The Effects of the ARRA Infrastructure Funds to the Economic Cycles of the 50 U.S. States and Puerto Rico

by

Miguel D. Cáliz Negrón

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Approved by:

_____	
Wolfgang Rolke, PhD Member, Graduate Committee	_____ Date
_____	_____
José Alameda Lozada, PhD Member, Graduate Committee	Date
_____	_____
Julio Quintana, PhD President, Graduate Committee	Date
_____	_____
Dr. Jaime Seguel Representative of Graduate Studies	Date
_____	_____
Silvestre Colón, MS Interim Chairperson of the Department	Date

Abstract

This study is dedicated to examine how the distribution and expenditure of the funds of the American Recovery and Reinvestment Act (ARRA) of 2009 destined to infrastructure projects impacted the economic cycles of the 50 U.S. states and District of Columbia. The main contribution of the study was the implementation of Cluster Analysis to group the states based upon their economic condition prior ARRA and the magnitude of the impact of the ARRA Infrastructure Funds (ARRAIF) to the states economies. We also constructed a linear model using Least Squares Regression to measure the impact of other sectors of the economy to percentage change of real Gross Domestic Product (GDP) in 2009. The main result is that states in good economic shapes, that is, low unemployment rates and high Gross State Product (GSP) per capita, were the ones that received more ARRAIF per capita; and those states with high unemployment rates, and those highly hurt by the 2007 recession, received fewer ARRAIF per capita. The study also shows how the U.S. States can be classified within 10 clusters based upon geographical characteristics such as the population, and land and water surface area. Likewise the U.S. states can be grouped within 10 clusters but by that impact of the ARRAIF to their economies. So far we concluded that the American Recovery and Reinvestment Act of 2009 appears to be designed not to take off the economy out of recession and take it back before the banking collapse of 2008, but rather to maintain economic activity, since only 14% of the total worth of $787 billion is invested in infrastructure and science.

Resumen

Este estudio está dedicado a examinar como la distribución y el gasto de los fondos del American Recovery and Reinvestment Act (ARRA) del 2009 destinados a proyectos para la infraestructura impactaron los ciclos económicos de los 50 estados de Estados Unidos y el Distrito de Columbia. La mayor contribución de este estudio fue la implementación de Análisis de Conglomerados para agrupar los estados basados en las condiciones económicas de éstos antes del ARRA y también por la magnitud del impacto de los fondos ARRA destinados a la infraestructura (ARRAIF) a sus economías. Además se construyo un modelo lineal usando Regresión por Mínimos Cuadrados para medir el impacto de otros sectores de la economía al cambio porcentual del Producto Interno Bruto real en el 2009. Un resultado importante de este estudio es que cuando los ARRAIF fueron ponderados por las poblaciones de los estados, aquéllos estados en buenas condiciones económicas, es decir con tasas de desempleo bajas y con un nivel relativamente alto de Producto Interno Bruto per capita, fueron los estados que más recibieron ARRAIF per capita; mientras que aquéllos con altas tasas de desempleo y los más impactados por la recesión del 2007 fueron los que recibieron la menor cantidad de ARRAIF per capita. El estudio conjuntamente muestra como se pueden clasificar los estados en 10 conglomerados usando datos demográficos y geográficos como la población y el tamaño en área de superficie incluyendo agua y tierra de los estados. También se demostró que los estados se aglomeran en 10 grupos basándonos en la magnitud del impacto de los ARRAIF al cambio porcentual en el Producto Interno Bruto real en 2009. Hasta ahora se pudo concluir que el American Recovery and Reinvestment Act del 2009 no estaba destinado a sacar a la economía de recesión y llevarla a como estaba antes del colapso del sistema financiero del 2008, sino a mantenerla operando, ya que sólo un 14% de los $787 billones del valor de la Ley son invertidos en ciencia e infraestructura.

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1 Introduction

1.1 Introduction

When Barack H. Obama was inaugurated as the 44th President of the United States of America at the beginning of 2009, the public had their hopes on Mr. Obama to put the American Economy back in place or at least out of recession. The Unites Sates economy was officially declared in recession in December 2007 by The Bureau of Economic Analysis from the U.S. Department of Commerce. In September 2008 during the presidency of Gorge W. Bush, big banks and insurance companies like Lehman Brothers, AIG, Fannie Mae, and Freddie Mac went bankrupt, and they threaten to take the U.S. Financial System with them. In response the government bailed them out for the amount of $700 billion to prevent them to collapse. The crisis started in the mortgage sector then expanded to others sectors in a domino effect. The Congress passed the **Emergency Economic Stabilization Act of 2008** (Division A of Pub.L. 110-343, enacted October 3, 2008), commonly referred to as a bailout of the U.S. financial system. In a related but separately action the Obama administration decided to inject the economy with $787 billion to put the economy out of recession, to stop the job losses, and to create new jobs. This act is better known as the Obama stimulus economic package, but the official name of the program is the **American Recovery and Reinvestment Act** abbreviated **ARRA** (Pub. L. 111-5). The Act includes federal tax cuts, expansion of unemployment benefits and other social welfare provisions, and domestic spending in education, health care, and infrastructure, including the energy sector. The Act also includes numerous non-economic recovery related items that were part of longer-term plans. The component of the Act that is most likely to create jobs and to cause economic expansion is the one destined to finance infrastructure projects. This component will receive $80.9 billions, which counts 10.2% of the Act, to be distributed among the states and territories.

This thesis is oriented to study the impact of the ARRA infrastructure funds (ARRAIF) to the 50 states, District of Columbia, and Puerto Rico economic cycles using statistical

techniques such as cluster analysis and regression analysis. The use of cluster analysis represented a great contribution because it has not been known yet to be use for that purpose.

The use of Cluster Analysis was indispensable to know the extent in which the ARRAIF worked their way into the states. It allowed us to group them based upon the magnitude that the ARRAIF had on the percentage change in real GDP in 2009. Also permitted us to group the states based upon their economic condition prior the distribution of the ARRAIF and evaluate from there the funds performance.

To measure the magnitude in percentage measures that the construction sector and other sectors of the economy had to the change in real GDP in 2009 based on 2005 dollars we performed Regression Analysis. The road to the best fitted model was full of bumps since in the economy everything is correlated, but with the help of Best Subsets Regression Algorithm, and intuition analyzing the correlation matrix we were able to find a model with the less multicollinearity and assumption violations. The other sectors included in the model were wholesale trade, mining, government, finance and insurance, professional and technical services, and nondurable-goods manufacturing. The percentage changes in these sectors were used as the predictor variables. After that we used Stepwise Forward Selection to rank the variables in order of the contribution in the explanation of the variability of the percentage change in real GDP in 2009. This application of the Stepwise Forward Selection is not the traditional one but it serves well the purpose that what we want to achieve.

1.2 Motivation

The main driver and inspiration for this thesis was the application of statistical methods of analysis to economics. The topic was not chosen on any political bias, or any other intention that was not academic. It happens that at the time of choosing a subject the

state of the economy was a very hot topic. The opinions on the stimulus package were diverse, some economists expressed themselves in articles they published, and others on news articles that requested their opinion. So my advisors and I decided to also make a contribution in the analysis of the effects of the stimulus package to the American economy at the same time completing a thesis investigation requisite for my graduation.

1.3 Hypothesis

The recession of 2007 was due to some specific factors that not all states share. All the 50 states were not in recession because of the dynamics and the nature of the states economies. Some states economies are very similar to the U.S. economy as a whole, others are not, and others share similar characteristics. Because of that, the ARRA whose purpose is to enhance the U.S. economy may or may not have the same effect in every state.

Given that, the hypothesis is that the impact of the ARRAIF to the states economies will not be same in all 50 states, District of Columbia, and Puerto Rico.

1.4 Objectives

First of all we want to study the effects of the infrastructure funds of the American Recovery and Reinvestment Act (ARRA) to the economic cycles of the U.S. states and District of Columbia. Also we want to group the states based on similar geographical characteristics such as the sizes and populations of the states. In addition we examined how the funds were distributed accordingly to the states economic condition prior ARRA and their role in the national economy. And finally we want to measure the magnitude in percentage points that the construction industry and others industry sectors of the economy had on the change in real GDP in 2009.

1.5 Methods

In order to achieve our goals we need to use grouping methods. To accomplish that, we used Cluster Analysis. We also used Scatter Plots to help with the visualization and discussion. To project the impact of the ARRAIF we used Type I final-demand multipliers for the construction industry for each state. Also we used Regression Analysis to measure the percentage change that the construction industry and others industry sectors of the economy had on the change in real GDP in 2009, and Forward Selection to rank the industry sectors on their relationship to change in real GDP in 2009.

1.6 Limitations

The big limitation of this particular investigation was the limited available data at the time of gathering the data. Only the funds expended from the third quarter of 2009 to the first quarter of 2010 were available. Because of unavailable data the study does not go beyond the 2009 economic indicators, such as Gross Domestic Product, Personal Income, and Unemployment.

1.7 Literature Review

On the American Recovery and Reinvestment Act opinions were diverse. Newspapers and news websites ask economists their analysis on the Act. Others published their own articles. Gary Becker an economist professor at The University of Chicago commented on Caijing Magazine [32]: “The effects of Obama’s stimulus package on the economy are overestimated. The value of the stimulus package depends on how effective the government expenditures are, relative to the private spending it crowds out.” He argued that if government increases its spending on infrastructure when the economy has full employment, its main impact would likely be to draw labor, capital, and raw materials away from other activities, in other words, it would crowd out private spending. GDP

would not be affected, and efficiency would fall if these government spending is more wasteful than the private sector that crowds out.

Politico.com published an article on February 13, 2009 called "Economist predicts stimulus effects" [31], in this article Politico took five of the largest components of the bill and asks Economists for their analysis. Most of them said that the stimulus was so big that it has to do some good. "It will generate some GDP growth", said U.S. Chamber of Commerce chief economist Martin Regalia [31]. On the infrastructure spending opinions were split on its effectiveness, with some arguing that is among the strongest provisions and others saying the money will take too long to hit the economy [31]. Others believe that it will have positive effects on the second half of 2009 [31]. Eric Rasmussen, a free market economist at Indiana University's Kelly School of Business, warns that the money could end funding economically inefficient projects [31].

In another article that the usatoday.com [29] published on February 2009, the Chief Economist at IHS Global Insight Nariman Behravesh said that the biggest effects will occur in 2010 from the bill's spending for aid to state and local governments, and also on infrastructure. Mark Zandi, Chief Economist of Moody's Economy.com [29] said: "The bill could help end the economic slide", however he warned that the stimulus spending will likely be too small, given the size of the economic decline, and suggested Congress may have to review the issue. The Congressional Budget Office told us that the bill could increase employment in the range of 800,000 to 2.3 millions jobs by the fourth quarter of 2009, and 1.2 million to 3.6 by the fourth quarter of 2010 [29].

Daniel Wilson, Senior Economist for the Federal Reserve Bank of San Francisco examined whether the federal stimulus funds were heading to those states best positioned to put the money into good use immediately in a way that maximizes their potential impact on the national economic growth. In an Economic Letter back in April 17, 2009 Wilson [23] addressed Becker's point, whether the impact of restricted funds of ARRA to states could be hampered by crowding out of the private sector resources. He looked at funds for transportation programs the largest source of restricted funds, he examined

whether or not they will be allocated disproportionally to those states most likely to have idle capacity (especially unemployed labor). Wilson pointed out that since the ARRA transportation funds were expected to be allocated using the same formulas that the Department of Transportation (DOT) uses to distribute non-ARRA funds to states, which are based upon state's total highway miles, needed repairs to roads, and bridges previous identified by DOT, and does not take into account the states economic condition, there is no reason to expect a positive relationship between the ARRA transportation funds per capita and the unemployment rates. However, on the Fiscal Relief and Stabilization provision of the Act, Wilson found a positive correlation with those funds per capita and the states budget gap per capita.

The Council of Economic Advisers from the Executive Office of The President (CEA) made estimates of the employment effects of the Act for the economy as a whole using multipliers similar to those used by the Federal Reserve for an increase in government purchases of 1% GDP and a decrease in tax of 1% of GDP. In a report on May 2009 [21] they estimated the jobs saved or created by the ARRA of 2009 at different times. As of the fourth quarter of 2009 they estimate 1.5 millions jobs saved or created and 0.7 million on average for that year, for 2010 3.5 million as of the fourth quarter and 3.0 million on average for that year, 1.7 million and 2.5 million for 2011, and 0.3 million and 0.7 million for 2012. They also estimated the creation of jobs do to different types of fiscal stimulus. They estimated that for $100 billion of government spending it creates 1,085,355 job-years, a job-year means one job for one year, $100 billions of tax cuts creates 687,991 job-years, and $100 billions of state fiscal relief creates 857,610 job-years. This means that $92,000 of government spending creates 1 job-year, $145,351 of tax cuts creates 1 job year, and $116,603 of state fiscal relief creates 1 job-year, 64% of the job-years created by government spending represents direct and indirect effects, and 36% are induced effects.

In a micro analysis dresserassociates.com made an overview of the impact of the federal stimulus legislation on the U.S. construction industry [24]. They pointed out the fact that the construction industry has suffered disproportionately since the subprime housing

crisis afflicted the economy in late 2007. Construction firms cut more than half million jobs by November 2008, while other estimates suggest that construction employment has plummeted by 1.3 million workers, from 9.3 million to 8 million. They go on to say that timing should be considered, because it takes time to have all the permits for some construction projects. Also some parts of the legislation are "use it or lose it", this puts pressure on the states to spend the money quickly, possibly closing the window for well planned projects with long positive economic effects.

The Federal Highway Administration (FHWA) estimates that for every $1 billion spend on high and road construction projects, 27,822 jobs are created, however the Bureau of Labor Statistics (BLS) calculates that for every $1 billion only 11,768 jobs are created. Regardless if $30 billion are invested on highways and roads, the potential creation of direct construction jobs ranges from 210,000 to 285,000, the report said.

On the macroeconomic scale, The Council of Economic Adviser reported in January 2010, The Economic Impact of the American Recovery and Reinvestment Act of 2009 [2]. Here are some of their key findings: As of the end of December 2009, $263.3 billions of the total $787B of the stimulus, around one third of the total, has been gone to American households and business in the form of tax reductions. An additional $149.7 billion has been obligated for projects and activities. Output and jobs continued to decline slightly after the implementation of ARRA, although the economy experienced 2.2 percentage points increase in GDP in the third quarter of 2009 after dropping −6.4% in the first quarter of that same year. On employment, they found that the biggest drop in job loss from the first to the fourth quarter of 2009 came form the manufacturing sector, and from professional and business services, construction was a close third. Overall their analysis showed that ARRA had played an important role in the turnaround of the economy in the fourth quarter of 2009 when the economy experience a positive growth in GDP, and hampered the acceleration of job losses.

1.7 Summary of following chapters

In the next chapter we would go through the necessary macroeconomic background, to set off the pillars of the theory of the study been discussed. In Chapter 3 we will discussed the economic cycles of the 50 U.S. states and Puerto Rico. Chapter 4 details the parts of The American Recovery and Reinvestment Act. Chapter 5 is the heart of the thesis it deals with the examination of the distribution of the funds and its effects to the states economies using statistical techniques such as scatter plots, cluster analysis and regression analysis. The results are summed up in Chapter 6, and the conclusions and recommendations in Chapter 7.

2 Some Macroeconomics Concepts

2.1 Introduction

2.2 Definitions

2.3 The Economy over Time

2.4 Keynesian Economics

2.5 Fiscal Policy

2.6 Financial Intermediation

2.7 Inflation and Unemployment

2.8 Government Debt and Deficit

2 Some Macroeconomics Concepts

2.1 Introduction

In this chapter we will go through some of the most important concepts of macroeconomics. This is the foundation for our study, the theory and concepts discussed here will be our guide at the time to make comments, and draw conclusions. First, we will go through some definitions, second explain how the economy behaves over time, third explain the changes in the economy from the Keynesian Economic Theory and Fiscal Policy. Then explain the role of banks in Financial Intermediation and go through two common topics inflation and unemployment, and finally finish with government debt and deficit, a regular topic in politics.

2.2 Definitions

The most common measure of output in the economy is **gross domestic product (GDP)**, it is the total market value of all the final goods and services produced within an economy in a given period of time. To avoid having larger GDP just because prices have increased economist have **real GDP,** it is a measure of output that controls the changes in prices. When the economy is in a sustained increase of real production over a period of time, we have an **economic growth**. GDP and prices typically grow over time. To calculate the growth rate from one period of time to another we use the **percentage change formula**.

$$GrowthRate = \frac{ChangeinGDP}{InitialGDP} = \frac{GDP(year_2) - GDP(year_1)}{GDP(year_1)} \tag{2.1}$$

Another measurement of change from one period to another is the **percentage points**. The percentage points are the unit for arithmetic differences between two percentages. For example going form 7% of growth rate to 10% of growth rate is an increase of 3 percentage points in growth rate, and going from 7% to 5% is a decline of 2 percentage points or a change of −2.0 percentage points.

When the economic growth is negative (real GDP falls) for two consecutive quarters the economy is said to be in **recession**. The time at which the recession begins is called the **peak,** and the time at which stops falling is called **trough**. When the recession is severe is called a **depression**.

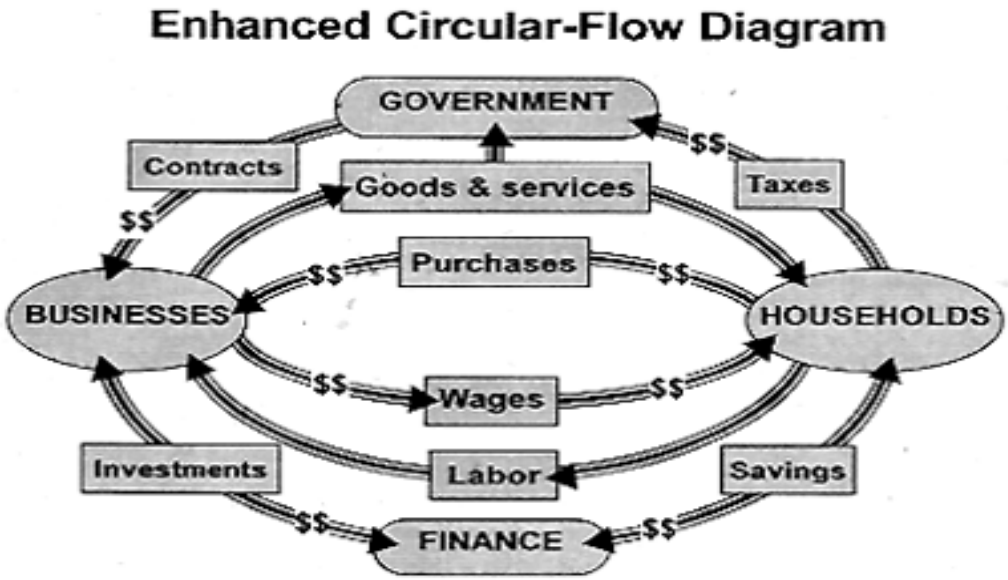
One of the primary reasons that we want to avoid recessions and depression is that they impose cost on individuals. During recessions GDP falls and as a consequence fewer people find jobs, this causes unemployment to rise. The **unemployed** are those individuals that are not currently employed but are actively looking for work. The **unemployment rate** is the number of the unemployed divided by the labor force. The labor force is the employed plus the unemployed. When the unemployment rate changes due to fluctuations in real GDP we call this **cyclical unemployment** and when there is no cyclical unemployment is the **natural rate of unemployment**, this is when the economy operates at **full employment**.

The study of the economy when it operates at or near full employment is **classical economics**. The study of **business cycles** or economic fluctuations is **Keynesian economics** with is the mayor concern of governments.

There are four broad categories that correspond to different types of purchasers of GDP. These are:

1. **Consumption expenditures**: purchases (good and services) by consumers (households).
2. **Private investment expenditures**: purchases (good and services) by firms.
3. **Government purchases**: purchases (good and services) by federal, state, and local government.
4. **Net exports**: net purchases by the foreign sector or export minus imports.

Figure 1.1 Circular Flow



2.3 The Economy Over Time

The way countries grow to better standards of living is by growth in GDP per person. They can do that basically by two mechanisms: the first by increases in the economy's **stock of capital** (this is the total stock of plant and equipment relative to its work force), and the second is by **technological progress**. With technological progress the economy operates more efficiently so it produces more output without using more inputs (capital or labor) in production. To measure the living standards across time and between countries economist use **real GDP** per capita, that is, the inflation-adjusted GDP per person.

The stock of capital increases only when there is a positive net investment. **Net investment** equals gross investment minus depreciation. **Gross investment** depends on the rate of saving in the economy. **Depreciation** depends on the total capital that the economy has in place. As the economy accumulates capital, and the stock of capital increases, there will be a naturally increase in the total amount of depreciation of capital in the economy. Eventually the economy reaches a point at which gross investment

equals depreciation. At this point, net investment becomes zero and the stock of capital no longer increases. Hence, there is a natural limit of growth by stocking capital as depreciation eventually catches up to the level of gross investment.

There are several factors that may influence the pace of technological progress in the economy: research and development in fundamental science, monopolies that spur innovation, the scale of the market, induced innovations, and education and the accumulation of knowledge. These factors combine make a great recipe for economic growth over a period time.

2.4 Keynesian Economics

The period of time where prices are fixed is the **short run in macroeconomics**. Models where outputs are determined by the demand in this period of time are examined in **Keynesian economics**. Recessions and excess of unemployment occurs when GDP falls and the rate of inflation grows too rapidly. These economic fluctuations can happen for a variety of reasons: increases or decreases in the price of oil, natural disasters, shifts in technological progress, wars, financial bubbles, and others. For this reason is important to coordinate economic affairs.

One way of coordinating the economy is through prices and the problems with these are:

1. **There may be too few prices**: The price system does not have the capacity to provide precise signals to the producers of specific goods far into the future.
2. **Prices may not contain enough information**: Prices increase with inflation and there will not be any incentive to expand production.
3. **Prices may be "sticky"**: The demands falls but prices stay fixed, the result is an excess of production.

In general, workers and firms let the demand determine the level of output in the short run. The relationship between the level of prices and the quantity of real GDP is called **aggregated demand**, and the relationship between the level of prices and the quantity of output supplied is called **aggregate supply**.

Some factors that affect aggregated demand are: changes in money supply, changes in taxes, changes in government spending, and any change in demand from households, firms or the foreign sector.

In the short run when the prices are sticky, the Keynesian approach suggests that aggregated demand has an effect on aggregated supply, causing a change in the level of output but not the prices. However, in the classical approach an increase in aggregated demand leads to a higher price level. In the long run the level of output is independent of the price level and is solely determine by the factors of production. External events that affect aggregated supply are called **supply shocks**. The most common supply shock is the price of oil. A sharp increase in the price of oil is an adverse supply shock that can cause a recession. A decrease in the price of oil is a favorable supply shock.

