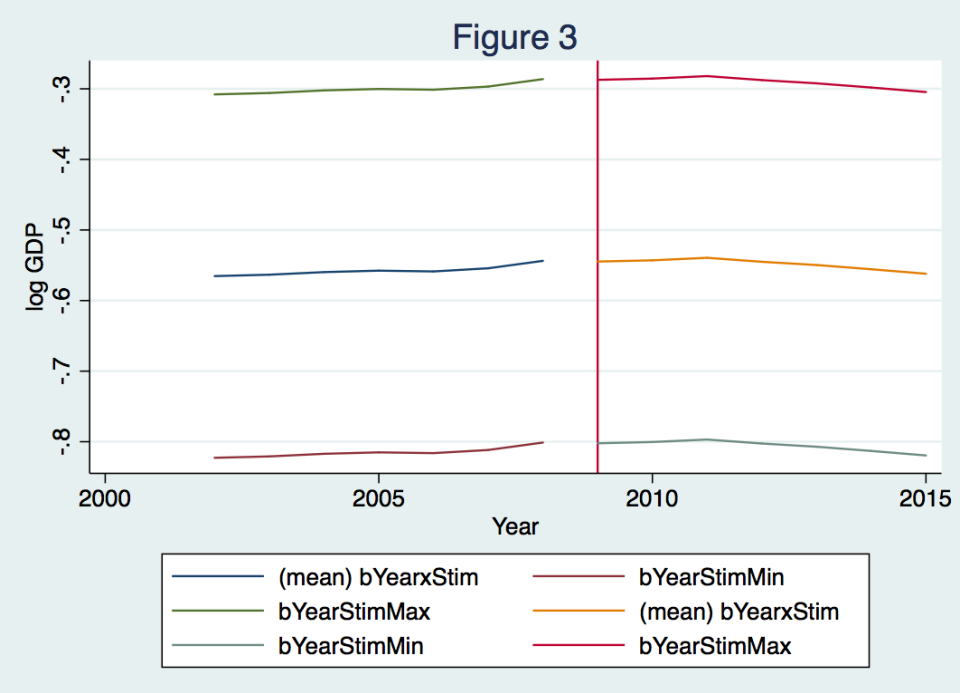
confidence interval. Not only is the coefficient of b3 extremely small, it is also statistically insignificant. Also in Table 2, we see that b0 is 13.2, which means the average level of logged GDP before 2009 in a hypothetical state that did not receive any funding from the stimulus package is 13.2. The b1 coefficient suggests that states with higher levels of stimulus spending had lower levels of GDP prior to 2009. The coefficient of b1 is -0.56, which tells us average GDP is 0.0056% lower for areas with a 1% higher stimulus. Intuitively, this makes sense, as the U.S government would want to target their budget to areas with lower levels of GDP. The value for b2 show that for an area which received no stimulus, the average GDP increased by 0.24% between the pre and post period.

Regression (2) is $ue_{st}=b0+b1(StimulusIntensity_s)+b2(Post_t)+b3(StimulusIntensity.Post_{st})$. Again, the most important value is the coefficient of b3, as it tells us how the unemployment rate changes in the post period when stimulus spending increases by 100 percentage of GDP. The coefficient is -0.28, which means a 1% increase in the stimulus intensity lowered unemployment rate by 0.0028 percentage points after the stimulus was enacted. Even if stimulus intensity increased by 100%, average unemployment rate would only fall by 0.28 percentage points. The value is statistically significant, falling within the 99% confidence interval. Although the coefficient for b3 is significant, the stimulus package's effect on unemployment rate is minimal. Also in Table 2, we see that the value of b0 is 4.7%, which shows us the average rate of unemployment for a state with no stimulus before 2009. The coefficient for b1 is 2.868, which tells us the average level of unemployment rate is 0.02868 percentage points higher when stimulus intensity increases by 1% before 2009. Here, we see that the stimulus package targeted areas that had a higher unemployment rate.

Moving on from the difference-in-difference analysis, we now look at an event study. Instead of having 2 times periods of before and after the stimulus was enacted, our new regression focuses on the yearly changes in GDP and unemployment rate. Firstly we look at the impact of the stimulus package on GDP. Regression (3) is

$loggdp_{st}$=b0+ b1(2001.$StimulusIntensity_{st}$)+b2(2002.$StimulusIntensity_{st}$)…+ b15(2015.$StimulusIntensity_{st}$).

Figure 3 details the yearly changes in GDP below.