2.5 Fiscal Policy

It is important for both government and private sector to purchase good and services, without sufficient spending an economy will remain in depression. **John Maynard Keynes**, a famous economist during the Great Depression, argued that spending determines output (GDP), at least over short period of time. According to Keynes

$$output = demand = consumption + investment \tag{2.2}$$

This is known as the equilibrium in **The Keynesian Cross**.

In the economy **consumer spending** depends on the level of income. For this relationship we have the **consumption function**

$$C = C_a + (MPC) * (LI) \tag{2.3}$$

Where

C_a is the **Autonomous consumption.** It is a constant and is independent of income. The consumption of food for example is under this category.

MPC is the **Marginal Propensity to Consume**. It is the fraction of additional income that is spent. In other words it tells us how much consumption will increase from any additional increase in income.

And

LI is the level of income.

The counter part of the marginal propensity to consume is the **Marginal Propensity to Save (*MPS*)**. This is the fraction of additional income that is saved. The sum of these two equals one

$$MPC + MPS = 1 \tag{2.4}$$

When we have equilibrium saving equals investment, this implies that what is not consume it must be invested. From (2.2) we have

$$LI = C + I$$

Where *I* is investment

Substituting (2.3) in (2.2) we have

$LI = C_a + (MPC) * (LI) + I$

Solving for *LI* we have the formula for the equilibrium income

$$LI^* = EquilibriumIncome = \frac{C_a + Investment}{(1 - MPC)} \tag{2.5}$$

Another principle is that the increase in output always exceeds the increase in investment. The change in output divided by the change in investment is called the **multiplier** and is always greater than one. The change in output for two levels of investments in equilibrium is

$$\Delta Output = LI_1 - LI_0 = \frac{C_a + I_1}{1 - MPC} - \frac{C_a + I_0}{1 - MPC} = \frac{I_1 - I_0}{1 - MPC} = \frac{\Delta I}{1 - MPC}$$

Dividing by the change in investment in both sides we have

$$\frac{\Delta Output}{\Delta Investment} = \frac{1}{1 - MPC} = Multiplier \tag{2.6}$$

The multiplier is the ratio of the change in income to the change in investment spending.

If we add taxes to the consumption function we get

$C = C_a + (MPC)*(LI - Taxes)$ (2.7)

And adding government spending to the level of income

$LI = C_a + (MPC)*(LI - Taxes) + Investment + Government\ Spending$ (2.8)

By the same procedure that we used to find (2.6) we get the multiplier for government spending

$$GovermentSpendingMultiplier = \frac{1}{1 - MPC} \tag{2.9}$$

And the tax multiplier is

$$TaxMultiplier = -\frac{MPC}{1 - MPC} \tag{2.10}$$

2.6 Financial Intermediation

Investment spending in an economy must ultimately come from savings. The source of investment is the savings from households. In order for firms not to borrow directly from savers (households) for their business projects we have Financial Intermediaries. Financial Intermediaries are institutions such as banks, savings and loans, insurance companies, money market funds, and such. These institutions accept funds from savers and make loans to business and individuals.

When such institutions go bankrupt due to failure from borrows to pay the loans, or if there are expected to go bankrupt it causes runs by the depositors for their money, households then can loose their savings and private investment dies. As a consequence jobs are not created and production decreases, causing more layups that then it turns into a significant decrease in GDP. The final result is massive unemployment, and a decrease in living standards. This forces the government to intervene by injecting them with capital or to invest in the economy or both. However, the decision is never easy since these increase public debt, and brings inflation because now there is more money in circulation. So there is no good remedy for this, is a situation that it must be avoided.

2.7 Inflation and Unemployment

Inflation increase when economic activity booms and unemployment falls below its natural rate. Similarly, the rate of inflation falls when the economy is in recession and unemployment exceeds its natural rate. During recessions high levels of unemployment lead to falling wages and prices. Another cause for inflation is a sustained increase in money growth. Excessive money growth can cause hyperinflation. We have **hyperinflation** when the inflation rate exceeds 50% per month. This is the worst that can happen to an economy. The value of money deteriorates quickly during hyperinflation. Money no longer serves as a good store of value. No country can easily live very long with hyperinflation. Governments are force to put an end to hyperinflation before it totally destroys their economies.

This excessive money growth happens when governments spend more than they collect, mainly to fight recessions, so they have the option to borrow money through bonds, or to print more money, both options causes government deficit to increase.

$$GovernmentDeficit = NewBorrowMoney + NewMoneyCreated \tag{2.11}$$

Hyperinflation always occurs in countries that have large deficits and can not borrow more, so they are force to print money. To stop hyperinflation, it is necessary to eliminate the government deficit either by increasing taxes or cutting on spending [1].

2.8 Government Debt and Deficits

In order for governments to finance their debt they either borrow money to the public or create new money or a combination of both. If a country has a central bank that controls the issue of the currency and it ends up buying government bonds, it takes the government debt out of the hands of the public and creates money through its purchase, this is called **monetizing the deficit**. This has the same effect as if the Treasury had printed money to finance the government deficit, as discussed before this will cause

inflation. The total debt relative to GDP generally rises during wars and falls during peacetime.

The deficit also rises as governments try to attack unemployment. The burden that national debt poses to society is that it can reduce the amount of capital in the economy and thereby reduce future incomes and real wages. Also a large national debt means that future generations will have to pay higher taxes to finance the interest on the debt. There are signs in the economy that the national debt is getting excessive: one is inflation, and another is low national investment. The last one may cause unemployment to increase. Deficits are more of a problem for countries that have low saving rates.

A big government debt imposes higher taxes to future generations to pay interest payments on the debt, retirement pension, social security, and health care benefits. These programs are financed through payroll taxes on current workers, not the past contributions of the retirees. So, in the case of an unemployment crisis all these programs will be affected.

3 The Economies of the 50 U.S. States and Puerto Rico

3.1 Introduction

3.2 The 50 States Business Cycles

3.3 Puerto Rico Business Cycles

3.4 The Current 2007 Recession

3 The Economies of the 50 U.S. States and Puerto Rico

3.1 Introduction

In this section we will discuss the recessions in the United States national economy, and its conjuncture with the states business cycles and Puerto Rico business cycles. **Business Cycles** are a type of fluctuation found in the aggregated economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similar general recessions, contractions, and revivals which emerge into the expansion phase of the next cycle [7].

The most all-inclusive manifestation of aggregate economic activity is real income, or the output of a nation, close to it is the rate of employment. Changes in output and prices together reflect changes in the total money value of all goods and services produced. The business cycle consists then of fluctuations in: (1) employment, (2) aggregated output, (3) prices, and (4) money value of the national product [7].

Every economy have a natural tendency to expand, then peak, followed by recession, and finally a bottoming out or a though. [7] Describe three different business cycles: one long (around 50 years), one of intermediate length (7-11 years), and one of shorter length (40 months). Joseph Schumpeter in Business Cycles (1939) argued that the primary cause of business cycles or changes in a capitalist economy is because of innovations. Swarm of copies of the new innovation would lead to a rash borrowing and investment spending creating a boom period. Eventually prices would be forced down, and the increased costs of production by competition would lead to disappearing profits and declines in investment with the inevitable contraction. This process of disturbing the steady state was accomplished by the innovator or the entrepreneur, this is called “creative destruction”.

3.2 The 50 States Business Cycles

The United States has been in 11 recessions from 1945 through 2005. However, when the national economy is in recession not every state is in recession, and sometimes states are in recession but not the national economy. The recession and expansion of the economy are business cycle phases within the economy. The Business Cycle Dating Committee of the National Bureau of Economic Research (NBER) is responsible of tracking these phases. The most prolonged recessions occurred between 1973 and 1975, and between 1981 and 1982, with 16 months of duration each. They were highly associated with a significant increase in crude oil prices [8]. The two most recent recessions were the 1990 - 1991 and the 2001. They were associated with the Persian Golf War, and the attacks on the Word Trade Center respectively. During these recessions not every state was in recession. Some states economies resemble the national economy, so when the national economy is in recession they are likely to be in recession as well. Some others are less tied to the national economy while others have done well even when the national economy is in recession.

Harding and Pagan [35] measure the degree to which two business cycles are in sync by the percentage of time the two economies were in the same regime. They called it the degree of concordance. Owyang, Piger, and Wall [9] measured the degree of concordance of the states with the U.S. economy using the same method. They found that the states that are more in sync with national economy are Minnesota, Wisconsin, Kansas, and Michigan showing a degree of concordance above 0.92. The states less in sync with the national economy are Alaska, and Hawaii, with 0.217 and 0.55 respectively. Also Maine, Louisiana, Maryland, Colorado, Arizona, Utah, Delaware, Washington, North Dakota, Montana, and New Mexico have degrees of concordance between 70 and 79.

Texas for example is often out of sync with the country as a whole because of the energy sector [9]. By the midpoint of the recession in the second quarter of 1980, nearly all the states were in recession except Texas, Oklahoma, and Louisiana, the oil states, along with

Florida and Wyoming. Also while the national economy was in expansion during the last quarter of 1985, 14 states were in recession. There was a plunge in oil prices during this period it possibly was the root of their recessions, because many of these states have large energy sectors.

Another business cycle characteristic is the persistence of remaining in a regime. Owyang, Piger, and Wall [9] found that for every state in either regime, the probability of remaining in that regime is much greater than the probability of switching to the other regime. They concluded that the regimes are persistent. Also for most states, the expected expansion duration is much longer than the expected contraction duration.

3.3 Puerto Rico Business Cycles

The first known recession in Puerto Rico after World War II occurred in the years 1973-1975, due mostly to an increase in oil prices and interest rates. Other recessions occurred in 1980-83, and in 1990-91 by related causes. There was another recession in the years 2001-2002 the only one to occur in Puerto Rico first than the United States. The average duration of a recession in Puerto Rico is 36 months in contrast with the United States that is 11 months [8].

3.4 The Current 2007 Recession

In the years of 1996 to 2006 the price of houses in the United Sates increased by 70% above the inflation rate due to a financial bubble in the sub-prime mortgage sector. As a consequence there was an $8 billion increase of fictional wealth. Many families view there houses as a source of great wealth and starting investing on their mortgages.

Then from December of 2006 to December of 2007 oil prices rose from $62.00/barrel to $91.70/barrel, this constitutes a 46.7% of increase. The prices kept steady through almost all 2008. An increase in oil prices is always an adverse supply shock to United States

economy. This shock affected GDP by −2.4% and also caused inflation. As a consequence of the burden of high prices families defaulted on their sub-prime mortgages. Plenty of foreclosures were felt across the United States. This hurt badly the financial sector. The speculated bubble exploded and all of theses actives became insolvent and toxic causing many banks to lose their liquidity.

The subprime mortgage crisis reached a critical level on September 2008, credit crunch and insolvency threatens investment banks and other financial institutions to go bankrupt. Among those were AIG (American International Group), Fannie Mae, Freddie Mac, and Lehman Brothers, very big companies with global reach. The collapse was so big that was felt around the world. The Dow Jones Industrial Index dropped 700+ points, Britain's FTSE 100 dropped 7.9%, Germany Dax dropped 7.1%, France's CAC 40 dropped 9%, and Russia's RTS dropped 20%.

To relieve the crisis the 110th Congress passed **The Emergency Economic Stabilization Act of 2008** (Division A of Public Law 110-343 enacted in October 3, 2008), commonly known as the bailout of the U.S. Financial System, the banker bailout, and the wall street bailout. The Act spends up to $700 billion to purchase toxic assets and especially mortgage-backed securities, and to inject banks with capital. The Act was proposed by the secretary of treasure at the time Henry Paulson.

4 The American Recovery and Reinvestment Act

4.1 What is ARRA?

4.2 Justification for ARRA

4.3 ARRA Disclosure

4.4 ARRA Distribution by State

4 The American Recovery and Reinvestment Act

4.1 What is ARRA?

The **American Recovery and Reinvestment Act of 2009**, abbreviated **ARRA** (Public Law 111-5), is an economic stimulus package enacted by the 111th United States Congress in February 13, 2009.

The measures are nominally worth $787 billion. The Act includes federal tax cuts, expansion of unemployment benefits and other social welfare provisions, and domestic spending in education, health care, and infrastructure, including the energy sector. The Act also includes numerous non-economic recovery related items that were part of longer-term plans.

The Public Law 111-5 defines ARRA as an act making supplemental appropriations for job preservation and creation, infrastructure investment, energy efficiency and science, assistance to the unemployed, state and local fiscal stabilization for the fiscal year ending September 30, 2009, and for other purposes.

The purposes of the Act include the following:

1. To preserve and create jobs and promote economic recovery.

2. To assist those most impacted by the recession.

3. To provide investments needed to increase economic efficiency by spurring technological advances in science and health.

4. To invest in transportation, environmental protection, and other infrastructure that will provide long-term economic benefits.

5. To stabilize state and local government budgets, in order to minimize and avoid reductions in essential services and counterproductive state and local tax increases.

According to the Public Law 111-5 the general principle concerning the use of funds is that The President and the heads of federal departments and agencies shall manage and expend the funds made available in this Act so as to achieve its purposes including commencing expenditures and activities as quickly as possible consistent with prudent management.

The Recovery Act intends to achieve these goals by:

1. Providing $288 billion in tax cuts and benefits for millions of working families and businesses.
2. Increasing federal funds for education and health care as well as entitlement programs such as extending unemployment benefits by $244 billion.
3. Making $275 billion available for federal contracts, grants, and loans.
4. Requiring recipients of recovery funds to report quarterly on how they are using the money. All the data is posted on Recovery.gov so the public can track the recovery funds.

In addition, offering financial aid directly to local school districts, expanding the Child Tax Credit, and underwriting a process to computerize health records to reduce medical errors and save on health care costs.

For infrastructure the Act plans to invest in the domestic renewable energy industry, weatherizing 75% of federal buildings and more than one million private homes. The Act also invests in the construction and repair of roads, scientific research, and the expansion of broadband and wireless service.

4.2 Justification for ARRA

At the beginning of 2009 the GDP of the United States was contracting at an annual rate of more than 6 percent, and employment was falling by about 700,000 jobs per month. To suppress the fall in demand caused by the Financial Crisis, and the subsequent decline in consumer and business confidence, households wealth, and access to credit the 111th Congress of the United States enacted the American Recovery and Reinvestment Act (ARRA) proposed by the Obama Administration. The ARRA was part of a comprehensive policy response to the economic turmoil that gripped the United States and the world economy in the fall of 2008 and early 2009 [2].

The stimulus intends to create jobs and promote investments. The rationale for the stimulus comes out of the Keynesian economic tradition that argues that government spending should be used to cover out gap created by the drop in consumer spending during a recession. Also changes in monetary policies had already been made, the Federal Reserve has cut interest rates almost to zero, and since the United States is so in debt, savings would likely go to pay out debts, and not to investments. These put hopes on ARRA to take America out of recession or at least to slow the decline.

4.3 ARRA Disclosure

The American Recovery and Reinvest Act of 2009 consists of $787 billion and are been distributed in the following way: Tax Benefits $288B (37%), Contracts, Grants, and Loans $275B (35%), and Entitlements $224B (28%). In more detail to Education and Training $53B (6.7%), to Infrastructure and Science $111 (14%), to State and Local Fiscal Relief $144B (18%), to Health Care $59B (7.5%), to Energy $43B (5.5%), to Protecting the Vulnerable $81B (10%), and other $8B (1%). Tax Benefits are meant to help both individuals and companies. According to Public 111-5, Tax Cuts for individuals reaches $237B (82% of all tax benefits), and for companies $51B (18% of all tax benefits). Here is the disclosure of most of these funds [3]:

Tax Cuts for Individuals ($237B)

New payroll tax credit of $400 per worker and $800 per couple in 2009 and 2010. Phaseout begins at $75,000 for individuals and $150,000 for joint filers.	$116 billion
Alternative minimum tax a one year increase in AMT floor to $70,950 for joint filers for 2009.	$70 billion
Expansion of child tax credit: A $1,000 credit to more families (even those that do not make enough money to pay income taxes).	$15 billion
Expanded college credit to provide a $2,500 expanded tax credit for college tuition and related expenses for 2009 and 2010. The credit is phased out for couples making more than $160,000.	$14 billion
Homebuyer credit: $8,000 refundable credit for all homes bought between 1/1/2009 and 12/1/2009 and repayment provision repealed for homes purchased in 2009 and held more than three years. This only applies to first-time homebuyers.	$6.6 billion
Excluding from taxation the first $2,400 a person receives in unemployment compensation benefits in 2009.	$4.7 billion

Expanded earned income tax credit to increase the earned income tax credit — which provides money to low income workers — for families with at least three children.	$4.7 billion
Home energy credit to provide an expanded credit to homeowners who make their homes more energy-efficient in 2009 and 2010. Homeowners could recoup 30 percent of the cost up to $1,500 of numerous projects, such as installing energy-efficient windows, doors, furnaces and air conditioners.	$4.3 billion
For deduction of sales tax from car purchases, not interest payments phased out for incomes above $250,000.	$1.7 billion

Tax Cuts for Companies (51B)

Allowing companies to use current losses to offset profits made in the previous five years, instead of two, making them eligible for tax refunds.	$15 billion
To extend tax credits for renewable energy production (until 2014).	$13 billion
Government contractors: Repeal a law that takes effect in 2012, requiring government agencies to withhold three percent of payments to contractors to help ensure they pay their tax bills. Repealing the law would cost $11 billion over 10 years, in part because the government could not earn interest by holding the money throughout the year.	$11 billion
Repeal bank credit: Repeal a Treasury provision that allowed firms that buy money-losing banks to use more of the losses as tax credits to offset the profits of the merged banks for tax purposes. The change would increase taxes on the merged banks by $7 billion over 10 years.	$7 billion
Bonus depreciation which extends a provision allowing businesses buying equipment such as computers to speed up its depreciation through 2009.	$5 billion

Healthcare ($147.7B)

More than 11% of the total bill is allocated to help states with Medicaid.

For Medicaid	$86.6 billion
To provide a 65 percent subsidy of health care insurance premiums for the unemployed under the COBRA program.	$24.7 billion
For health information technology.	$19 billion
For health research and construction of National Institutes of Health facilities.	$10 billion
For medical care for service members and their families (military).	$1.3 billion
For prevention and wellness.	$1 billion
For the Veterans Health Administration.	$1 billion
For Community Health Centers.	$2 billion
To research the effectiveness of certain healthcare treatments.	$1.1 billion
To train healthcare personnel.	$500 million
For healthcare services on Indian reservations.	$500 million

Education ($90.9B)

In aid to local school districts to prevent layoffs and cutbacks, with flexibility to use the funds for school modernization and repair (State Equalization Fund).	$44.5 billion
To increase Pell Grants from $4,731 to $5,350.	$15.6 billion
For low-income public schoolchildren.	$13 billion
For IDEA special education.	$12.2 billion
For Head Start.	$2.1 billion
For childcare services.	$2 billion
For educational technology.	$650 million

For increased teacher salaries.	$300 million
For states to analyze student performance.	$250 million
To support working college students.	$200 million
For the education of homeless children.	$70 million

Aid to low income workers, unemployed and retirees, including job training ($82.5B)

To provide extended unemployment benefits through Dec. 31, and increase them by $25 a week.	$40 billion
For the Food Stamp Program.	$19.9 billion
To give one-time $250 payments to Social Security recipients, people on Supplemental Security Income, and veterans receiving disability and pensions.	$14.2 billion
For job training.	$3.95 billion
Temporary welfare payments.	$3 billion
For vocational training for the disabled.	$500 million
For employment services.	$400 million
For subsidized community service jobs for older Americans.	$120 million
To help refill food banks.	$150 million
For meals programs for seniors, such as Meals on Wheels.	$100 million
For free school lunch programs	$100 million

Infrastructure Investment ($80.9 billions)

Core Investments: roads, bridges, railways, sewers, and other transportation. ($51.2 billions)

For highway and bridge construction projects.	$27.5 billions
For intercity passenger rail projects and rail congestion grants, with priority for high speed rail.	$8 billions
For new equipment for public transportation projects.	$6.9 billions
For wastewater and drinking water infrastructure (EPA).	$6 billions
For Amtrak.	$1.3 billions
To help public transit agencies.	$100 millions
For the construction of new public rail transportation system, and other fixed way guide system.	$750 millions
For the maintenance of existing public transportation system.	$750 millions

Investment into government facilities and vehicle fleets ($29.5 billions)

For the Army Corps of Engineers for environmental restoration, flood protection, hydropower, and navigation infrastructure projects.	$4.6 billions
For energy efficiency and renewable energy to the U.S. General Service Administration (GSA).	$4.5 billions
To repair and modernize Defense Department facilities.	$4.5 billions
To the establishment of an Office of Federal High-Performance Green Buildings with the GSA.	$4 billions
For the waste water treatment infrastructure improvements (Clean Water State Revolving Fund).	$4 billions

For public housing improvements and energy efficiency (Department of Housing and Urban Development).	$4 billions
For drinking water infrastructure improvements (Drinking Water State Revolving Fund).	$2 billions
To improve housing for service members.	$890 millions
To acquire electric vehicles for federal vehicle fleet.	$300 millions
To improve job corps training facilities.	$250 millions
For new child development centers.	$240 millions
For the construction of state extended-care facilities.	$240 millions
To improve facilities of the National Guard.	$100 millions
For the maintenance of the United States Coast Guard facilities.	$240 millions

Supplemental investments ($15B)

For complete broadband and wireless Internet access.	$7.2 billion
For competitive grants to state and local governments for transportation investments.	$1.5 billion
For rural drinking water and waste disposal projects.	$1.38 billion

Water, sewage, environment, and public lands ($18B)

To the Bureau of Reclamation for drinking water projects for rural or drought-likely areas.	$1 billion
To the National Park Service.	$750 million
To the Forest Service.	$650 million
For wildfire prevention projects.	$515 million
For Bureau of Indian Affairs infrastructure projects.	$500 million

To the Natural Resources Conservation Service for watershed infrastructure projects.	$340 million
To the Bureau of Land Management.	$320 million
For National Wildlife Refuges.	$280 million
For the National Fish Hatchery System.	$280 million
To the International Boundary and Water Commission to repair flood control systems along the Rio Grande.	$220 million
For other public lands management agencies.	$220 million
To update the computer center at the Social Security Administration.	$500 million
To upgrade IT platforms at the State Department.	$290 million
For IT improvements at the Farm Service Agency.	$50 million

Energy ($61.3 billion)

Funding for an electric smart grid.	$11 billion
For state and local governments to make investments in energy efficiency.	$6.3 billion
For renewable energy and electric transmission technologies loan guarantees.	$6 billion
For the cleanup of radioactive waste (mostly nuclear power plant sites).	$6 billion
For weatherizing modest-income homes.	$5 billion
For the Office of Electricity and Energy Reliability to modernize the nation's electrical grid and smart grid.	$4.5 billion
For state and local governments to increase energy efficiency in federal buildings.	$4.5 billion
For carbon capture experiments.	$3.4 billion
For the Western Area Power Administration for power transmission system upgrades.	$3.25 billion

For energy efficiency research.	$2.5 billion
For manufacturing of advanced car battery (traction) systems and components.	$2 billion
Forward Energy Efficiency and Conservation Block Grants.	$3.2 billion
For training of green-collar workers (by the Department of Labor).	$500 million
For electric vehicle technologies.	$400 million
For federal vehicle fleets, to cover the cost of acquiring electric vehicles including plug-in hybrid vehicles.	$300 million
To buy energy efficient appliances.	$300 million
For reducing diesel fuel emissions.	$300 million
For state and local governments to purchase energy efficient vehicles.	$300 million
To increase energy efficiency in low-income housing.	$250 million
To cleanup hazardous waste that threaten health and the environment.	$600 million
To cleanup petroleum leaks from underground storage tanks.	$200 million
To evaluate and cleanup brown field land.	$100 million
For the Geothermal Technologies Program.	$400 million

Scientific Research ($8.9B)

To the National Science Foundation.	$3 billion
To the United States Department of Energy.	$2 billion
For university research facilities.	$1.3 billion
To NASA.	$1 billion
To the National Oceanic and Atmospheric Administration (NOAA).	$600 million

To the National Institute of Standards and Technology.	$580 million
For NOAA operations, research and facilities.	$230 million
To the United States Geological Survey.	$140 million

Housing ($12.7B)

To the Department of Housing and Urban Development (HUD) for repairing and modernizing public housing, including increasing the energy efficiency of units.	$4 billion
In tax credits for financing low-income housing construction.	$2.25 billion
For Section 8, housing rental assistance.	$2 billion
To help communities purchase and repair foreclosed housing.	$2 billion
For rental assistance and housing relocation.	$1.5 billion
For the rehabilitation of Native American housing.	$510 million
For helping rural Americans buy homes.	$200 million
For rural community facilities.	$130 million
To help remove lead paint from public housing.	$100 million

Other ($18.1 billion)

State Block Grants: in aid to states to defray budget cuts.	$8.8 billion
For state and local law enforcement agencies.	$4 billion
For improving airport security.	$1.1 billion
In preparation for the 2010 census.	$1 billion
For improving security at the border and ports of entry.	$720 million

For DTV conversion coupons and DTV transition education.	$750 million
To build and upgrade fire stations.	$210 million
For the security of transit systems.	$150 million
For the security of ports.	$250 million
To improve security systems at the Department of Agriculture headquarters.	$26 million
For an increase of claims processing military staff.	$150 million
For VA general operating expenses.	$150 million
For the National Endowment for the Arts to support artists.	$50 million
For the National Cemetery Administration.	$50 million
For veterans affected by the Rescission Act of 1946.	$198 million

4.4 ARRA Distribution by State

The reported recipient of ARRA and ARRA funds for infrastructure by state in 2009 are display in Appendix 4 Tables 11, and 12.