Ideally, what we want to see is for total GDP to have no changes or trends from 2001-2009. No deviations or trends in total GDP before the stimulus makes us more confident in our analysis. The blue line shows the mean change in GDP from 2001 to 2009. The green line shows the maximum level of changes in GDP, and the brown line represents the minimum level of changes in GDP. What we are looking for here is the slope of the blue line. As we can see in Figure 3, a 1% increase in stimulus intensity for areas lowers average GDP by 0.0056 percentage points

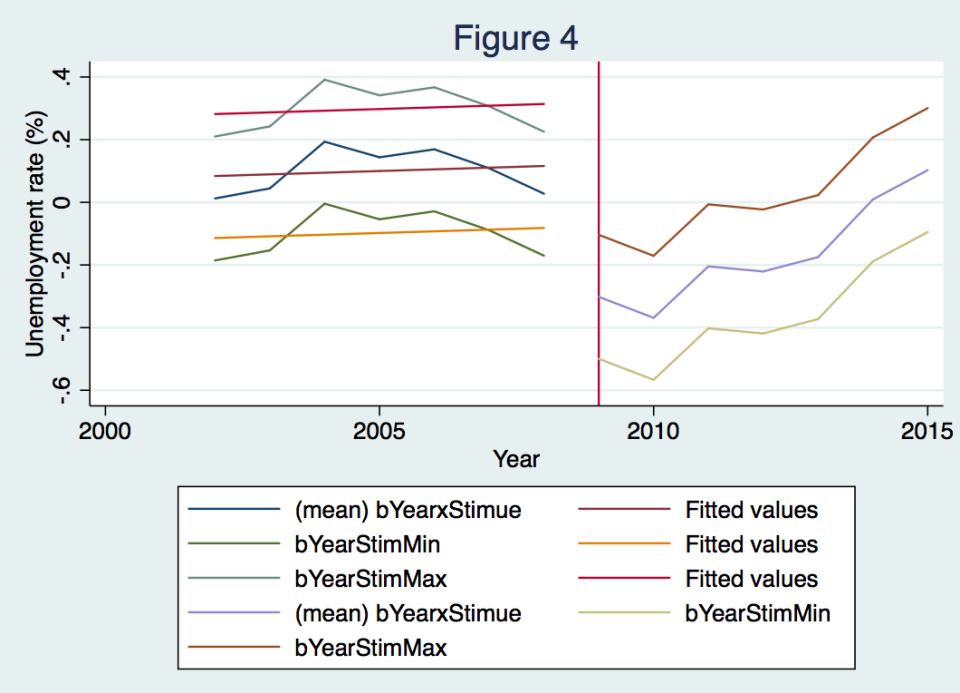
between the years 2001-2009. As the slope of the blue line is almost flat, we can say that there are close to or almost no trends in GDP before the stimulus was enacted, making us confident that the effect of the stimulus is not coming from a pre-existing trend.

The yellow line shows the impact of the stimulus on GDP. As shown in Figure 3, the slope of the yellow line remains almost flat and the values consistently fall between where log GDP equals -0.54 to -0.56. This shows that enacting the stimulus package had almost no effect on GDP. Table 5 shows the exact values of the changes in GDP every year from 2001-2015. In our event study, we can conclude that the stimulus package was inefficient in raising the average GDP level for all areas. This verdict is consistent with our conclusion for Regression 1. Whether the change in GDP level is between 2 time periods, or interacted on a yearly basis, the stimulus package had almost no effect on changing the average GDP levels for every area.

Secondly, we look at the effect on the stimulus package on the yearly changes in unemployment rate. Regression (4) is

$$loggdp_{st}=b0+ b1(2001.StimulusIntensity_{st})+b2(2002.StimulusIntensity_{st})\ldots+ b15(2015.StimulusIntensity_{st}).$$

Figure 4 shows the trend of unemployment rate for all the areas from 2001-2009, and from 2009-2015.



The red vertical line indicates the year 2009, the time when the stimulus package was enacted. On the left of the red vertical line, the blue line shows the average changes in unemployment rate for all our areas between 2001-2009. Both the green lines above and below indicate the maximum and minimum changes in unemployment rate for the 95% confidence interval. As we can see from Figure 4, the blue line shows that there is a concave looking trend for unemployment rate between 2001-2009. When stimulus intensity increases by 100%, average unemployment rate increases up to 0.2 percentage points. This is immediately shown between the years 2002-2005, but then the rate falls back to around 0% in 2009. One can argue that the existence of a concave trend makes our event study hard to interpret and may threaten the validity of our results. However, the line of best fit on the blue line shows us the changes in unemployment rate even out close to being flat on average. Moreover, the variations in unemployment rate only range up to 0.2 percentage points when stimulus intensity increased by 100 percentage points, which is very small in the scale of our variable as average unemployment

rate is approximately 6%. Thus, it can also be argued that there are close to no trends or changes in the average unemployment rate between 2002-2009, making us confident that the effect of the stimulus is not coming from a pre-existing trend. Instead of looking at the visual representation of the changes in unemployment rate in Figure 4, Table 5 details a more precise outlook into what is happening in our data.