5 The Study

5.1 Introduction

5.2 The Data

5.3 Examination of the Allocation of Funds by Scatter Plots

5.4 Application of Multipliers

5.5 Introduction to Cluster Analysis

5.6 Clustering the States using Geographical Data

5.7 Clustering the States using Economical Data of 2008

5.8 Impact Path Clusters due to ARRA Infrastructure Funds

5.9 Statistical Models for the Problem

5 The Study

5.1 Introduction

To study the impact or the effects of the ARRA funds destined to infrastructure to the states economies, we first constructed scatter plots that allowed us to visualize the relationships of the data. The data shows how the funds were distributed and expended from the third quarter of 2009 to the first quarter of 2010 with respect to the population of the state, and some economic variables such as GDP per Capita in 2008, Personal Income per Capita in 2008, contribution to National GDP from 2002 - 2007, contribution to the 2007 Recession, and Unemployment in 2008. Then we measured the projected impact to the states GDP using multipliers. After that, the new variable created was incorporated in a cluster analysis. This classified or grouped the states based upon the impact of the ARRA Infrastructure Funds (ARRAIF) to the states GDP. Once we grouped the states in this form we were able to tell which states recovered thanks to ARRAIF, and in which states ARRAIF did not work.

5.2 The Data

The data used in this study was acquired from the web pages of the Bureau of Economic Analysis from the U.S. Department of Commerce, the U.S. Census Bureau, the official website of ARRA, *La Junta de Planificación de Puerto Rico*, and *El Informe al Gobernador de Puerto Rico 2008 [12]*. The data is show in Appendix 4.

5.3 Examination of the Allocation of Funds by Scatter Plots

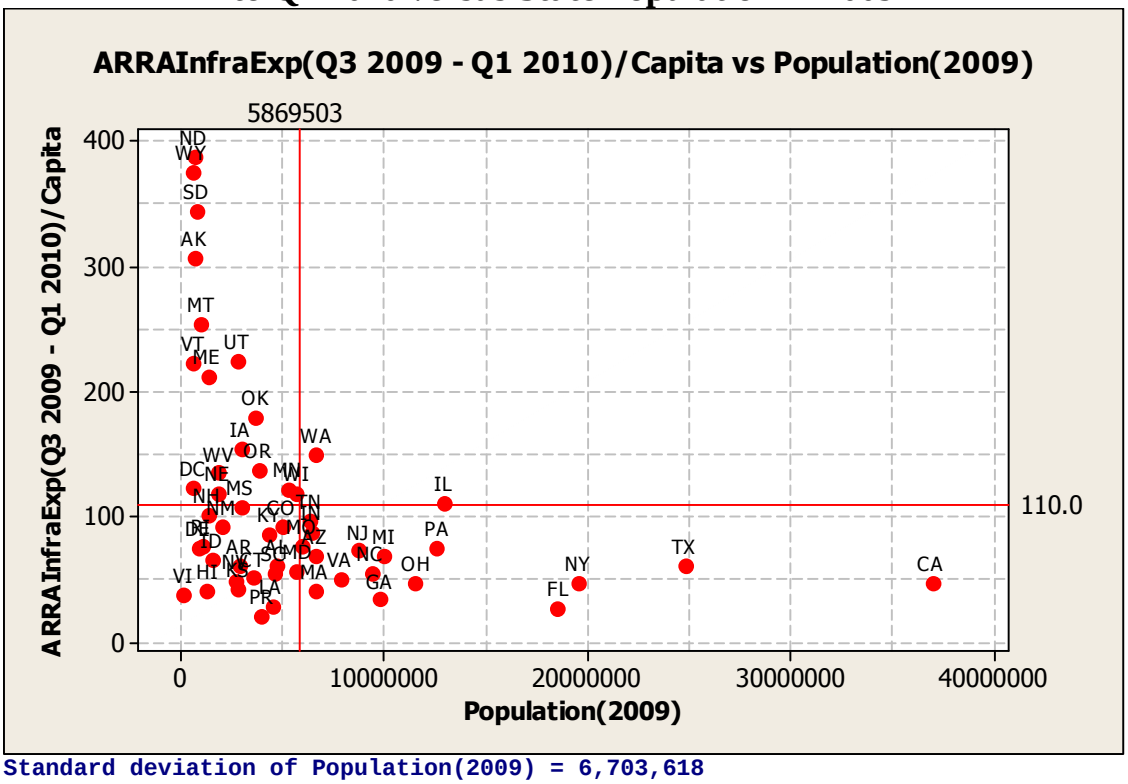
The idea here is to visualize how the ARRA funds for infrastructure were expended from the third quarter of 2009 to the first quarter to 2010 per Capita, vis-à-vis, their economic necessity or condition via scatter plots. The ARRA funds for infrastructure per Capita is the dependent variable, and the independent variables are the economic variables, GDP per Capita in 2008, Personal Income per Capita in 2008, Unemployment in 2008, the states contribution to the nation GDP from 2002 to 2007, and the contribution to the 2007 recession, and the population in 2009. The GDP per Capita and the Personal Income per Capita are indicators of wealth, the unemployment is an indicator of the state of the economy, and the contribution to the national GDP and the contribution to the 2007 recession constitutes the role that the state played recently in the nation's economy.

To check if the funds were put where they needed the most, we used the year 2008 as contrast. There are three distinct versions of the variable that represents the ARRA Infrastructure Funds Expenditure from Q3 2009 to Q1 2010 per Capita. The first one is explained by the variable *ARRAInfraExp(Q3 2009 - Q1 2010)/Capita*. This variable contains data about the 50 states, District of Columbia, Puerto Rico, and the Virgin Islands. The variable *ARRAInfraExp(Q3 2009 - Q1 2010)/Capita1* contains data only about the 50 states, District of Columbia, and Puerto Rico, and the variable *ARRAInfraExp(Q3 2009 - Q1 2010)/Capita2* contains data only about the 50 states, and District of Columbia. This was needed because for some other variables all 53 observations were not available, or did not apply. For the sake of discussion all observations are referred as states.

We started with plotting the ARRAIF per capita versus the populations of the states in 2009, Figure 5.1. The figure shows that states with small populations like North Dakota (ND), Wyoming (WY), South Dakota (SD), and Alaska (AK) among others, have received and expended more ARRA Infrastructure funds per capita than those with larger populations like California (CA), Texas (TX), New York (NY), and Florida (FL). The reference lines in the figure are the means of the variables, and we can see that all the

states with large populations fall below the mean of expended infrastructure funds per capita, and the ones with small populations are high above it.

Figure 5.1 ARRA Infrastructure Expenditure per Capita from Q3 2009 to Q1 2010 versus State Population in 2009

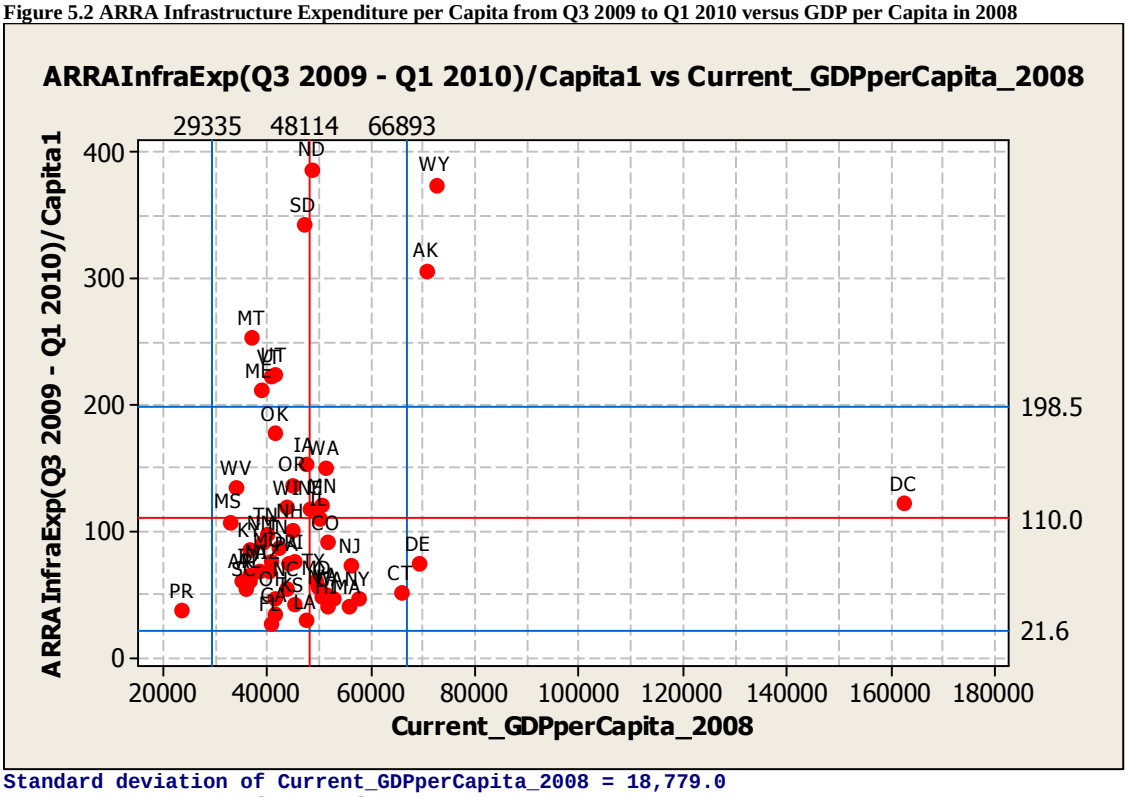


Standard deviation of Population(2009) = 6,703,618
Standard deviation of ARRAInfraExp(Q309-Q110)/Capita = 88.5035

The cross section diagram on Figure 5.2 shows the distribution of the ARRAIF per capita with the GDP per capita in 2008 as the *X* variable. The blue lines represent the addition and subtraction of the standard deviation with the mean. Notice that the GDP per capita of the states is less dispersed than the expenditure of the ARRAIF per capita. Also notice that District of Columbia (DC) and Puerto Rico (PR) are outliers. This shows the difference in wealth per capita of both of them from the states of the union.

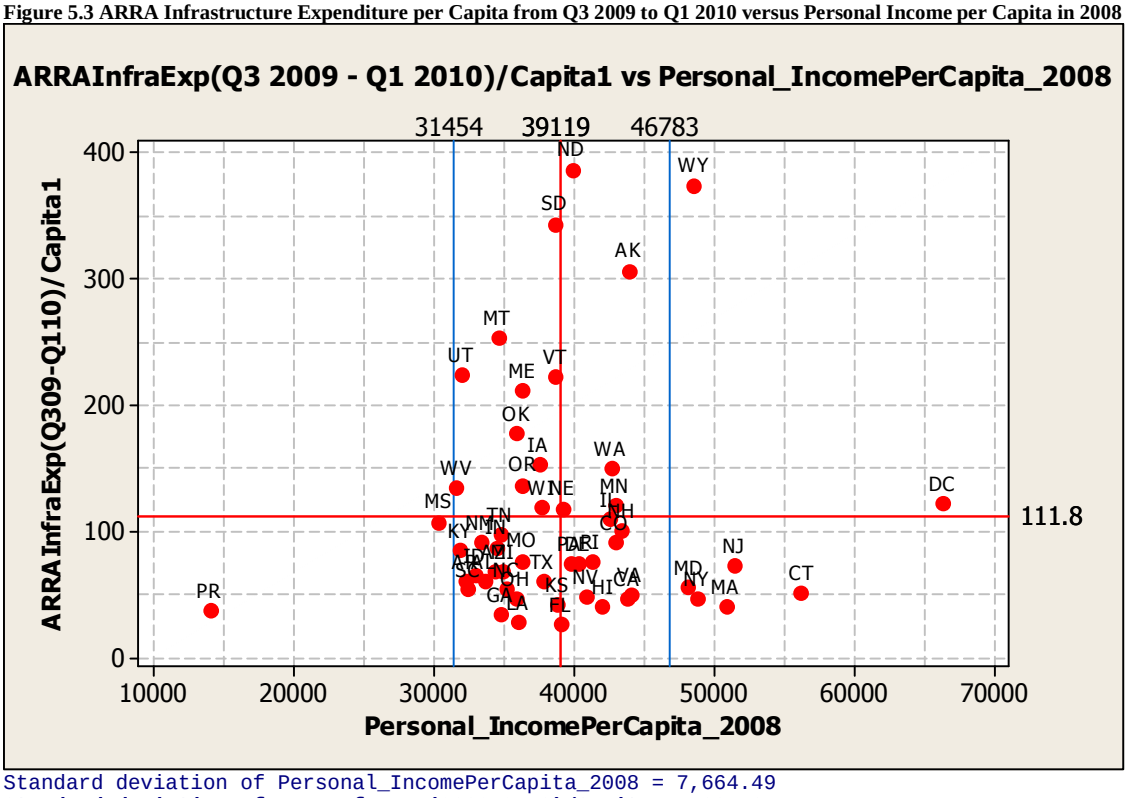
In figure 5.3 the Personal Income per Capita in 2008 is the *X* variable. States with larger Personal Income per capita in 2008 were District of Colombia (DC), the richest per capita, Connecticut (CT), New Jersey (NJ), Massachusetts (MA), Maryland (MD), and

Figure 5.2 ARRA Infrastructure Expenditure per Capita from Q3 2009 to Q1 2010 versus GDP per Capita in 2008



Standard deviation of Current_GDPperCapita_2008 = 18,779.0
Standard deviation of ARRAInfraExp(Q309-Q110)/Capita1 = 88.4617

Figure 5.3 ARRA Infrastructure Expenditure per Capita from Q3 2009 to Q1 2010 versus Personal Income per Capita in 2008

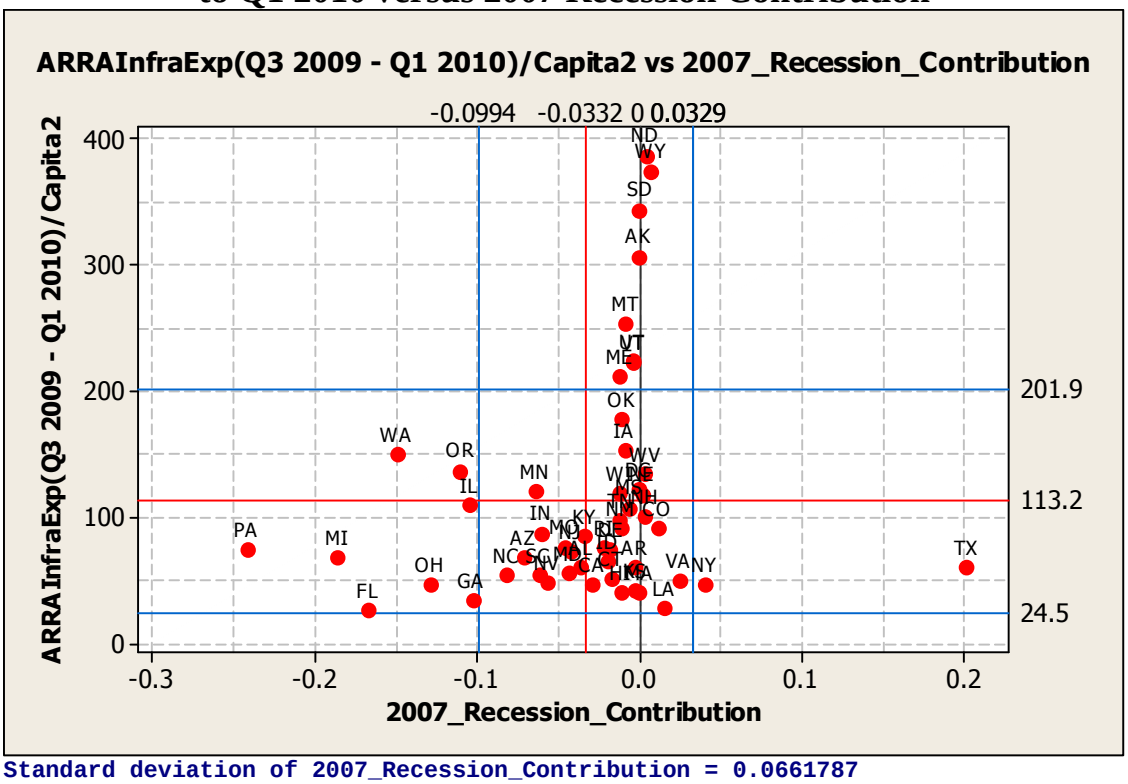


Standard deviation of Personal_IncomePerCapita_2008 = 7,664.49
Standard deviation of ARRAInfraExp(Q309-Q110)/Capita1 = 88.4617

Wyoming (WY). On the other side Puerto Rico (PR) had a lot less.

An interesting result is found in Figure 5.4. The contribution to the 2007 recession is the independent variable. Most of the states are on the negative side of the *X* axis. These states contributed some what to the recession. Among these states are Pennsylvania (PA), Michigan (MI), Florida (FL), Washington (WA), Oregon (OR), Illinois (IL), Georgia (GA), and California (CA). They combined contributed 33.74% to national GDP between 2002-07 see Appendix 4 Table 3. On the positive side of the *X* axis we

Figure 5.4 ARRA Infrastructure Expenditure per Capita from Q3 2009 to Q1 2010 versus 2007 Recession Contribution



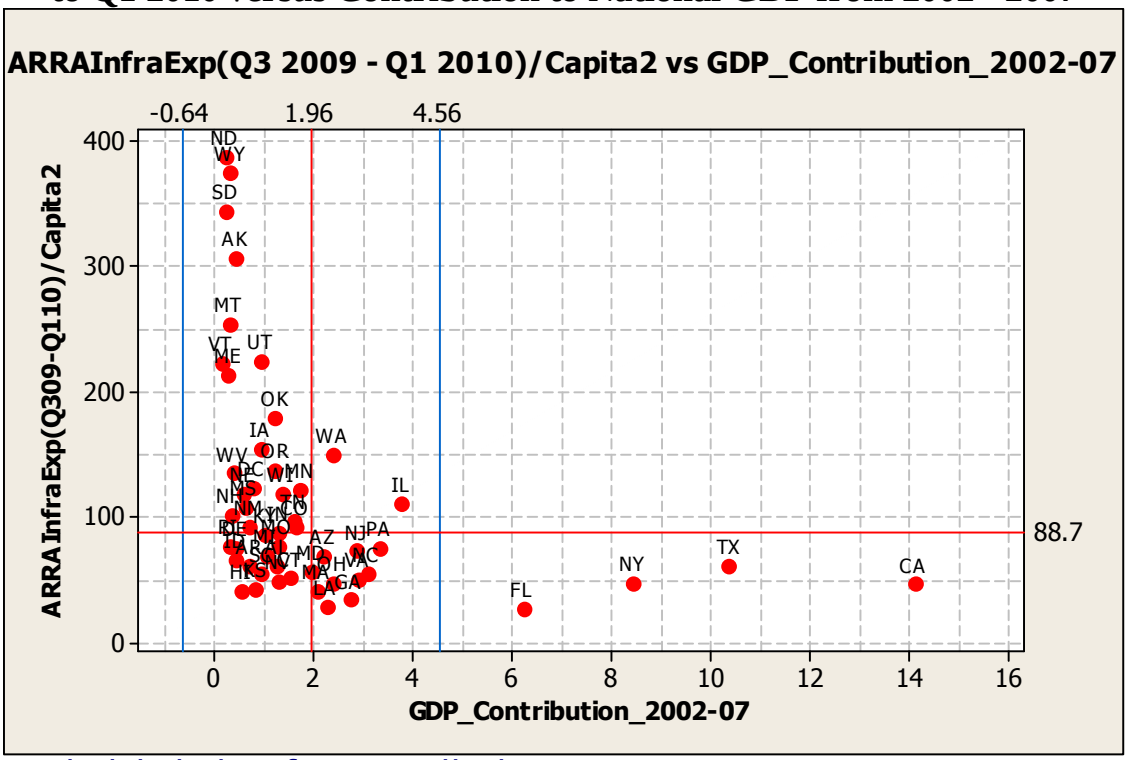
Standard deviation of 2007_Recession_Contribution = 0.0661787
Standard deviation of ARRAInfraExp(Q309-Q110)/Capita2 = 88.7119

have Texas (TX), and New York (NY) preventing a bigger drop of national GDP, since they contributed 18.77% combined to national GDP from 2002 - 2007. Also important, the states receiving the larger amount of ARRA funds for infrastructure per capita are North Dakota (ND), Wyoming (WY), South Dakota (SD), and Alaska (AK). These states were kind of neutral in their contribution to the 2007 recession, since all of them

had a close 0% of contribution to it. Having the states getting more ARRAIF per capita is a misallocation since the main goal of ARRA is to promote economic recovery and to assist the most impacted by the recession.

Figure 5.5 and Figure 5.1 are very similar in showing the direct relation that exist between the GDP contribution of the state to the national economy and the population of the state, which make sense in an economy working at full employment. We can see from the figure that the big contributors to the national economy are California (CA), Texas (TX), New York (NY), and Florida (FL). They contributed 39.08% combined from 2002 to 2007. However, these were ones that received the fewer amounts of ARRAIF per capita in the period mentioned.

Figure 5.5 ARRA Infrastructure Expenditure per Capita from Q3 2009 to Q1 2010 versus Contribution to National GDP from 2002 - 2007

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Standard deviation of GDP_Contribution_2002-07 = 2.60320
Standard deviation of ARRAInfraExp(Q309-Q110)/Capita2 = 88.7119
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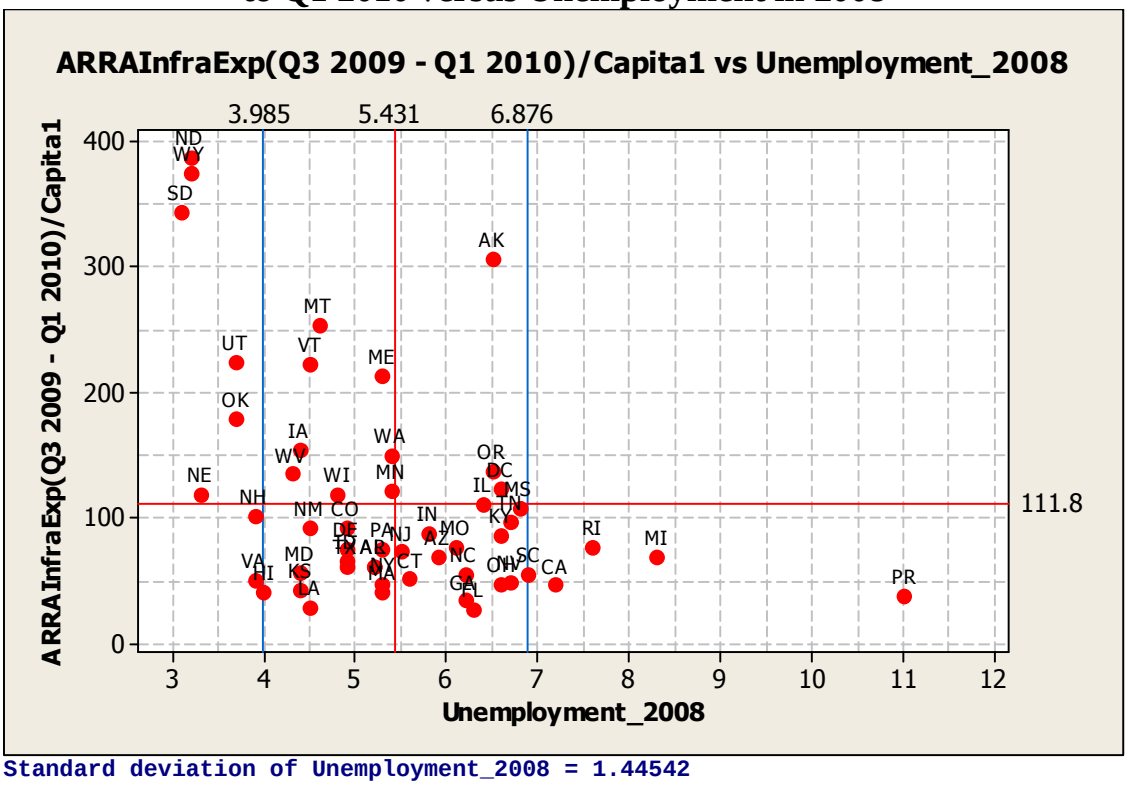
We also need to point out that the majority of the states contributed around 1.96% to national GDP.

To complete the discussion let us check the scatter plot of ARRAIF per Capita versus the unemployment rate in 2008 Figure 5.6. Again we see some type of misallocation of the funds since states with low unemployment rates are receiving more funds per capita that those with higher unemployment rates.

Based upon these observations is not going to be surprising if ARRA does not have the desired results. It does not seem to be allocating enough infrastructure projects to combat the recession in states that are big contributors to national GDP, nor in those most affected by the recession, nor in those with higher unemployment rates.

Figure 5.6 ARRA Infrastructure Expenditure per Capita from Q3 2009 to Q1 2010 versus Unemployment in 2008

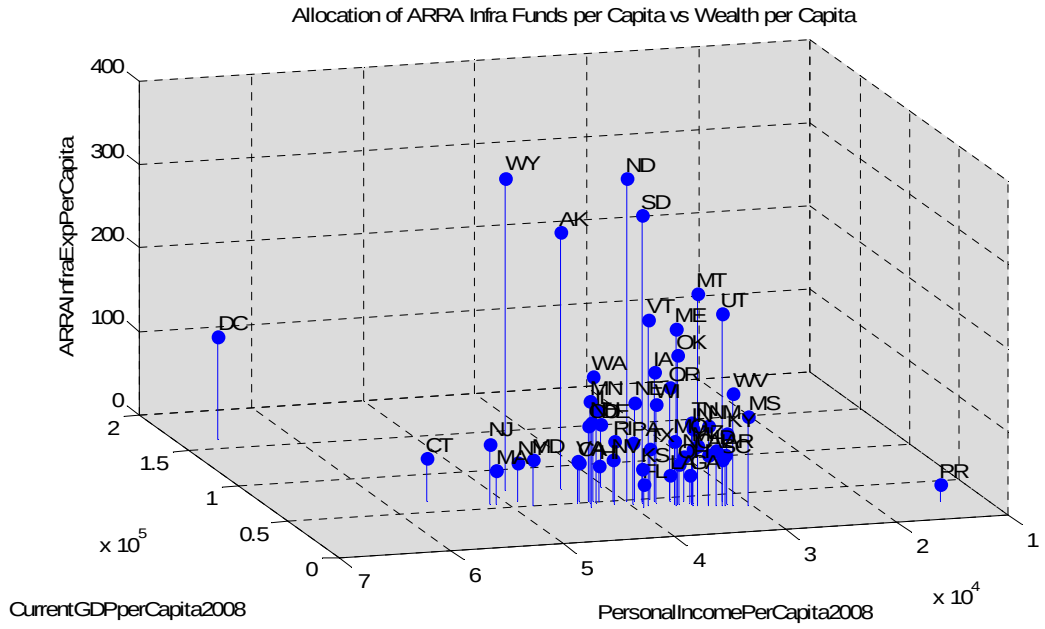


Standard deviation of Unemployment_2008 = 1.44542
Standard deviation of ARRAInfraExp(Q309-Q110)/Capita1 = 88.4617

As an extra investigation let us examine a 3D scatter plot of ARRAIF per capita versus GDP per Capita in 2008 vs. Personal Income per Capita in 2008 showed in Figure 5.7, let us called it Allocation versus Wealth. The figure shows that the District of Columbia (DC) has more wealth per capita than any other state, its followed by Connecticut (CT),

New Jersey (NJ), Massachusetts (MA), Wyoming (WY), New York (NY), and Maryland (MD). From that group Wyoming received a lot more ARRAIF per capita. From this point of view the distribution of the ARRAIF does not seems too disperse or poorly distributed, since we have states that received the most ARRAIF per capita in almost every level of wealth per capita, except Puerto Rico that is at a low level on the three ends.

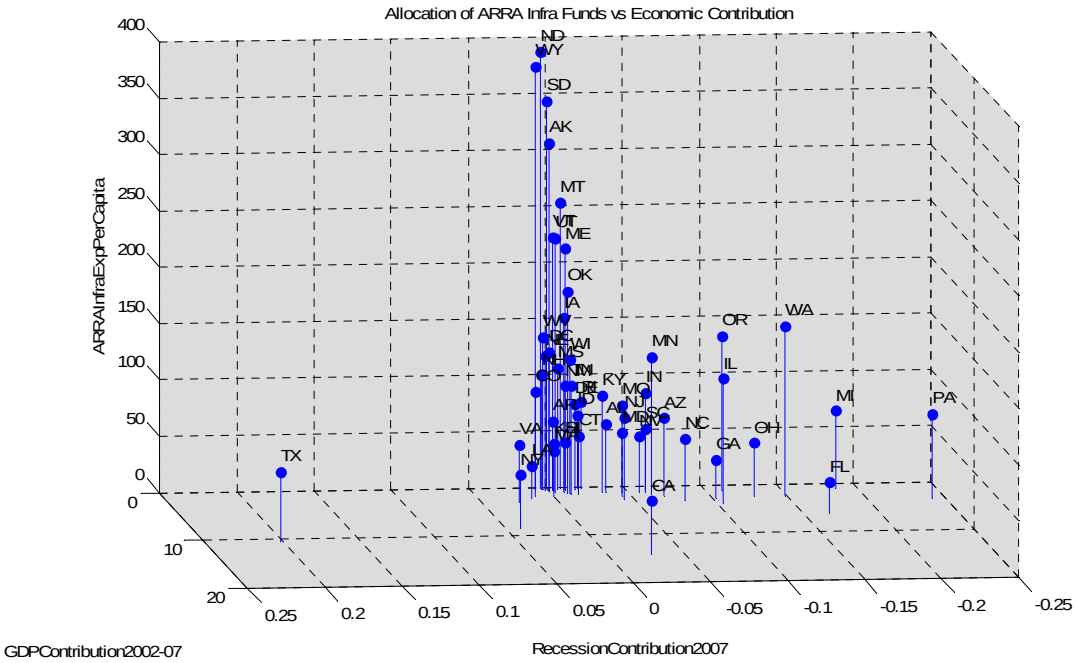
Figure 5.7 Allocation of ARRA Infrastructure Funds per Capita versus Wealth per Capita



However, from the perspective of the allocation of the funds per capita versus national economic contribution Figure 5.8 we observe a misallocation of the funds. The larger cluster of observations lay on the back and the middle of the XY plane. This means that they are small contributors individually to the national GDP and were small contributors to the 2007 recession. These states expended more infrastructure funds per capita in 2009 than those who contributed a lot more to the national GDP and of those that were big players in the recession.

In order for these new projects to have a significant impact to the economy this graph should look like an escalator going up to the right, so that the big players of the recession are the ones expending (investing) the most per capita in constructing, developing, and maintaining the infrastructure of the state faster that the others, so they can have a big impact to the national economy.

Figure 5.8 Allocation of ARRA Infrastructure Funds per Capita versus National Economic Contribution

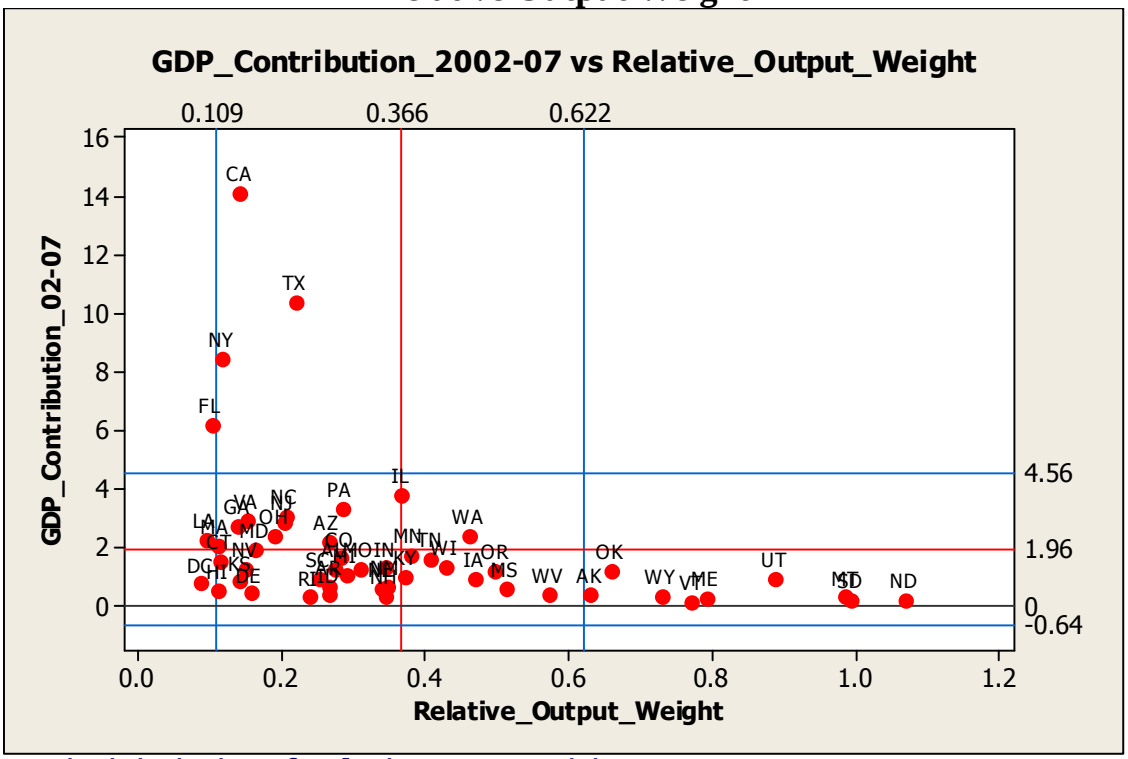


In every figure we noticed similar characteristics and dissimilarities among the states. We need to group the states based upon the weighted investments and the change in output of the state to produce impact path clusters of these funds. For that end we will use Cluster Analysis, and to forecast the weighted output of the investments we will use Multipliers.

5.4 Application of Multipliers

To find the projected output due to the ARRAIF investment, we multiplied the ARRA infrastructure funds per capita by the final demand output multiplier for the construction industry (RIMS II), provided by the Bureau of Economic Analysis see Appendix 4 Table 3 for details. That gave us the projected impact on GDP per capita for each state. Then we divided by the GDP per Capita in 2009, and multiplied it by 100. We call this new variable *Relative Output Weight*. Although the funds expended in the first quarter of 2010 were added to projected impact on GDP in 2009 the result will not change significantly. The relative output weight is a measure of how much percentage of GDP per capita was due to the ARRA infrastructure funds. See Appendix 4 Table 4 and

Figure 5.9 Contribution to National GDP from 2002 - 2007 versus Relative Output Weight




```
Standard deviation of Relative_Output_Weight = 0.256208
Standard deviation of GDP_Contribution_2002-07 = 2.60320
Sum of Relative_Output_Weight = 18.6429
Sum of GDP_Contribution_2002-07 = 99.99
```

Appendix 5 Table 9 for results and ranks. We let the relative output weight be the *X* variable and the Contribution to GDP from 2002 - 2007 the *Y* variable of the scatter plot in Figure 5.9.

The figure shows the particular foot form of Figure 5.1 and Figure 5.5. Looks like every time the data is weighted it has this form with California (CA), Texas (TX), New York (NY), an Florida (FL) at one end, and North Dakota (ND), South Dakota (SD), Montana (MT), Utah (UT), Wyoming (WY), Vermont (VT), and Maine (ME) at the other. This marks a great difference of economic significance on the US economy as a whole.

The projected impact of the ARRA Infrastructure funds from Q3 2009 - Q1 2010 is 18.64% of the GDP per capita in 2009 for the whole nation. The percentage change of real GDP in 2009 was −2.1% in the United States, and −0.44% for the construction industry see Appendix 4 Table 5.

Now that we have a weighted the investment we are ready to use cluster analyses to group the states based upon their projected similarities thanks to these funds. In other words we are going to classify the states not only based upon wealth and contribution, but also by the struggle in the recession.

5.5 Introduction to Cluster Analysis

Cluster Analysis is explained in detail in Appendix 2 but what it basically does is to group or classify the data by establishing similar characteristics by means of how close or apart the observations are. To perform the clustering algorithm we need first to choose a method to measure the distances among the observations, and then a method to link them. The algorithm will compute the distances of all observation from one to another, and it will store it in a matrix, called the **distance matrix**. Then the two closest observations are joined in one cluster, and then based upon the linkage method a new coordinate that represents the position of the cluster in the vector space is created, like the center for

example. Now the distances are computed again and the observation that is closest to the cluster joins the cluster or the other two closest observations form another cluster, and the process is repeated until all observations are joined in one cluster.

It is up to the researcher to determine how many clusters should be. It comes down to what makes sense for the data. However, the first time that the algorithm is performed the final partition can be chosen arbitrarily. We can choose the number of clusters as the final partition or a desired percentage of similarity. After the program is run we examine the dendogram. The **dendogram** is a graphical depiction of the amalgamation of observations into one cluster. The step where the distances change abruptly identifies a good point for cutting the dendrogram. Cutting the dendrogram is like drawing a horizontal line across the diagram to specify the final grouping. Then next time we run the program we specify the appropriate number of clusters as the final partition.

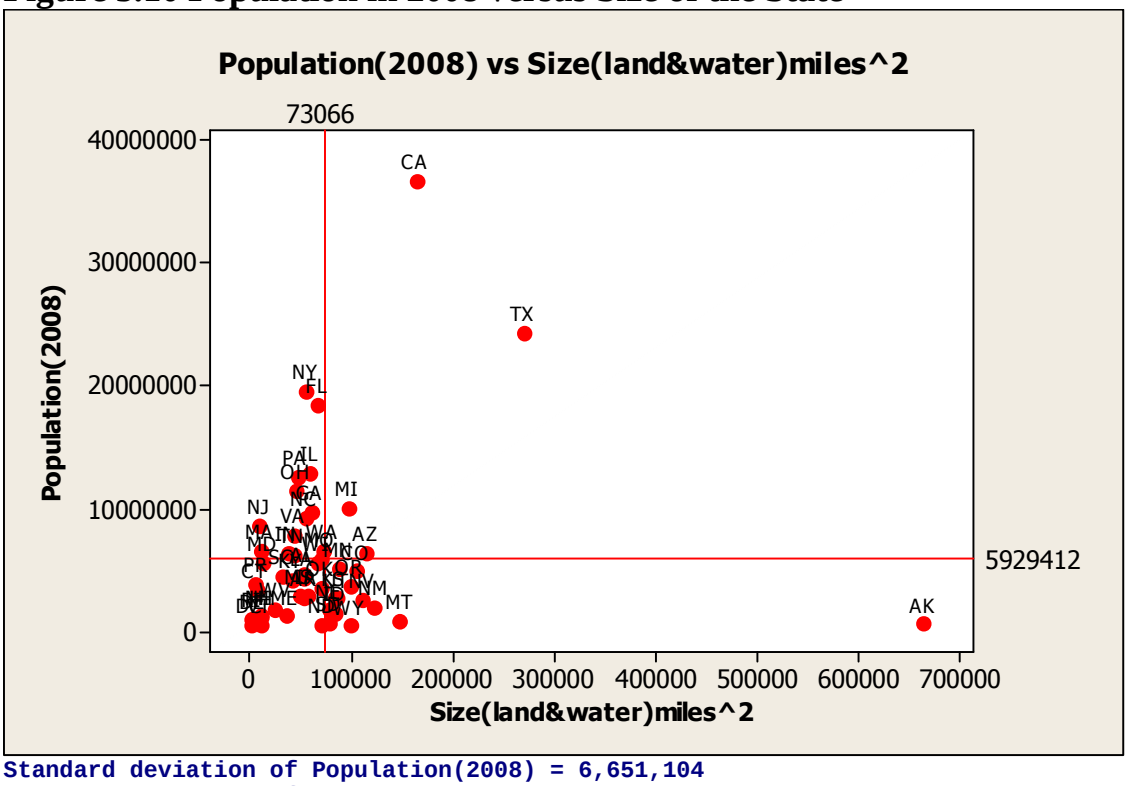
5.6 Clustering the States using Geographical Data

Let us first Cluster Analysis to group the states in a geographical perspective. For that purpose we are going to use the population in 2008 and the size of the state (including land and water) as variables. Let us call this the Geo-Cluster. The scatter plot in Figure 5.10 shows four clusters with New York (NY) and Florida (FL) being one cluster, California (CA) and Texas (TX) in another, Alaska (AK) in another, and the rest. The dendogram or the hierarchical tree diagram Figure 5.11 was run for four clusters. This resulted in a 66.67% of similarity.

The distance measure and linkage method that worked the best in our study were the Euclidian distance and the complete linkage method. The Euclidean distance is the square root of the sum of squared differences, and the complete linkage method uses the furthest neighbor criterion to link the observations. The complete linkage chooses the furthest distance between an observation in one cluster and an observation in the other.

Figure 5.11 shows the dendogram with four clusters as the final partition using the Euclidean distance and the complete linkage method.