Table 5

VARIABLES	(3) loggdp	(4) ue
2001b.Year#c.StimulusIntensity	-0.57***	0.22**
	(0.13)	(0.10)
2002.Year#c.StimulusIntensity	-0.57***	0.012
	(0.13)	(0.10)
2003.Year#c.StimulusIntensity	-0.56***	0.045
	(0.13)	(0.10)
2004.Year#c.StimulusIntensity	-0.56***	0.19*
	(0.13)	(0.10)
2005.Year#c.StimulusIntensity	-0.56***	0.14
	(0.13)	(0.10)
2006.Year#c.StimulusIntensity	-0.56***	0.17*
	(0.13)	(0.10)
2007.Year#c.StimulusIntensity	-0.55***	0.11
	(0.13)	(0.10)
2008.Year#c.StimulusIntensity	-0.54***	0.028
	(0.13)	(0.10)
2009.Year#c.StimulusIntensity	-0.54***	-0.30***
	(0.13)	(0.10)
2010.Year#c.StimulusIntensity	-0.54***	-0.37***
	(0.13)	(0.10)
2011.Year#c.StimulusIntensity	-0.54***	-0.20**
	(0.13)	(0.10)
2012.Year#c.StimulusIntensity	-0.55***	-0.22**
	(0.13)	(0.10)
2013.Year#c.StimulusIntensity	-0.55***	-0.17*
	(0.13)	(0.10)
2014.Year#c.StimulusIntensity	-0.56***	0.0091
	(0.13)	(0.10)
2015.Year#c.StimulusIntensity	-0.56***	0.10
	(0.13)	(0.10)
Constant	13.0***	4.03***
	(0.33)	(0.26)
Observations	765	3,060
R-squared	0.286	0.525

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

Between the years 2009-2013, the coefficients are negative. This means that in the following 4 years after the stimulus was enacted, average unemployment rate decreased more in the states that received more stimulus money. Immediately after the stimulus was enacted in 2009, a 1% increase in stimulus intensity caused the unemployment rate to decrease by 0.003 percentage points. In 2010, the stimulus had a larger effect, decreasing the unemployment rate by 0.0037 percentage points when areas increased their stimulus intensity by 1%. Multiplying the scale of stimulus intensity, even if areas received 100% Stimulus intensity, average unemployment rate only decreased by 0.3 and 0.37 percentage points in 2009 and 2010, respectively. The following years after 2010 saw the effect of the stimulus package diminish. An important aspect to note when interpreting Table 5 is the p value or statistical significance of the values. In 2009 and 2010, we see the p value is less than 0.01, meaning the confidence level falls within the 99% interval. This also means the stimulus package had a larger effect on unemployment rate in the first two years it was enacted. In 2011, the p value changes to being less than 0.05, meaning the confidence level only falls within the 95% interval. In 2013, with the value being -0.17%, the one star around the value means the stimulus package had a very little impact on unemployment rate at this point. The gradual diminishing effect on unemployment rate is expected. In a report by the Congressional Budget Office on the estimated impact of the ARRA stimulus package, it finds that nearly 95% of all effects from the stimulus package were realized by 2014 (Congressional Budget Office). In the immediate years after the policy was enacted, changes of -0.003 and -0.0037 percentage points when stimulus intensity increased by 1% are quite minute. This observation is similar and in line with our conclusion for Regression 2. In regression 2, we conclude the stimulus package had a small effect on unemployment rate whilst looking at two time periods: before and after the policy was enacted. In the event study here, when we focus on

the changes in unemployment rate between 2009 and 2013, we see the stimulus package had a similarly small effect on unemployment rate. We can conclude that the stimulus package had a very minimal effect on unemployment rate.

Conclusion

In conclusion, fiscal policy was not particularly effective in raising average GDP and had a minute impact in lowering the unemployment rate during the economic recession of 2008. When regressing over two time periods or on a yearly interaction, we see that the stimulus package had almost no effect on GDP. Furthermore, although the stimulus package had a slight effect on unemployment rate, the difference was very small. In a study by Joshua Aizenman and Gurnain Pasricha from the National Bureau of Economic Research on the Net Fiscal Stimulus during the recession, they concluded the net fiscal stimulus was very small and government expenditure only grew at an annual rate of 0.31% from 2009 to 2010. In context, Germany's government expenditure increased by almost 10 times that amount relative to their GDP during the same period. Although the size of the stimulus package can be called into question, other reasons such as the distribution of funds, or choosing the correct policy, may have contributed to the lack of effectiveness of the fiscal stimulus. However, these reasons are beyond the scope of this paper. Moving forward, the U.S government would need to have a better recession response if another economic downturn is to come. Due to the nature of economic cycles, periods of negative economic growth are inevitable. As shown in this study, the strategies used to lift the economy out of the recession were relatively unsuccessful. Ascertaining the reasons behind the ineffectiveness of the ARRA fiscal stimulus package are extremely important for the U.S government to deal with future recessions.

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Appendix

(See attached data files)