Figure 5.10 Population in 2008 versus Size of the State

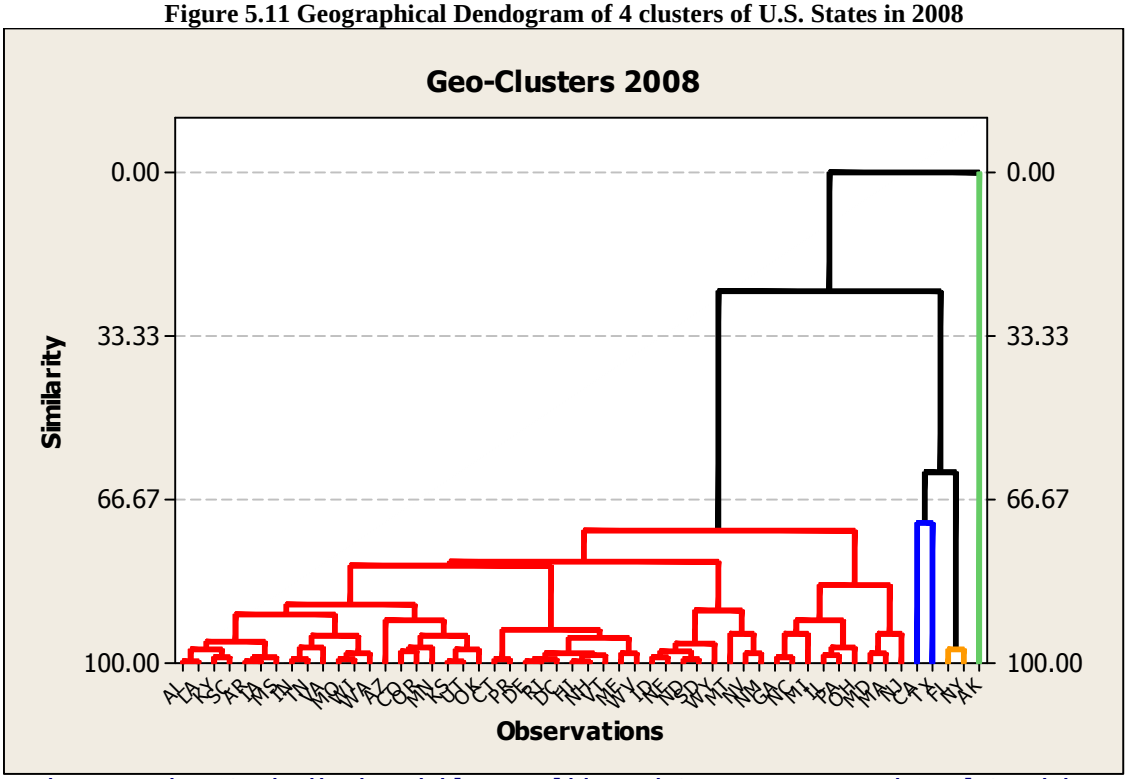


Standard deviation of Population(2008) = 6,651,104
Standard deviation of Size(land&water)miles^2 = 96,202.5

The horizontal line represents the level of similarity, for example four clusters can be formed with 66.67% of similarity. Looking closely we can choose 10 clusters to be the final partition which is approximately 90% of similarity. Let us run the program again, this time with 10 clusters as the final partition Figure 5.12.

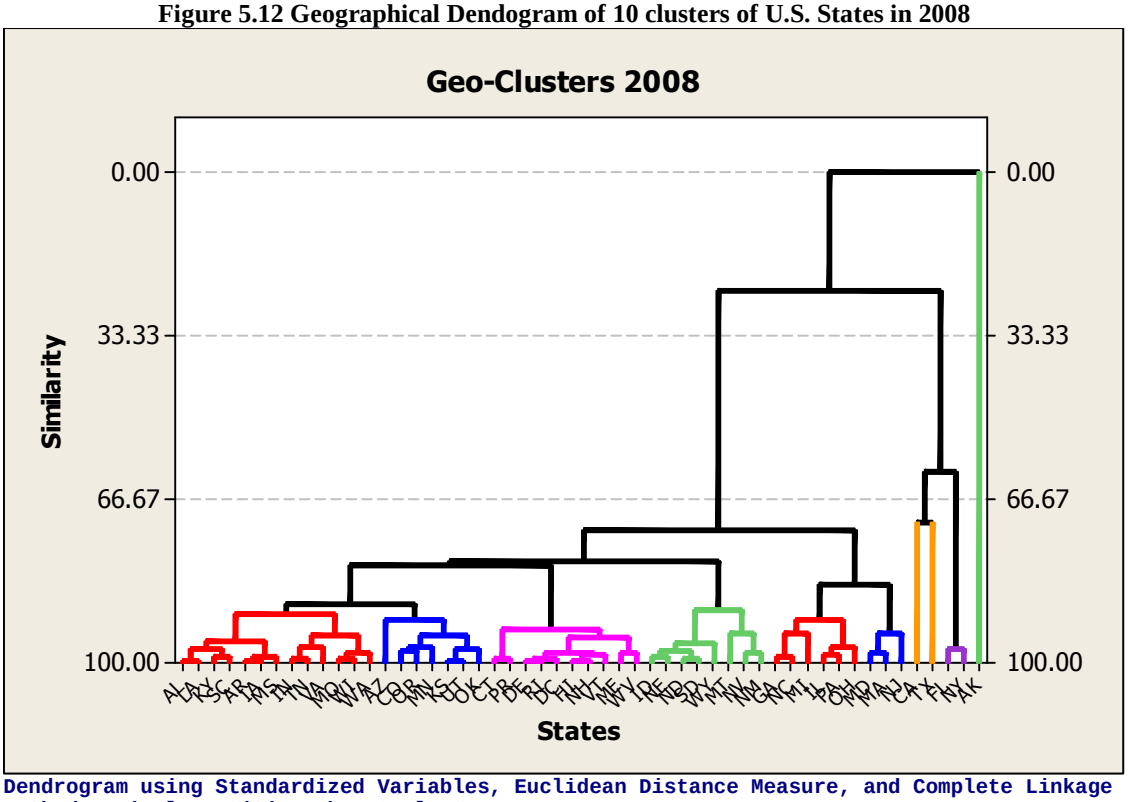
The data has now been divided into 10 groups or 10 clusters. This will help us establish economic comparisons within the states falling in the same Geo-Cluster. The Minitab Output 5.1 in the Addendum shows the amalgamation steps and the distance matrix. To help the discussion we also have the members and statistics of each cluster. California (CA) is the biggest state in population with 36,580,371 inhabitants, and Alaska (AK) is the biggest state in land and water with 663,267 square miles. The District of Colombia

Figure 5.11 Geographical Dendogram of 4 clusters of U.S. States in 2008



Dendrogram using Standardized Variables, Euclidean Distance Measure, and Complete Linkage Method. Final partition by four clusters.

Figure 5.12 Geographical Dendogram of 10 clusters of U.S. States in 2008



Dendrogram using Standardized Variables, Euclidean Distance Measure, and Complete Linkage Method. Final partition by 10 clusters.

(DC) is the smallest with 68 square miles and has the smallest population with 590,074 inhabitants. The mean for the population in 2008 for U.S. states is 5,929,412 and the mean for the size of U.S. states is 73,066 square miles. The smallest states in size are the members of Cluster 5, which ranges in population from 590,074 (DC) to 3,954,553 (PR) inhabitants. The members of Cluster 8 and 5 have small populations, while the members Cluster 7 and 6 have large populations. The states with large populations are big contributors to national GDP Figure 5.5.

Clusters Members and Statistics for Geo-Clusters

Cluster 1

Members (13):

'AL' 'AR' 'IN' 'IA' 'KY' 'LA' 'MS' 'MO' 'SC' 'TN' 'VA' 'WA' 'WI'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	50,954.31	12,399.99	32,020 'SC'	71,300 'WA'
Population(2008)	5,022,796.77	1,554,743.11	2,867,764 'AR'	7,795,424 'VA'

Cluster 2

Members (1):

'AK'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	663,267.00	0.00	663,267 'AK'	663,267 'AK'
Population(2008)	688,125.00	0.00	688,125 'AK'	688,125 'AK'

Cluster 3

Members (7):

'AZ' 'CO' 'KS' 'MN' 'OK' 'OR' 'UT'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	91,498.00	14,878.41	69,898 'OK'	113,998 'AZ'
Population(2008)	4,230,984.43	1,384,563.77	2,727,343 'UT'	6,499,377 'AZ'

Cluster 4

Members (1):

'CA'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	163,696.00	0.00	163,696 'CA'	163,696 'CA'
Population(2008)	36,580,371.00	0.00	36,580,371 'CA'	36,580,371 'CA'

Cluster 5

Members (10):

'CT' 'DE' 'DC' 'HI' 'ME' 'NH' 'RI' 'VT' 'WV' 'PR'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	10,448.00	11,128.49	68 'DC'	35,385 'ME'
Population(2008)	1,634,223.80	1,166,854.76	590,074 'DC'	3,954,553 'PR'

Cluster 6

Members(2):

'FL' 'NY'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	60,155.50	7,918.89	54,556 'NY'	65,755 'FL'
Population(2008)	18,945,833.50	738,156.55	18,423,878 'FL'	19,467,789 'NY'

Cluster 7

Members (6):

'GA' 'IL' 'MI' 'NC' 'OH' 'PA'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	59,792.33	19,054.85	44,825 'OH'	96,716 'MI'
Population(2008)	10,980,808.67	1,542,065.99	9,247,134 'NC'	12,842,954 'IL'

Cluster 8

Members (8):

'ID' 'MT' 'NE' 'NV' 'NM' 'ND' 'SD' 'WY'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	98,218.25	26,551.58	70,700 'ND'	147,042 'MT'
Population(2008)	1,357,369.88	740,495.64	532,981 'WY'	2,615,772 'NV'

Cluster 9

Members (3):

'MD' 'MA' 'NJ'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	10,561.00	1,843.01	8,721 'NJ'	12,407 'MD'
Population(2008)	6,955,216.00	1,544,083.55	5,658,655 'MD'	8,663,398 'NJ'

Cluster 10

Members (1):

'TX'

Stats:

Variable	Mean	Standard deviation	Min	Max
StateSize	268,581.00	0.00	268,581 'TX'	268,581 'TX'
Population(2008)	24,304,290.00	0.00	24,3042,90 'TX'	24,304,290 'TX'

5.7 Clustering the States using Economical Data of 2008

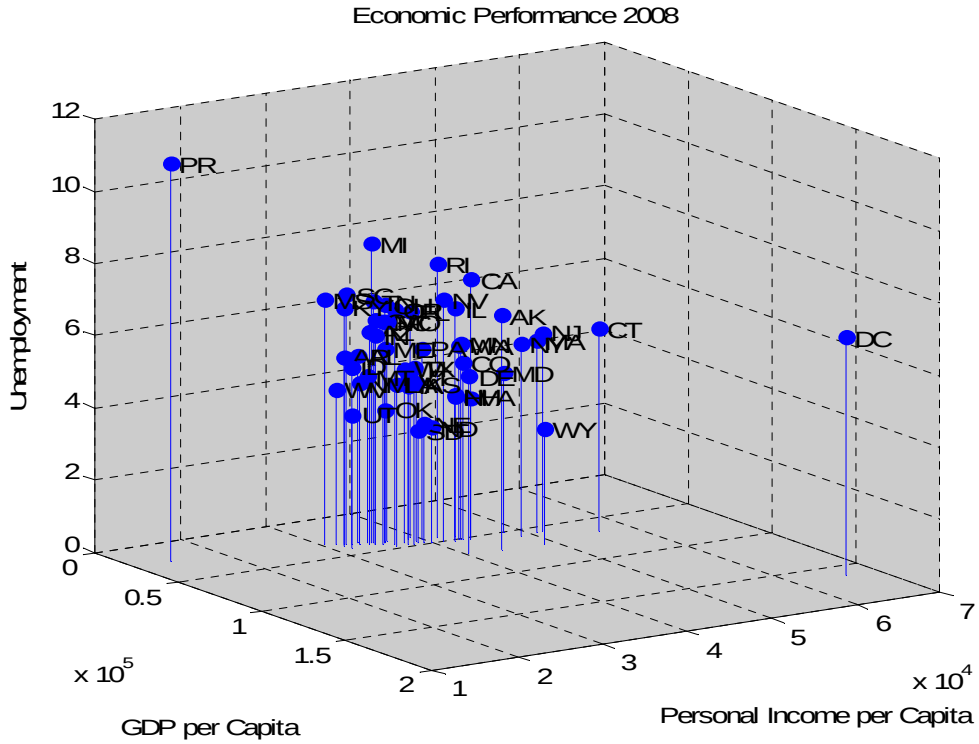
Now let us use the same procedure using current GDP per Capita 2008, Personal Income per Capita 2008, and Unemployment 2008 as variables, this way we will cluster the states based upon how they did economically in 2008. A year in the recession without the ARRA founds been expended yet.

Table 5.1: Stats for Economic Performances 2008

VARIABLE	MEAN	STANDARD DEVIATION	MIN	MAX
Current_GDPperCapita_2008	48,114.4	18,779.00	23,498.5 'PR'	162,534 'DC'
Personal_IncomePerCapita_2008	39,118.6	7,664.49	14,080 'PR'	66,316 'DC'
Unemployment_2008	5.43077	1.44542	3.1 'SD'	11 'PR'

A 3D scatter plot Figure 5.13 shows the dissimilarities of some economies as well as the similarities. Puerto Rico (PR) and the District of Colombia (DC) are the most dissimilar from the rest. Puerto Rico has the higher unemployment rate, the lowest GDP per Capita, and the lowest Personal Income per Capita clearly the worst performance. The District of Colombia (DC) however had the best, and Connecticut (CT) the second best.

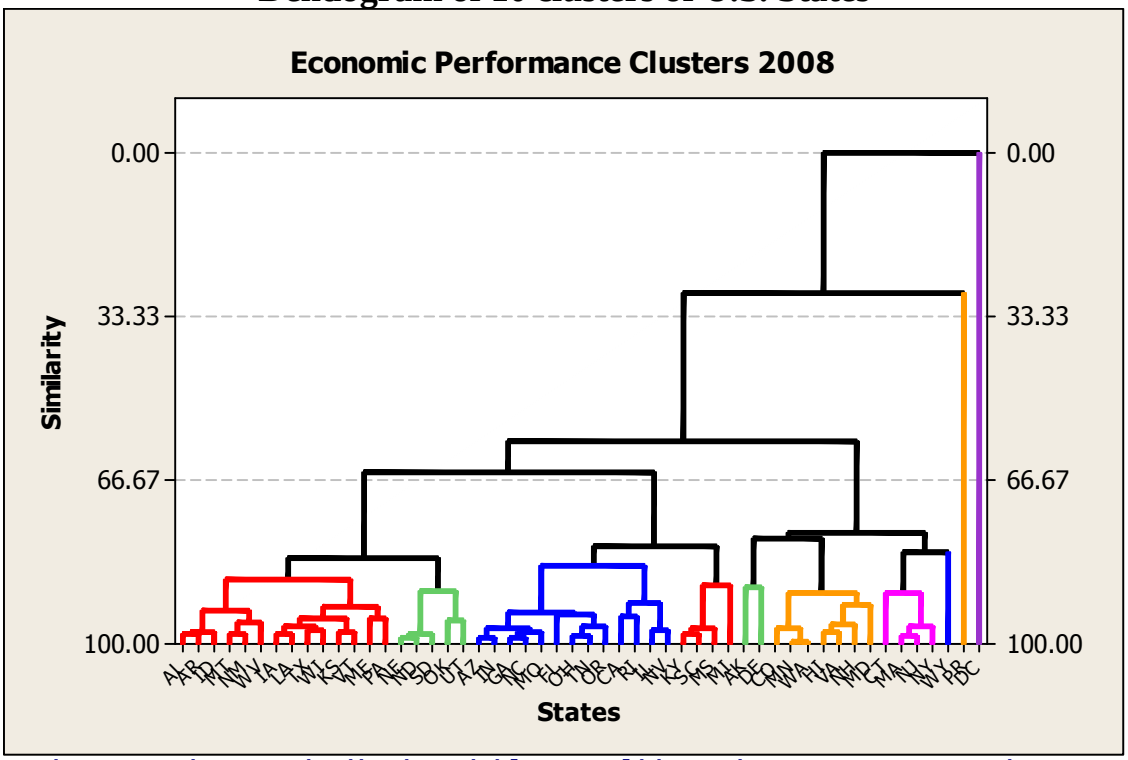
Figure 5.13 Economic Performances in 2008



So we applied cluster analysis with 10 clusters as the final partition taking the number of clusters from the geographical classification. The dendogram in Figure 5.14 shows that at 66.67% of similarity five clusters can be formed, but around 84% 10 can be formed. So since we needed less similarity to obtain 10 clusters this means that the data is less dispersed that the previous clusters, meaning that they have more in common in this perspective.

The Cluster's Stats are shown next. To help us with the discussion the mean and standard deviations are rank in descending order. Careful must be taken in discussing

Figure 5.14 Economic Performances in 2008
Dendogram of 10 clusters of U.S. States



Dendrogram using Standardized Variables, Euclidean Distance Measure, and Complete Linkage Method. Final partition by 10 clusters.

unemployment because higher ranks mean higher unemployment rates. Check MINITAB OUTPUT 5.2 in the addendum for cluster analysis details.

Clusters Members and Statistics

Cluster 1

Members (14):

'AL' 'AR' 'ID' 'IA' 'KS' 'LA' 'ME' 'MT' 'NM' 'PA' 'TX' 'VT' 'WV' 'WI'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	41,044.43 (8)	5,034.79 (1)	33,981 'WV'	49,212 'TX'
PersonalIncomePerCapita2008	35,817.57 (8)	2,695.51 (4)	31,634 'WV'	39,762 'PA'
Unemployment2008	4.77 (7)	0.36 (5)	4.30 'WV'	5.30 'ME'

Cluster 2

Members (2):

'AK' 'DE'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	69,820.50 (3)	1,038.74 (7)	69,086 'DE'	70,555 'AK'
PersonalIncomePerCapita2008	42,148.50 (5)	2,508.11 (5)	40,375 'DE'	43,922 'AK'
Unemployment2008	5.70 (5)	1.13 (1)	4.90 'DE'	6.50 'AK'

Cluster 3

Members (13):

'AZ' 'CA' 'FL' 'GA' 'IL' 'IN' 'MO' 'NV' 'NC' 'OH' 'OR' 'RI' 'TN'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	44,098.62 (7)	4,325.08 (3)	39,800 'TN '	52,528 'CA'
PersonalIncomePerCapita2008	37,698.15 (6)	3,376.04 (1)	34,339 'AZ'	43,852 'CA'
Unemployment2008	6.48 (4)	0.50 (4)	5.80 'IN'	7.60 'RI'

Cluster 4

Members (7):

'CO' 'HI' 'MD' 'MN' 'NH' 'VA' 'WA'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	50,085.00 (5)	2,445.83 (5)	44,733 'NH'	51,657 'CO'
PersonalIncomePerCapita2008	43,780.14 (4)	2,027.22 (6)	42,078 'HI'	48,164 'MD'
Unemployment2008	4.56 (8)	0.68 (3)	3.90 'NH'	5.40 'MN'

Cluster 5

Members (4):

'CT' 'MA' 'NJ' 'NY'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	58,776.50 (4)	4,668.02 (2)	55,752 'MA'	65,688 'CT'
PersonalIncomePerCapita2008	51,856.00 (2)	3,141.86 (3)	48,809 'NY'	56,245 'CT'
Unemployment2008	5.42 (6)	0.15 (7)	5.30 'MA'	5.60 'CT'

Cluster 6

Members (1):

'DC'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	162,534.00 (1)	0.00 (10)	162,534 'DC'	162,534 'DC'
PersonalIncomePerCapita2008	66,316.00 (1)	0.00 (10)	66,316 'DC'	66,316 'DC'
Unemployment2008	6.60 (3)	0.00 (10)	6.60 'DC'	6.60 'DC'

Cluster 7

Members (4):

'KY' 'MI' 'MS' 'SC'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	35,849.75 (9)	2,311.15 (6)	32,760 'MS'	38,256 'MI'
PersonalIncomePerCapita2008	32,441.75 (9)	1,897.67 (7)	30,383 'MS'	34,953 'MI'
unemployment2008	7.15 (2)	0.78 (2)	6.60 'KY'	8.30 'MI'

Cluster 8

Members (5):

'NE' 'ND' 'OK' 'SD' 'UT'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	45,377.20 (6)	3,650.35 (4)	41,336 'UT'	48,714 'ND'
PersonalIncomePerCapita2008	37,143.80 (7)	3,208.81 (2)	32,050 'UT'	39,874 'ND'
unemployment2008	3.40 (9)	0.28 (6)	3.10 'SD'	3.70 'OK'

Cluster 9

Members (1):

'WY'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	72,383.00 (2)	0.00 (10)	72,383 'WY'	72,383 'WY'
PersonalIncomePerCapita2008	48,580.00 (3)	0.00 (10)	48,580 'WY'	48,580 'WY'
unemployment2008	3.20 (10)	0.00 (10)	3.20 'WY'	3.20 'WY'

Cluster 10

Members (1):

'PR'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
CurrentGDPperCapita2008	23,498.00 (10)	0.00 (10)	23,498 'PR'	23,498 'PR'
PersonalIncomePerCapita2008	14,080.00 (10)	0.00 (10)	14,080 'PR'	14,080 'PR'
unemployment2008	11.00 (1)	0.00 (10)	11.00 'PR'	11.00 'PR'

The richest state per capita in 2008 was District of Colombia Cluster 6, leading by far ranking number one on GDP per Capita 2008, and Personal Income per Capita 2008, but with an unemployment rate above average. The second richest per capita but the best among the states of the union was Wyoming Cluster 9.

Adding unemployment to the analysis Wyoming had the lowest unemployment rate in 2008 3.20%, followed by Cluster 8 3.40% on average, which are the states receiving more infrastructure funds per capita. On the other end Puerto Rico Cluster 10, had the highest unemployment rate in 2008 11%. Cluster 3 contains states that are big contributors to national GDP and also were big contributors to the 2007recession. As a consequence their unemployment rate rose to 6.48% on average. These states are the most important to the recovery of the nation.

5.8 Impact Path Clusters due to ARRA Infrastructure Funds

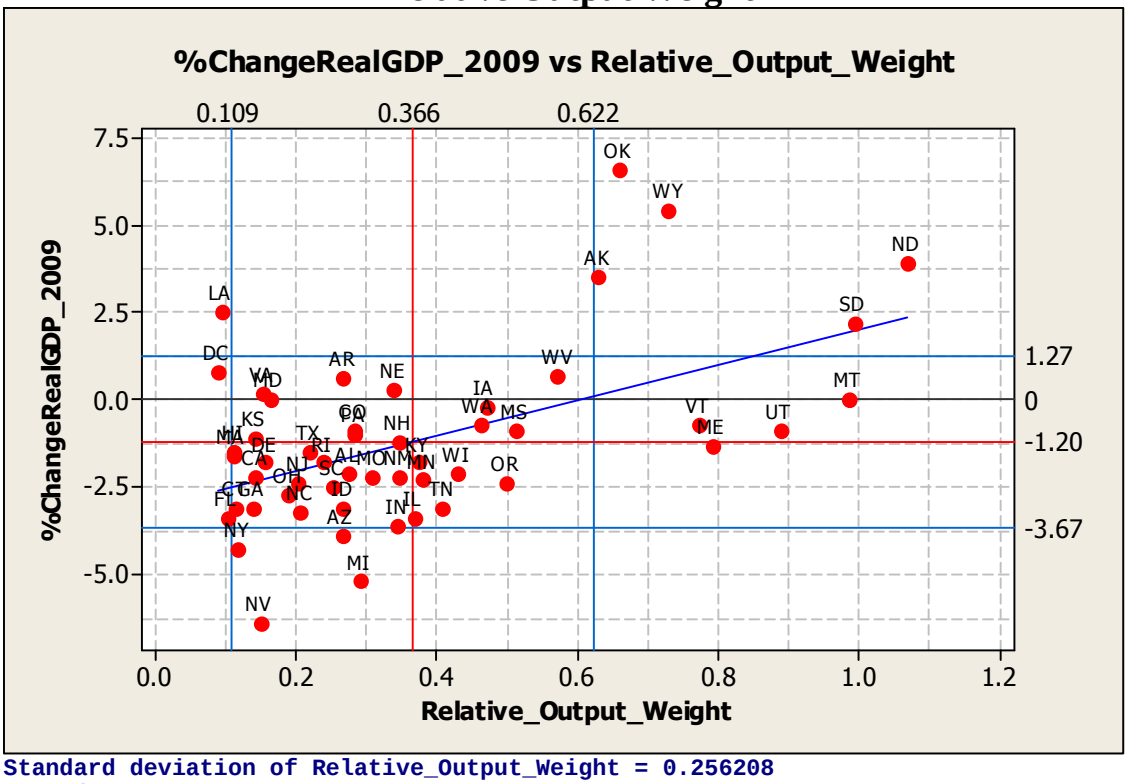
Let us perform now cluster analysis with *Relative Output Weight*, and *Percentage Change in Real GD in 2009* as variables. This is done to group the states in a form where they share similar characteristics on the magnitude of the impact of the ARRA infrastructure funds. Table 5.3 shows the stats for the variables. On average the real GDP dropped −1.20%, but the United States dropped −2.1% see Appendix 4 Table 5. The state that with the greatest increase in real GDP in 2009 was Oklahoma with an increase of 6.6%, and Nevada had the biggest drop with a −6.4%. Oklahoma rank 8 in relative output weight and Nevada rank 40. There is a possible direct relation here.

Table 5.2: Stats for Impact Path Variables

VARIABLE	MEAN	STANDARD DEVIATION	MIN	MAX
Relative_Output_Weight	0.366	0.256	0.087 ‘DC’	1.066 ‘ND’
PercentageChangeRealGDP2009	-1.20	2.471	-6.4 ‘NV’	6.6 ‘OK’

To check on that we have a scatter plot diagram Figure 5.15 with regression line. Clearly there is and upward tendency. So let us group the states and establish an impact path clusters.

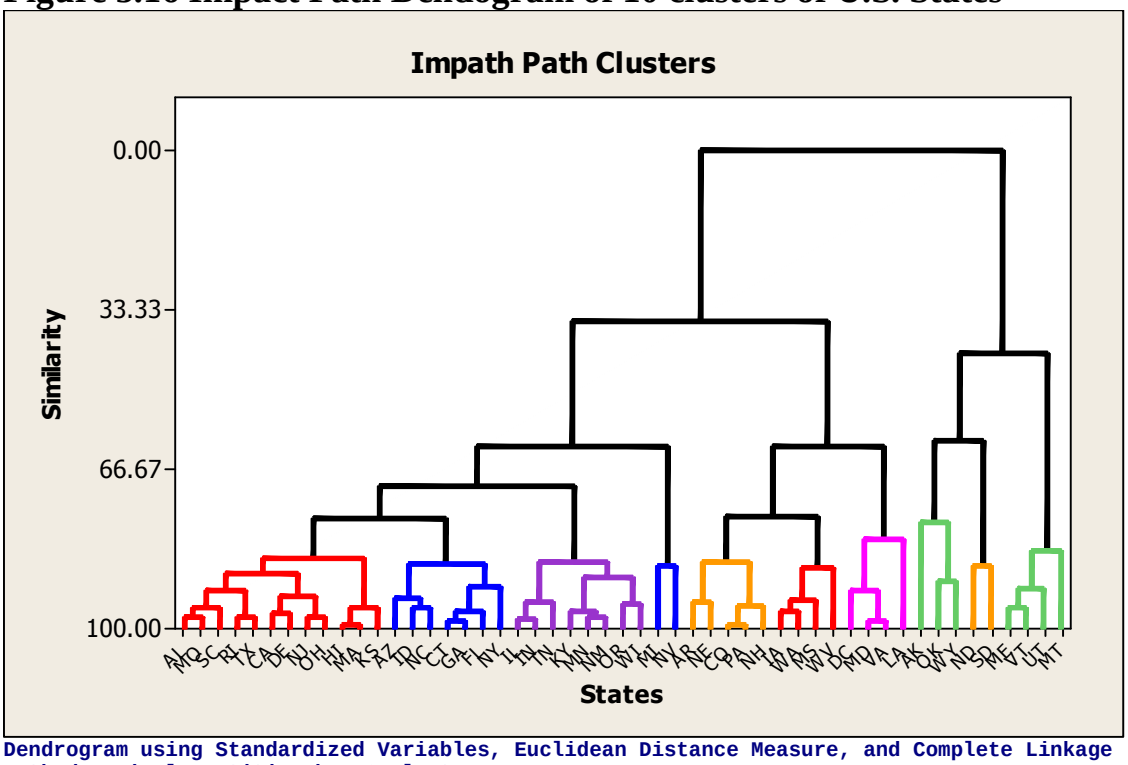
Figure 5.15 Percentage change in real GDP in 2009 versus Relative Output Weight



Standard deviation of Relative_Output_Weight = 0.256208
Sum of Relative_Output_Weight = 18.6429
Standard deviation of %ChangeRealGDP_2009 = 2.47148

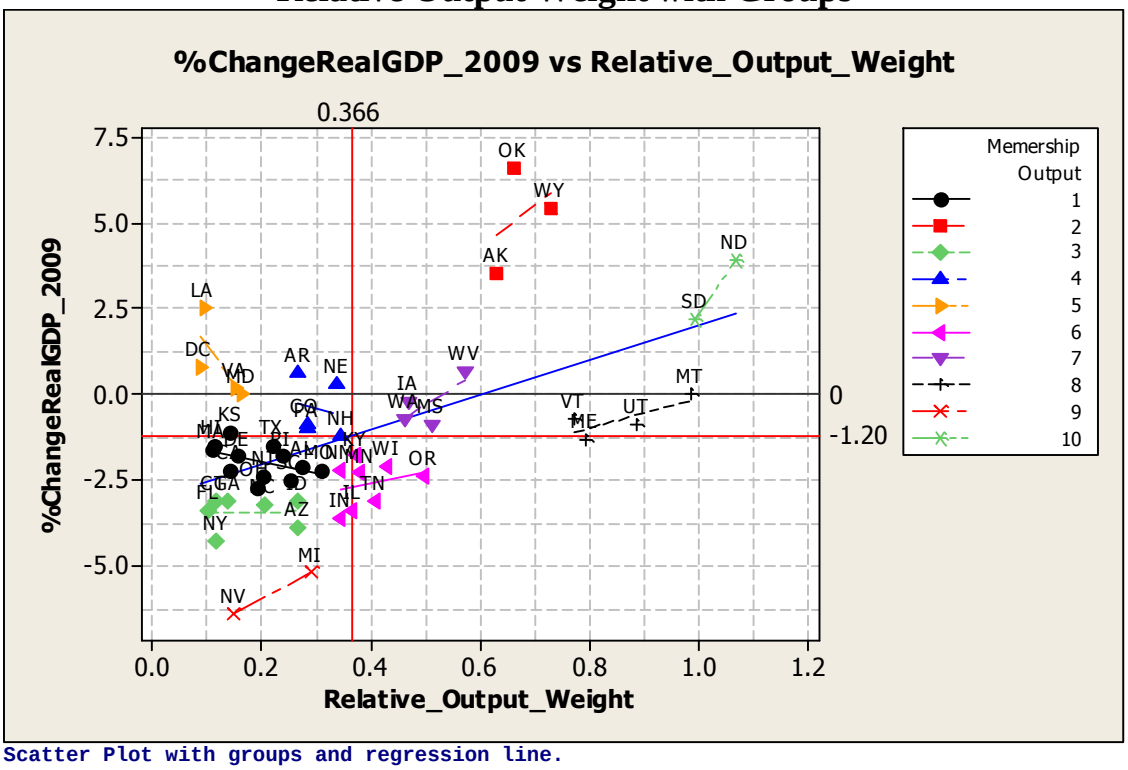
Figure 5.16 shows the hierarchy tree diagram with 10 clusters as the final partition, about 77% of similarity. Check MINITAB OUTPUT 5.3 in the addendum for details. The statists of the clusters are shown next, and the scatter plot with groups and regression lines are shown Figure 5.17. Looking at the plot closely and the statistics for each cluster, we observed that the clusters that have larger relative output weight than average had a positive change in GDP. However those states were in expansion in 2008. Those states are the members of Clusters 2, 10, 8, and 7. The states with relative output weight less than average are the members of Clusters 5, 4, 3, 9, and 1. The only cluster with a

Figure 5.16 Impact Path Dendogram of 10 clusters of U.S. States



Dendrogram using Standardized Variables, Euclidean Distance Measure, and Complete Linkage Method. Final partition by 10 clusters.

Figure 5.17 Percentage change in real GDP in 2009 versus Relative Output Weight with Groups



Scatter Plot with groups and regression line.

positive change in real GDP in that list is Cluster 9. The states in Cluster 3 had a relative output weight around average. Notice that seven clusters had on average negative change in real GDP, only the states in Clusters 2, 10, and 5 had a positive increase in real GDP in 2009.

There were some other factors that impacted in a positive way the economies of Louisiana (LA), and District of Columbia (DC), since they experienced an increase in real GDP yet they had a low relative output weight. The funds apparently gave states that were not affected by the recession like Oklahoma (OK), Wyoming (WY), South Dakota (SD), and North Dakota (ND) a little boost to their economies, but in general most of the states had a negative change in real GDP in 2009, check Figure 5.18. The Figure also shows that most of the states had a positive change in real GDP in 2008. The recession was drive mainly by few states but with large GDP as Figure 5.8 showed. That changed in 2009 were most states had contractions. So far we can say that the funds are not doing enough, or not fast enough to keep up with the decline of the economy.

Clusters 1, 3, and 9 are composed of states with very little relative output weight, and most of them were in recession and may still under it. Those states lost the most percentage points in real GDP in 2009. They also lost the most percentage points in construction in 2009 see Figure 5.19.

Clusters Members and Statistics

Cluster 1

Members (12):

'AL' 'CA' 'DE' 'HI' 'KS' 'MA' 'MO' 'NJ' 'OH' 'RI' 'SC' 'TX'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	0.19 (7)	0.06 (9)	0.11 'MA'	0.31 'MO'
PercentageChangeRealGDP2009	-1.95 (8)	0.48 (4)	-2.70 'OH'	-1.10 'KS'

Cluster 2

Members (3):

'AK' 'OK' 'WY'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	0.67 (3)	0.05 (7)	0.63 'AK'	0.73 'WY'
PercentageChangeRealGDP2009	5.17 (1)	1.56 (1)	3.50 'AK'	6.60 'OK'

Cluster 3

Members (7):

'AZ' 'CT' 'FL' 'GA' 'ID' 'NY' 'NC'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	0.17 (9)	0.07 (3)	0.10 'FL'	0.27 'ID'
PercentageChangeRealGDP2009	-3.44 (9)	0.48 (10)	-4.30 'NY'	-3.10 'CT'

Cluster 4

Members (5):

'AR' 'CO' 'NE' 'NH' 'PA'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	0.30 (6)	0.04 (10)	0.27 'AR'	0.34 'NH'
PercentageChangeRealGDP2009	-0.44 (5)	0.83 (5)	-1.20 'NH'	0.60 'AR'

Cluster 5

Members (4):

'DC' 'LA' 'MD' 'VA'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	0.12 (10)	0.04 (9)	0.09 'DC'	0.16 'MD'
PercentageChangeRealGDP2009	0.88 (3)	1.14 (3)	0.00 'MD'	2.50 'LA'

Cluster 6

Members (8):

'IL' 'IN' 'KY' 'MN' 'NM' 'OR' 'TN' 'WI'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	0.39 (5)	0.05 (6)	0.34 'IN'	0.50 'OR'
PercentageChangeRealGDP2009	-2.61 (8)	0.66 (7)	-3.60 'IN'	-1.80 'KY'

Cluster 7

Members (4):

'IA' 'MS' 'WA' 'WV'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	0.50 (4)	0.05 (8)	0.46 'WA'	0.57 'MS'
PercentageChangeRealGDP2009	-0.28 (4)	0.71 (6)	-0.90 'WV'	0.70 'WV'

Cluster 8

Members (4):

'ME' 'MT' 'UT' 'VT'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	0.86 (2)	0.10 (2)	0.77 'VT'	0.98 'ME'
PercentageChangeRealGDP2009	-0.73 (6)	0.54 (8)	-1.30 'MT'	0.00 'MT'

Cluster 9

Members (2):

'MI' 'NV'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	0.22 (7)	0.10 (1)	0.15 'NV'	0.29 'MI'
PercentageChangeRealGDP2009	-5.80 (10)	0.85 (4)	-6.40 'NV'	-5.20 'MI'

Cluster 10

Members (2):

'ND' 'SD'

Stats:

Variable	Mean (Rank)	Standard deviation (Rank)	Min	Max
Relative_Output_Weight	1.03 (1)	0.05 (5)	0.99 'SD'	1.07 'ND'
PercentageChangeRealGDP2009	3.05 (2)	1.20 (2)	2.20 'SD'	3.90 'ND'

Figure 5.18 Percentage Change in real GDP in 2009 versus Percentage Change in real GDP in 2008

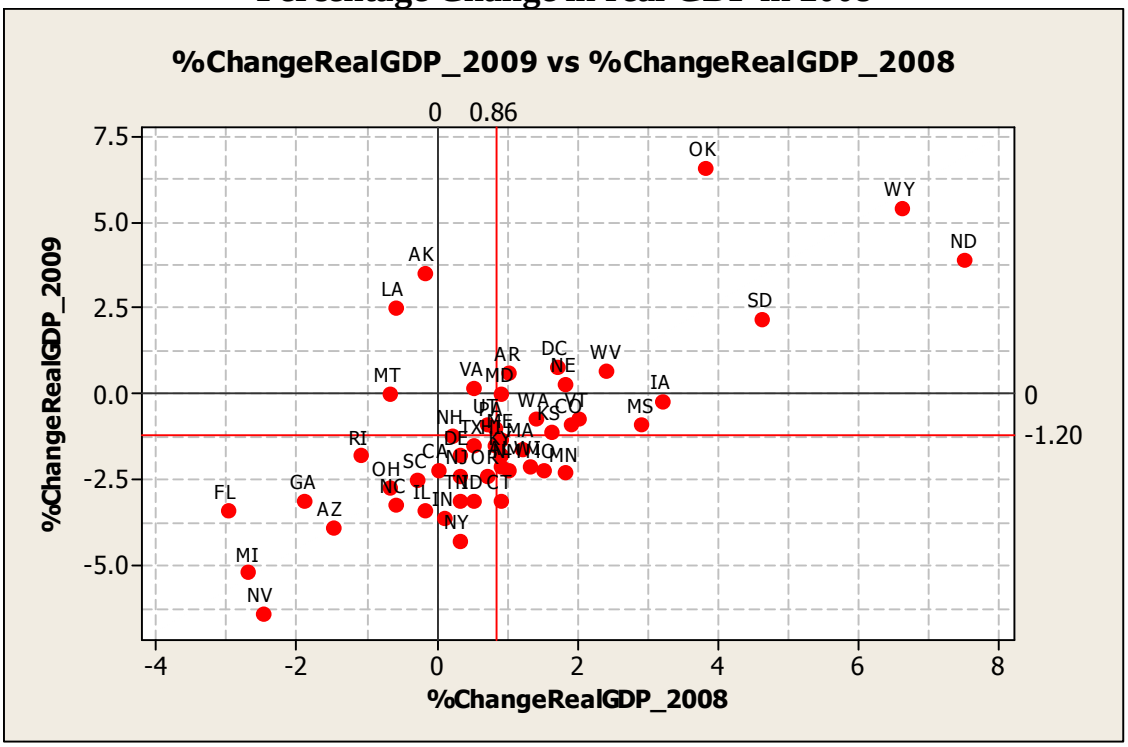
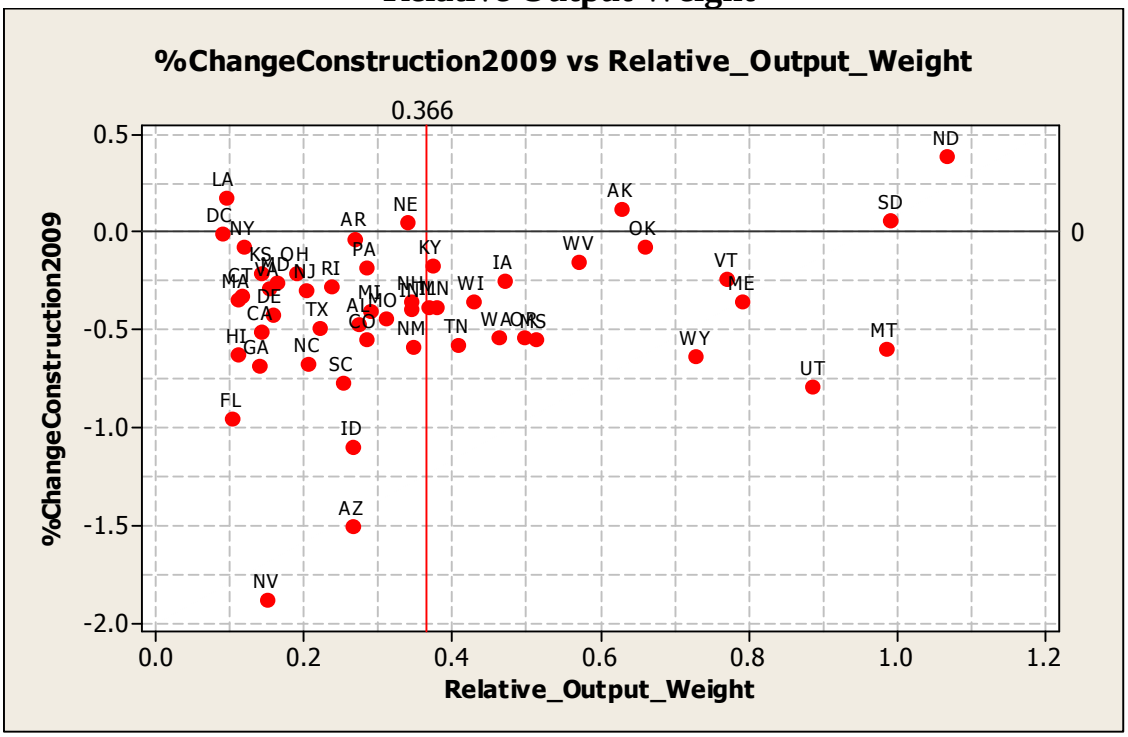


Figure 5.19 Change in Percentage Points in Construction in 2009 versus Relative Output Weight



5.9 Statistical Models for the Problem

Now to complete the investigation let us measure how much of the change in the state's GDP in 2009 the construction industry in general explains. For that end we will use regression analysis. Let the percentage change in construction in 2009 be the independent variable, and the percentage change in real GDP in 2009 be the dependent variable. The complete output is in the Addendum, but we have the most relevant part below. For little more details in regression analysis and linear models check Appendix 3. For simplicity the change in percentage points in construction in 2009 is referred as just Construction.

MINITAB OUTPUT 5.4

Regression Analysis: ChangeRealGDP2009 versus Construction

```
The regression equation is
ChangeRealGDP2009 = 0.338 + 3.72 Construction


Predictor       Coef  SE Coef     T      P
Constant      0.3384   0.4184  0.81  0.423
Construction  3.7226   0.7437  5.01  0.000

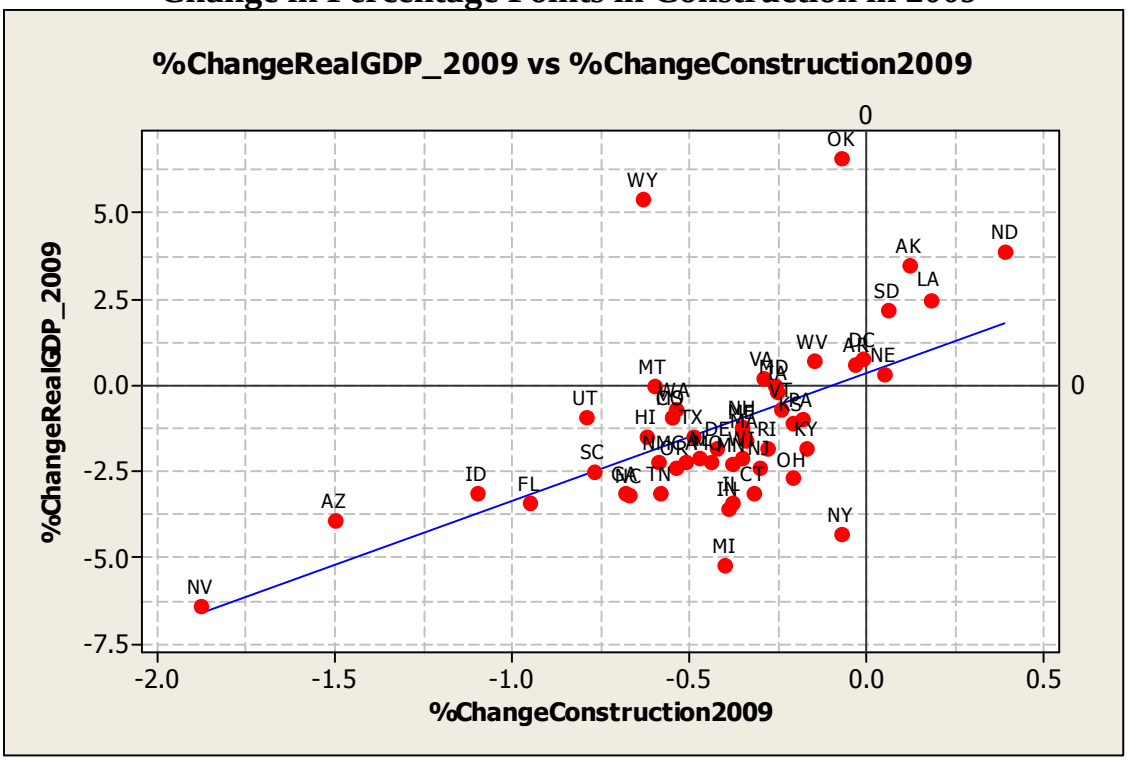

S = 2.03079   R-Sq = 33.8%   R-Sq(adj) = 32.5%
```

The regression line explains 33.8% of the change in GDP. This information is giving by the R-sq. However, this model is not completely credible since we have a problem of **heteroscedasticity**. The residual plot in the Addendum shows the problem. This is when the variance of the errors is not constant, and violates an assumption of the model. Although Figure 5.20 shows a positive linear relationship of the variables, we need to fix this problem, or else we are implying that some observation contains more information than others [13 pp. 328]. Also the coefficient of the predictor or dependent variable could be overestimate or underestimate [14 pp. 383].

We might have this problem because we are excluding all the others components of GDP causing bias in the variance [14 pp. 429]. Let us then performed regression analysis with all other components of GDP as independent variables. Minitab Output 5.5 has the

results. The variables are Construction, Durable-goods manufacturing, Nondurable-goods manufacturing, Wholesale Trade, Retail Trade, Transportation and warehousing, Information, Finance and insurance, 'Agriculture, forestry, fishing, and hunting', Mining, Utilities, 'Real estate, rental, and leasing', 'Professional and technical services', Management of companies, 'Administrative and waste services', Educational services, Health care and social assistance, 'Arts, entertainment, and recreation', Accommodation and food services, Other services, and Government. **They represent the change in percentage points of GDP in 2009 for that sector.**

Figure 5.20 Percentage Change in real GDP in 2009 versus Change in Percentage Points in Construction in 2009



MINITAB OUTPUT 5.5

Regression Analysis: ChangeRealGD versus Construction, Durable-good, ...

```
The regression equation is
ChangeRealGDP2009 = 0.0622 + 0.997 Construction
                    + 1.01 Durable-goods manufacturing
                    + 0.968 Nondurable-goods manufacturing
                    + 1.09 Wholesale Trade + 0.985 Retail Trade
                    + 0.969 Transportation and warehousing + 0.949 Information
                    + 1.02 Finance and insurance
```

```
                    + 0.946 Agriculture, forestry, fishing, + 0.999 Mining
                    + 1.08 Utilities + 0.990 Real estate, rental, and leasin
                    + 0.989 Professional and technical serv
                    + 1.00 Management of companies
                    + 1.01 Administrative and waste servic
                    + 1.11 Educational services
                    + 0.903 Health care and social assistan
                    + 0.798 Arts, entertainment, and recrea
                    + 1.07 Accommodation and food services
                    + 1.46 Other services
                    + 0.998 Government

49 cases used, 2 cases contain missing values

Predictor                          Coef   SE Coef       T      P  VIF
Constant                        0.06222   0.04398    1.41  0.169
Construction                    0.99719   0.04285   23.27  0.000  9.6
Durable-goods manufacturing     1.01123   0.01851   54.63  0.000  3.0
Nondurable-goods manufacturing  0.96807   0.03117   31.05  0.000  4.7
Wholesale Trade                 1.09043   0.07467   14.60  0.000  3.9
Retail Trade                     0.9847    0.1279    7.70  0.000  9.3
Transportation and warehousing  0.96861   0.05441   17.80  0.000  2.0
Information                     0.94878   0.03924   24.18  0.000  1.4
Finance and insurance           1.01950   0.01527   66.75  0.000  2.0
Agriculture, forestry, fishing, 0.94554   0.03920   24.12  0.000  2.7
Mining                         0.998878  0.006145  162.55  0.000  2.4
Utilities                        1.0808    0.1133    9.54  0.000  2.5
Real estate, rental, and leasin 0.98986   0.03557   27.83  0.000  3.9
Professional and technical serv 0.98946   0.04285   23.09  0.000  2.4
Management of companies         1.00097   0.03421   29.26  0.000  1.5
Administrative and waste servic  1.0089    0.1177    8.57  0.000  3.9
Educational services             1.1137    0.3607    3.09  0.005  1.7
Health care and social assistan  0.9025    0.1284    7.03  0.000  2.9
Arts, entertainment, and recrea  0.7984    0.2223    3.59  0.001  3.6
Accommodation and food services 1.06642   0.05695   18.73  0.000  3.7
Other services                   1.4591    0.3397    4.29  0.000  4.6
Government                      0.99847   0.02847   35.07  0.000  2.3

S = 0.0376652   R-Sq = 100.0%   R-Sq(adj) = 100.0%
```

Of course now we have an R-Sq of 100%, makes sense since we used all the components, however the heterocedasticity problem has not yet been solved, although improved, check the residual plot in the Addendum. It also makes sense to assume that some variables might be correlated with others since in the economy some sectors depend on others, causing a problem of **multicollinearity** for our model.

To check the existence of multicollinearity in the model, we included the **variance inflation factor** (VIF), in the output. Large numbers of VIF suggests a near-singularity with other independent variables, Marquardt [35] guideline for serious multicollinearity

is VIF > 10. We see relative large numbers of VIF in the output, for construction 9.6, and for retail trade 9.3. Apparently these two variables have some correlation with others. The VIF is a simple diagnostic for detecting overall multicollinearity problems that do not involved the intercept. They will not detect multiple near-singularities, nor identify the source of the singularity [14 pp. 373]. .

Let us then find the best subsets of variables using the Best Subsets Algorithm in Minitab (check Minitab Output 5.6 in the Addendum for details). The best subsets algorithm identifies the best-fitting regression models that can be constructed from one predictor to *p* predictors. The output shows the two best models for each number of predictors. For one predictor the two best models are with Mining and Retail Trade with an R^2 of 45.5% and 36.1% respectively. The point where the R^2 becomes the same for the two best models is at 7 variables. This is a good to point to cut the number of predictor variables.

Let us then perform regression analysis with the variables of these models. The first model has as predictors Construction, Durable-goods manufacturing, Wholesale Trade, Finance and Insurance, Mining, Health care and social assistance, and Government. The second model has as predictors Construction, Durable-goods manufacturing, Wholesale Trade, Finance and Insurance, Mining, 'Real estate, rental, and leasing', and Government. Those are Minitab Outputs 5.7, and 5.8 respectively. In both models the variance is not constant, and in the model of the Output 5.8 the VIF for construction is 2.6. This number can be reduced if we detect and eliminate the variables that are the most correlated with construction.

To identify which variables are correlated, we preformed a correlation analysis, check Minitab Output 5.9 in the Addendum. The goods correlations, that is, the variables that are correlated with the dependent variable are marked in gray, and the bad ones in red. The variables with significant correlation with the change in the real GDP in 2009 are: Construction, Nondurable-goods, Wholesale Trade, Retail Trade, Finance and Insurance, Mining, Professional and technical services, 'Administrative and waste services, Accommodation and food services, Other services, and Government. Among these

variables Construction, Wholesale Trade, Retail Trade, Administrative and waste services, and Other services are correlated. So let us eliminate Administrative and waste services, and Other services, for their correlation with all the others. Also let us eliminate Retail Trade because is correlated with Wholesale Trade, and Accommodation and food services because is correlated with Construction.

Our new model contains the variables Construction, Nondurable-goods manufacturing, Wholesale Trade, Finance and Insurance, Mining, Professional and technical services, and Government. The regression analysis in Minitab Output 5.8 shows the p-values for the coefficients of the variables, having p-values less that .01 strongly suggest that the coefficients are distinct of zero and therefore they have an impact on the dependent variable. If we take a look at the residual plot we see that the pattern has dispersed, and the VIF in the output are small, we have finally fixed the model from the problems of multicollinearity and heterocedasticity. To help with the discussion and to rank the variables from the one that explains the most variability of the dependent variable to the least we performed stepwise forward selection regression. For more information on Stepwise Regression see Appendix 3. The results are in Minitab Output 5.9 in the Addendum.

MINITAB OUTPUT 5.8

Regression Analysis: ChangeRealGD versus Construction, Nondurable-g, ...

```
The regression equation is
ChangeRealGDP2009 = - 0.816 + 1.84 Construction
                    + 1.35 Nondurable-goods manufacturing
                    + 3.76 Wholesale Trade
                    + 0.911 Finance and insurance + 0.928 Mining
                    + 1.98 Professional and technical serv + 1.76 Government


49 cases used, 2 cases contain missing values

Predictor                          Coef  SE Coef       T      P  VIF
Constant                        -0.8157   0.2123   -3.84  0.000
Construction                     1.8353   0.2730    6.72  0.000  1.5
Nondurable-goods manufacturing   1.3505   0.2576    5.24  0.000  1.2
Wholesale Trade                  3.7598   0.8231    4.57  0.000  1.8
Finance and insurance            0.9112   0.1910    4.77  0.000  1.2
Mining                          0.92769  0.07027   13.20  0.000  1.2
Professional and technical serv  1.9811   0.5377    3.68  0.001  1.4
Government                       1.7574   0.3464    5.07  0.000  1.3
```

```
S = 0.612584   R-Sq = 95.0%   R-Sq(adj) = 94.1%
```

The change in Mining was the first variable to enter the model it is the sector that explains the variability of the change in real GDP in 2009 the most, with an R-Sq of 40.46% alone. The same conclusion can be drawn by looking at the T value 13.20 which is relatively large. And it is also the variable that has the biggest correlation with the dependent variable, 0.63 of correlation. Wholesale trade comes next improving the R-Sq to 74.25%, then Government taking it to 81.81%, and then Construction raising it to 86.02%. The fact that Mining was the variable with the most correlation with the change in GDP in 2009 does not mean that it had the biggest impact. Those are still manufacturing, wholesale trade, retail trade, construction, finance and insurance, and government.

Although construction is not the variable with the highest correlation with the change in real GDP in 2009, it was sector that had the biggest drop in the United States −0.44%, not a good sign in for an economy on a supposedly recovery phase. However, it did have impact to some states in particular. If we now look at the unusual observations, some of the **outliers** in the output can be related to the ARRA funds for construction projects. For example Alaska [AK (obs. 2)] was one of the states receiving more ARRA infrastructure funds per capita, the construction sector in that state experienced an increase of 0.12%, and 3.5% in real GDP in 2009, while Nevada [NV (obs. 29)] received much less ARRA infrastructure funds per capita than others, and experienced a decline of −1.88% points in the construction sector, and −6.4% in real GDP in 2009. The others outliers are District of Columbia [DC (obs. 9)], New York [NY (obs. 33)], and Oklahoma [OK (obs. 37)].

The possible reason for why the District of Columbia is an outlier might have been because Government rose 1.70%, relatively large from the others see Scatter Plot A.6 in the Addendum. The reason for New York might had been an outlier is because of the lost of −2.78% points in the Financial Sector see Scatter Plot A.2 in the Addendum. And for Oklahoma, which has a history of being out of sync with the nation's economy as a whole, could have been because of the increase of 7.23% points in the Mining sector.

The model shows that the ARRA funds for infrastructure did not have a big impact to the states GDP in 2009, around 14% of all the stimulus money is for infrastructure. If more money were expended in infrastructure or distributed more effectively, surely the ARRA stimulus money would it have a noticeable positive effect on the economy.

The prices of minerals, precious metals, oil, gas, and other commodities increased in 2009, and they are still increasing today. To help, we have in Table 5.4 the prices of some precious metals in 2009 from Kitco's historical charts. The change and percentage change are computed below. Gold went up 25.04% in USD, Silver experienced a 57.46% increase in value, and Platinum and Palladium had an increase of 62.69% and 114.75% respectively.

Table 5.3 2009 Precious Metals Performance

2009 Precious Metals Performance

	Gold	Silver	Platinum	Palladium
Last 2008 Price	869.75	10.79	898.00	183.00
Last 2009 Price	1,087.50	16.99	1,461.00	393.00
Change	217.75	6.20	563.00	210.00
Percentage Change	25.04%	57.46%	62.69%	114.75%

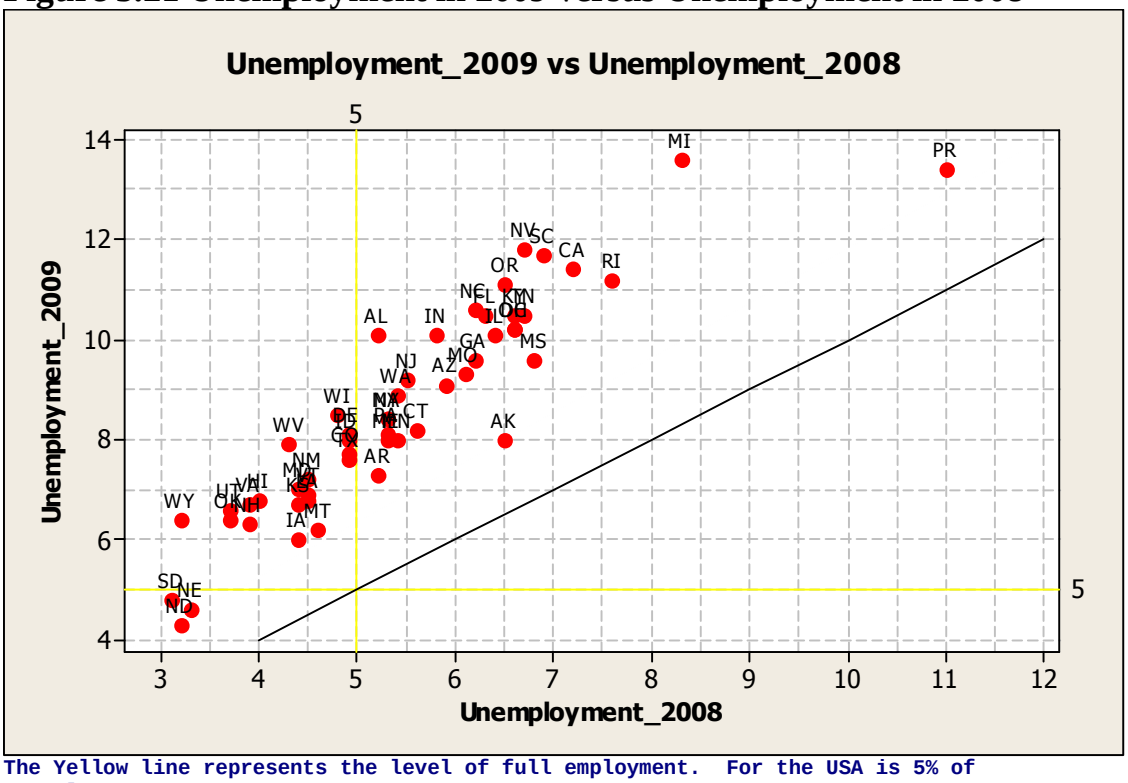
Source: www.kitco.com

Maybe the massive input of money in to the economy combine with the failure to reduce unemployment and to increase output, are causing devaluation of the currency or confidence in dollar to decline or both as it was explained in section 2.7. These brings inflation causing precious metals and commodities (oil, gas, gold...) to appear to go up value. This is the adverse effect of any kind of stimulus.

On other economic indicator, the unemployment had an increase of 3.5% in the United States in 2009. The rate of unemployment in the U.S. was 9.3% in 2009. In fact unemployment rose in every state as Figure 5.21 shows. States like North Dakota (ND), South Dakota (SD), Nebraska (NE), Wyoming (WY), Oklahoma (OK), Utah (UT), Virginia (VA), Iowa (IA), and Montana (MT) had the lowest increase in unemployment

in 2009, coincidently they also received more ARRA infrastructure funds per capita than the others states.

Figure 5.21 Unemployment in 2009 versus Unemployment in 2008



The Yellow line represents the level of full employment. For the USA is 5% of unemployment [#].

Although those states were not in recession in 2008, it appears that the used of the funds prevented a big jump in unemployment for them. This is not the case for the states that received the less ARRA Infrastructure funds per capita. They had a big increase in unemployment and a decline in output. This is showed by Figures 5.22 and 5.23.

Figure 5.22 Unemployment in 2009 versus ARRA Infrastructure Expenditure per capita from Q3 2009 to Q1 2010

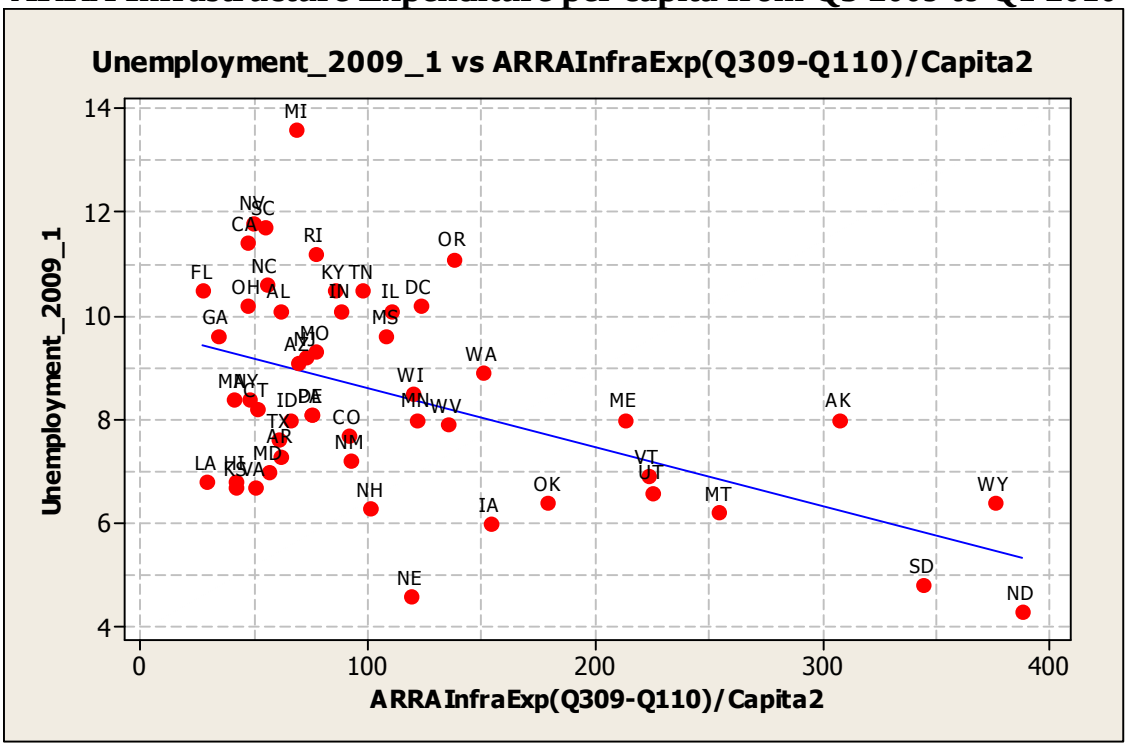
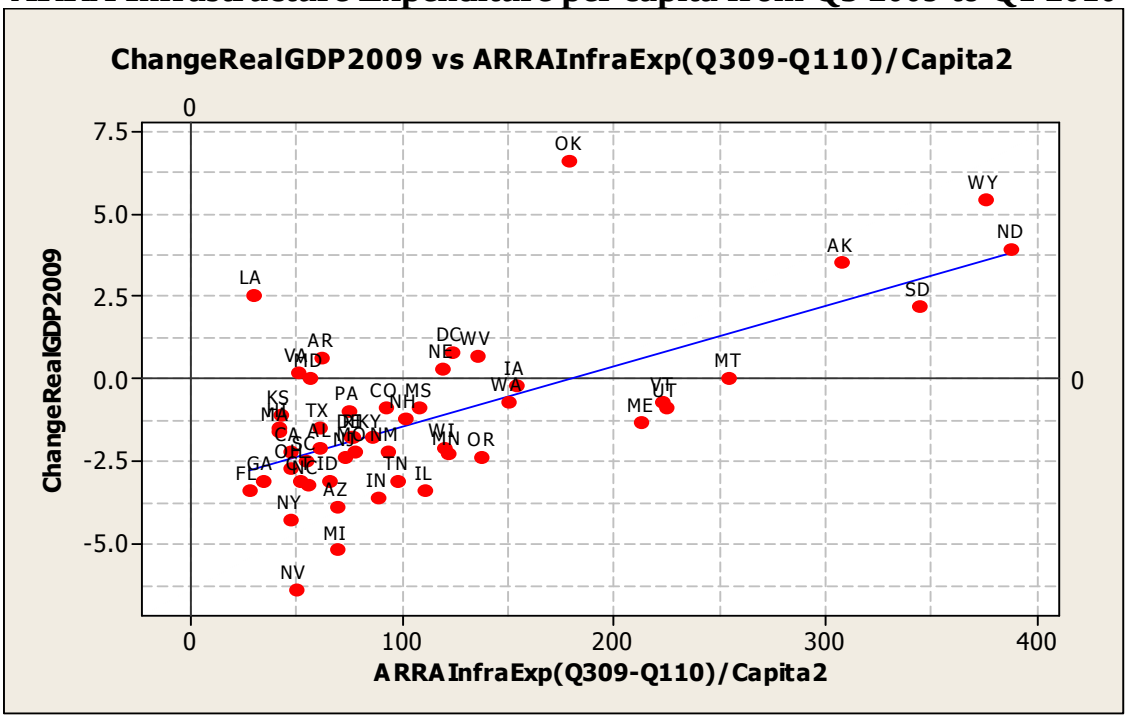


Figure 5.23 Percentage change in real GDP in 2009 versus ARRA Infrastructure Expenditure per capita from Q3 2009 to Q1 2010



6 Results

6 Results

The most notable and the most constant result through out the study was that when the ARRA funds expended for construction projects from the third quarter of 2009 to the first quarter of 2010 were weighted by the population of the state, the states receiving more funds per capita were states that were not in recession, in fact they were expanding. Coincidentally these states are not big in population therefore their contribution to the national GDP is not of great significance. Big states in population contribute the most national GDP, those are California, Texas, New York, Florida, Illinois, Pennsylvania, North Carolina, Virginia, New Jersey , Georgia, and Ohio, they carried 60% of the US economy from 2002 to 2007 [12]. The states that were the most affected by the recession received the fewer funds per capita for construction projects, less than the average $113.20 per capita. The funds per capita ranged from $387.5 North Dakota to $20.3 Puerto Rico, and for the states of the union from $387.5 North Dakota to $27.3 Florida.

The funds did not do much since most states had a decline on both the construction sector and in GDP in 2009. The states that experienced expansion in the construction sector in 2009 were Nebraska, South Dakota, Alaska, Louisiana, and North Dakota. The states with the biggest dropped in the construction sector were Nevada, Arizona, Idaho, and Florida. The states that received the most ARRA infrastructure funds per capita were North Dakota, Wyoming, South Dakota, Alaska, Utah, Vermont, Maine, Oklahoma, and Iowa. The states that received fewer funds per capita were Puerto Rico, Florida, Louisiana, Georgia, Virgin Islands, Massachusetts, Hawaii, Kansas, California, Ohio, New York, and Nevada.

In the United States the average GDP per capita in 2008 was $48,114 and $47,402 in 2009. The GDP per capita in 2008 ranged form $162,534 District of Colombia to $23,495 Puerto Rico and for the states of the union from $72,383 Wyoming to $32,760 Mississippi. In 2009 it ranged from $165,310 District of Colombia to $24,124 Puerto Rico, and for the states of the union from $68, 980 Wyoming to $32,488 Mississippi.

The average personal income per capita in the United States in 2008 was $39,117 and $38,302 in 2009. The personal income per capita in 2008 ranged from $66,316 District of Colombia to $14,080 Puerto Rico and for the states of the union from $56,245 Connecticut to $30,383 Mississippi. In 2009 it ranged from $66,000 District of Colombia to $14,905 Puerto Rico and for the states of the union from $54,397 Connecticut to $30,103 Mississippi.

The states with the biggest unemployment rates in 2008 were Puerto Rico with 11%, Michigan with 8.3%, Rhode Island with 7.6%, and California with 7.2%. The lowest unemployment rates in 2008 belonged to North Dakota with 3.2%, Wyoming with 3.2%, Nebraska with 3.3%, Oklahoma with 3.7%, Utah with 3.7%, and New Hampshire with 3.9%. From 2008 to 2009 the unemployment rate rose from 5.8% to 9.3% in the United States for a 3.5% of increase. The biggest increases of unemployment in 2009 were by Michigan 5.3%, Nevada 5.1%, Alabama 4.9% (10.1% in 2009), and South Carolina 4.8%. The biggest unemployment rates in 2009 were by Michigan 13.6%, Puerto Rico 13.4%, Nevada 11.8%, South Carolina 11.7%, California 11.4%, Rhode Island 11.2%, and Oregon 11.1%. The lowest unemployment rates in 2009 were by North Dakota 4.3%, Nebraska 4.6%, and South Dakota 4.8%.

The states with good similar economic performances in 2008 were the states in Cluster 2 Alaska and Delaware, also the ones in Cluster 5 Connecticut, Massachusetts, New Jersey, and New York. The members of Cluster 3 have the most concordance with the US economy as a whole, this was concluded by [8] and [7], and we also found the similarities by comparing the GDP per capita and personal income per capita of this cluster with the United States as whole. Cluster 3 had $44,098 GDP per Capita on average in 2008, the GDP per capita in United States in 2008 was $48,114, the personal income per capita in the United States in 2008 was $39,117, and it was $37,698 for Cluster 3, very similar. The worst performance was by Puerto Rico Cluster 10, fallowed by those in Cluster 7 Kentucky, Michigan, Mississippi, and South Carolina.

There are nine others states that share common characteristics with Puerto Rico in the matter of population and state size. Those are the members of Cluster 5 in the Geo-Clusters Connecticut, Delaware, District of Columbia, Hawaii, Maine, New Hampshire, Rhode Island, Vermont, and West Virginia. These states have far better economic performances than Puerto Rico in 2008.

The states where the ARRA infrastructure funds were felt the most were the states in Clusters 10 North Dakota and South Dakota, then those in Clusters 2 Alaska, Oklahoma, and Wyoming, and then the states in Cluster 7 Iowa, Mississippi, Washington, and West Virginia. Although the states in Cluster 8 Maine, Montana, Utah, and Vermont received relatively large amount of funds per capita, their economies decreased by −0.73% on average. Very contrary to the states in Cluster 5 District of Columbia, Louisiana, Maryland, and Virginia, that despite having received fewer funds per capita, the construction sector grew, and the GDP grew by 0.88% on average in 2009.

The change in real GDP in 2009 and the relative output weight are correlated by 0.52, and a higher correlation of 0.66 is found between the change in real GDP in 2009 and the ARRA infrastructure expenditure per capita, but there was an even higher correlation of 0.67 between the ARRA infrastructure expenditure per capita and the change in real GDP in 2008. The sum of *relative output weight* is 18.6%. This is the total percentage of output per capita due to the ARRA Infrastructure Funds in 2009.

The percentage change in construction sector was 0.58 correlated with the change in real GDP in 2009. The only two sectors that were more correlated with the change in real GDP in 2009 were the change in retail trade with 0.59 and the change in mining with 0.63. Let us not confuse the correlation with the actual impact or effect that the variables have to real GDP. For that end is that we constructed a statistical model. The regression coefficient of the change in construction is 1.84 in the regression equation, it is the third largest coefficient. The change in wholesale trade has the largest regression coefficient 3.76, and then the change in professional and technical services 1.98.

The regression coefficient in theory signifies that for 1% of change in percentage points of any variable in question the percentage change in real GDP will increase by the magnitude of the regression coefficient of that variable, if all the other variables are held constant. So the change in percentage points of the construction sector and the percentage change in real GDP for the U.S. states in 2009 were linked by a factor of 1.84. The construction industry in the United States fell −0.44 points in 2009 and real GDP decline −2.1%, if we take the U.S. as a state and apply our model to it, we find that the dropped of −0.44 points in the construction sector caused real GDP to decline 1.84*(−0.44) = −0.81% in 2009.

7 Conclusions

7 Conclusions

This study was devoted to examine how the distribution of the funds of the American Recovery and Reinvestment Act (ARRA) of 2009 destined to infrastructure projects impacted the 50 U.S. states and District of Columbia. The hypothesis was that ARRA expenditures, which main purpose is to enhance the U.S. economy, might not have the same effect in each state, because the states economies are not alike, so the construction multipliers differs among states. If the ARRA funds are invested in states whose contributions to the U.S. economy are relatively small, then the former will not be driven out of the 2007 recession. In order to test that hypothesis two main statistical techniques were used, Cluster Analysis and Regression Analysis.

The study found a significant positive correlation between the relative output weight and the change in real GDP per capital in 2009. Nevertheless, the study highlights the following:

1. The distribution of the ARRAIF impacted states under good economic conditions and small populations. In fact the ARRAIF per capita were found to be more correlated with the change in real GDP in 2008 than in 2009. However, these states were not the main contributors to the national economy. States like North Dakota, South Dakota, Nebraska, Alaska, and Montana, that received the most funds per capita had the lowest increase in unemployment in 2009.

2. States with large populations received lower amounts of ARRAIF per capita. These states are main contributors to the U.S. economy as a whole. With the exception of Louisiana states like Nevada, California, Oregon, South Carolina and Florida that received the fewer funds per capita, had the biggest increase in unemployment in 2009. Also exceptional was Puerto Rico that has a relative small population and received the lowest ARRAIF per capita with only $20.30 per person.

The stepwise was used to determine the hierarchical correlation of the predictors with the dependent variable. It was the change in percentage points in mining that has the highest correlation with the change in real GDP in 2009, then wholesale trade, then government, then construction, then finance and insurance, then Nondurable-goods, and then professional and technical services. The states that experienced a large increase in the mining sector experienced a large increased in GDP as well. Again not to get confuse with contribution not every state has a mining sector. Also the coefficient of mining in the regression equation was 0.928 the second lowest. The change in professional and technical services was second in the magnitude of the regression coefficient but last in correlation.

These results found in the regression equation are similar with the result that The Council of Economic Adviser reported in January 2010 in The Economic Impact of the American Recovery and Reinvestment Act of 2009 [2]. They found that the biggest drop in job loss from the first to the fourth quarter of 2009 came form the manufacturing sector, and from professional and business services, and that construction was a close third. The model constructed in this study have as variables among four others, the change in percentage points in professional and technical services, the change in percentage points in construction, and the change in percentage points in nondurable-goods manufacturing. The regression equation coefficients of these variables are 1.98, 1.84, and 1.35 respectively.

The study also brings up a new angle of economic comparison of Puerto Rico with the United States. The angle is not to compare Puerto Rico with the United States as a whole, which is the usual way, but rather to compare Puerto Rico with states that have almost the same size and population. Those states are Connecticut, Delaware, Hawaii, Maine, New Hampshire, Rhode Island, Vermont, and West Virginia. Another view of comparison is to compare Puerto Rico with states that have almost the same Personal Income per capita. In this perspective Puerto Rico is its own cluster only $14,080 of Personal Income per capita in 2008. The nearest state was Mississippi with $30,383.

There were differences in the effects of the ARRAIF by states. This shows distinction in the dynamics of the states economic cycles. I would recommend having different stimulus packages that takes into account the differences in the states economic cycles and populations. That way priority can be put to states that are big contributors to national GDP. They need to invest more than $113 per capita in infrastructure projects to slow down the unemployment rates, not even taking about recovery, since the economy is loosing jobs fast in other sectors as well.

In addition I also recommend the use of Cluster Analysis for the design and distribution of future stimulus packages with other variables that the researchers considerer of interest. We demonstrated here that Cluster Analysis can be a useful tool to study, classify, and design economies.

ADDENDUM

MINITAB OUTPUT 5.1

Cluster Analysis of Observations: Size(land&water)miles^2, Population(2008)

Standardized Variables, Euclidean Distance, Complete Linkage
Amalgamation Steps

Step	Number of clusters	Similarity level	Distance level	Clusters joined		New cluster	Number of obs. in new cluster
1	51	99.7700	0.01723	12	30	12	2
2	50	99.6207	0.02840	8	40	8	2
3	49	99.6099	0.02922	17	45	17	2
4	48	99.5393	0.03450	1	19	1	2
5	47	99.5015	0.03733	4	16	4	2
6	46	99.1518	0.06353	15	43	15	2
7	45	99.1189	0.06599	26	50	26	2
8	44	99.0928	0.06794	7	52	7	2
9	43	99.0512	0.07106	35	42	35	2
10	42	99.0473	0.07135	8	9	8	3
11	41	98.9974	0.07509	13	28	13	2
12	40	98.9062	0.08192	4	25	4	3
13	39	98.8066	0.08937	11	34	11	2
14	38	98.7580	0.09302	18	41	18	2
15	37	98.5926	0.10541	12	46	12	3
16	36	98.2629	0.13010	14	39	14	2
17	35	98.2049	0.13444	21	22	21	2
18	34	98.1600	0.13780	20	49	20	2
19	33	98.0157	0.14861	29	32	29	2
20	32	97.9511	0.15345	26	48	26	3
21	31	97.9424	0.15409	8	12	8	6
22	30	97.5547	0.18313	6	38	6	2
23	29	97.4790	0.18880	13	35	13	4
24	28	97.3907	0.19541	10	33	10	2
25	27	97.2212	0.20811	17	37	17	3
26	26	97.1472	0.21365	1	18	1	4
27	25	96.8771	0.23388	15	47	15	3
28	24	96.7955	0.23999	14	36	14	3
29	23	96.6883	0.24802	6	24	6	3
30	22	96.2117	0.28371	13	51	13	5
31	21	95.4710	0.33918	1	4	1	7
32	20	94.8839	0.38315	8	20	8	8
33	19	94.6252	0.40253	15	26	15	6
34	18	94.5920	0.40502	6	17	6	6
35	17	93.9518	0.45296	27	29	27	3
36	16	93.9461	0.45339	21	31	21	3
37	15	93.8560	0.46014	11	23	11	3
38	14	93.2063	0.50880	7	8	7	10
39	13	91.3617	0.64694	3	6	3	7
40	12	91.2858	0.65262	11	14	11	6
41	11	90.0025	0.74873	1	15	1	13
42	10	89.3837	0.79507	13	27	13	8
43	9	87.9367	0.90344	1	3	1	20
44	8	84.2546	1.17920	11	21	11	9
45	7	80.2315	1.48050	1	7	1	30
46	6	79.4367	1.54003	1	13	1	38
47	5	72.8221	2.03540	1	11	1	47
48	4	71.3764	2.14367	5	44	5	2
49	3	61.0971	2.91351	5	10	5	4
50	2	24.2615	5.67219	1	5	1	51
51	1	0.0000	7.48918	1	2	1	52

Final Partition
Number of clusters: 10

	Number of observations	Within cluster sum of squares	Average distance from centroid	Maximum distance from centroid
Cluster1	13	0.855075	0.236351	0.425451
Cluster2	1	0.000000	0.000000	0.000000
Cluster3	7	0.403523	0.221596	0.413545
Cluster4	1	0.000000	0.000000	0.000000
Cluster5	10	0.397438	0.175960	0.352905
Cluster6	2	0.019093	0.097706	0.097706
Cluster7	6	0.464934	0.267743	0.411032
Cluster8	8	0.619986	0.255611	0.510875
Cluster9	3	0.108525	0.171769	0.257538
Cluster10	1	0.000000	0.000000	0.000000

Cluster Centroids

Variable	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5
Size(land&water)miles^2	-0.229841	6.13499	0.191600	0.94208	-0.650893
Population(2008)	-0.136310	-0.78803	-0.255360	4.60840	-0.645786

Variable	Cluster6	Cluster7	Cluster8	Cluster9	Cluster10
Size(land&water)miles^2	-0.13420	-0.137972	0.261455	-0.649719	2.03233
Population(2008)	1.95703	0.759482	-0.687411	0.154231	2.76268

Variable	Grand centroid
Size(land&water)miles^2	-0.0000000
Population(2008)	0.0000000

Distances Between Cluster Centroids

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7
Cluster1	0.00000	6.39811	0.43793	4.88730	0.66095	2.09553	0.90049
Cluster2	6.39811	0.00000	5.96721	7.48918	6.78737	6.84383	6.46102
Cluster3	0.43793	5.96721	0.00000	4.92132	0.92856	2.23625	1.06702
Cluster4	4.88730	7.48918	4.92132	0.00000	5.49036	2.86149	3.99759
Cluster5	0.66095	6.78737	0.92856	5.49036	0.00000	2.65361	1.49595
Cluster6	2.09553	6.84383	2.23625	2.86149	2.65361	0.00000	1.19756
Cluster7	0.90049	6.46102	1.06702	3.99759	1.49595	1.19756	0.00000
Cluster8	0.73830	5.87439	0.43766	5.33937	0.91330	2.67388	1.50101
Cluster9	0.51060	6.84982	0.93573	4.73006	0.80002	1.87506	0.79260
Cluster10	3.67717	5.42580	3.53509	2.14367	4.33790	2.31147	2.95348

	Cluster8	Cluster9	Cluster10
Cluster1	0.73830	0.51060	3.67717
Cluster2	5.87439	6.84982	5.42580
Cluster3	0.43766	0.93573	3.53509
Cluster4	5.33937	4.73006	2.14367
Cluster5	0.91330	0.80002	4.33790
Cluster6	2.67388	1.87506	2.31147
Cluster7	1.50101	0.79260	2.95348
Cluster8	0.00000	1.24040	3.87803
Cluster9	1.24040	0.00000	3.74131
Cluster10	3.87803	3.74131	0.00000

MINITAB OUTPUT 5.2

Cluster Analysis of Observations: Current_GDPp, Personal_Inc, Unemployment

Standardized Variables, Euclidean Distance, Complete Linkage
Amalgamation Steps

Step	Number of clusters	Similarity level	Distance level	Clusters joined		New cluster	Number of obs. in new cluster
1	51	99.5952	0.0426	24	48	24	2
2	50	98.8996	0.1157	28	35	28	2
3	49	98.8716	0.1186	3	15	3	2
4	48	98.7075	0.1359	11	34	11	2
5	47	98.4879	0.1590	22	31	22	2
6	46	98.3248	0.1761	36	43	36	2
7	45	98.1212	0.1975	16	19	16	2
8	44	98.1177	0.1979	28	42	28	3
9	43	98.1009	0.1997	1	4	1	2
10	42	98.0150	0.2087	27	32	27	2
11	41	97.8526	0.2258	18	41	18	2
12	40	97.7767	0.2337	11	26	11	3
13	39	97.7351	0.2381	1	13	1	3
14	38	97.6739	0.2445	17	46	17	2
15	37	97.4357	0.2696	12	47	12	2
16	36	97.1857	0.2959	14	29	14	2
17	35	97.1624	0.2983	44	50	44	2
18	34	96.9107	0.3248	18	25	18	3
19	33	96.9043	0.3255	3	11	3	5
20	32	96.6632	0.3508	6	24	6	3
21	31	96.5705	0.3606	36	38	36	3
22	30	96.5000	0.3680	16	44	16	4
23	29	96.3773	0.3809	22	33	22	3
24	28	96.1890	0.4007	12	30	12	3
25	27	95.5195	0.4710	27	49	27	3
26	26	95.1353	0.5114	37	45	37	2
27	25	95.0257	0.5230	20	39	20	2
28	24	94.7938	0.5473	16	17	16	6
29	23	94.4763	0.5807	5	40	5	2
30	22	94.1089	0.6193	10	36	10	4
31	21	93.4563	0.6880	3	10	3	9
32	20	93.4206	0.6917	1	27	1	6
33	19	92.4526	0.7935	16	20	16	8
34	18	91.9592	0.8454	12	21	12	4
35	17	91.6036	0.8827	5	14	5	4
36	16	89.6927	1.0836	7	22	7	4
37	15	89.5671	1.0968	6	12	6	7
38	14	89.0882	1.1472	28	37	28	5
39	13	88.5637	1.2023	2	8	2	2
40	12	88.1757	1.2431	18	23	18	4
41	11	86.9548	1.3715	1	16	1	14
42	10	84.1740	1.6638	3	5	3	13
43	9	82.4083	1.8495	1	28	1	19
44	8	81.2539	1.9708	7	51	7	5
45	7	80.3383	2.0671	3	18	3	17
46	6	78.4549	2.2651	2	6	2	9
47	5	77.5088	2.3646	2	7	2	14
48	4	65.1947	3.6592	1	3	1	36
49	3	58.6341	4.3489	1	2	1	50
50	2	28.7201	7.4939	1	52	1	51
51	1	0.0000	10.5134	1	9	1	52

Final Partition
Number of clusters: 10

	Number of observations	Within cluster sum of squares	Average distance from centroid	Maximum distance from centroid
Cluster1	14	3.36015	0.473471	0.73878
Cluster2	2	0.72281	0.601170	0.60117
Cluster3	13	4.41178	0.529362	1.04709
Cluster4	7	1.83165	0.499651	0.60140
Cluster5	4	0.72180	0.370532	0.69140
Cluster6	1	0.00000	0.000000	0.00000
Cluster7	4	1.09570	0.457285	0.86993
Cluster8	5	1.00540	0.418577	0.72875
Cluster9	1	0.00000	0.000000	0.00000
Cluster10	1	0.00000	0.000000	0.00000

Cluster Centroids

Variable	Cluster1	Cluster2	Cluster3	Cluster4
Current_GDPperCapita_2008	-0.376480	1.15589	-0.213843	0.104935
Personal_IncomePerCapita_2008	-0.430688	0.39532	-0.185325	0.608203
Unemployment_2008	-0.456159	0.18627	0.723773	-0.604411

Variable	Cluster5	Cluster6	Cluster7	Cluster8	Cluster9
Current_GDPperCapita_2008	0.56777	6.09294	-0.65311	-0.14575	1.29235
Personal_IncomePerCapita_2008	1.66187	3.54850	-0.87114	-0.25765	1.23445
Unemployment_2008	-0.00399	0.80892	1.18944	-1.40497	-1.54334

Variable	Cluster10	Grand centroid
Current_GDPperCapita_2008	-1.31082	-0.0000000
Personal_IncomePerCapita_2008	-3.26683	0.0000000
Unemployment_2008	3.85303	0.0000000

Distances Between Cluster Centroids

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7
Cluster1	0.00000	1.85557	1.21610	1.15457	2.33985	7.6999	1.72583
Cluster2	1.85557	0.00000	1.58184	1.33229	1.40934	5.8911	2.42543
Cluster3	1.21610	1.58184	0.00000	1.57968	2.13371	7.3297	0.93815
Cluster4	1.15457	1.33229	1.57968	0.00000	1.29805	6.8190	2.44560
Cluster5	2.33985	1.40934	2.13371	1.29805	0.00000	5.8947	3.05466
Cluster6	7.69985	5.89107	7.32968	6.81902	5.89472	0.0000	8.07385
Cluster7	1.72583	2.42543	0.93815	2.44560	3.05466	8.0739	0.00000
Cluster8	0.99168	2.15700	2.13106	1.20559	2.48122	7.6361	2.71380
Cluster9	2.59608	1.92725	3.06988	1.63821	1.75422	5.8253	3.96060
Cluster10	5.24269	5.73943	4.52672	6.07363	6.53435	10.5134	3.64234

	Cluster8	Cluster9	Cluster10
Cluster1	0.99168	2.59608	5.2427
Cluster2	2.15700	1.92725	5.7394
Cluster3	2.13106	3.06988	4.5267
Cluster4	1.20559	1.63821	6.0736
Cluster5	2.48122	1.75422	6.5344
Cluster6	7.63606	5.82526	10.5134
Cluster7	2.71380	3.96060	3.6423
Cluster8	0.00000	2.07693	6.1692
Cluster9	2.07693	0.00000	7.4939
Cluster10	6.16920	7.49391	0.0000

MINITAB OUTPUT 5.3

Cluster Analysis of Observations: Relative_Output_Weight, %ChangeRealGDP_2009

Standardized Variables, Euclidean Distance, Complete Linkage
Amalgamation Steps

Step	Number of clusters	Similarity level	Distance level	Clusters joined		New cluster	Number of obs. in new cluster
1	50	99.2759	0.04073	12	22	12	2
2	49	99.2753	0.04076	6	39	6	2
3	48	98.3844	0.09088	21	47	21	2
4	47	98.2938	0.09598	7	11	7	2
5	46	97.8330	0.12190	14	15	14	2
6	45	97.6604	0.13161	31	36	31	2
7	44	97.5894	0.13560	24	32	24	2
8	43	97.5041	0.14040	40	44	40	2
9	42	97.4701	0.14231	1	26	1	2
10	41	96.9685	0.17052	5	8	5	2
11	40	96.6215	0.19004	7	10	7	3
12	39	96.3782	0.20373	18	24	18	3
13	38	96.3562	0.20496	16	48	16	2
14	37	95.7761	0.23760	13	34	13	2
15	36	95.7631	0.23833	12	17	12	3
16	35	95.5954	0.24776	1	41	1	3
17	34	95.4699	0.25482	20	46	20	2
18	33	95.1686	0.27177	6	30	6	3
19	32	94.7464	0.29552	38	50	38	2
20	31	94.5846	0.30462	4	28	4	2
21	30	94.3312	0.31887	14	43	14	3
22	29	94.1868	0.32700	16	25	16	3
23	28	93.5053	0.36533	3	13	3	3
24	27	93.1234	0.38681	5	31	5	4
25	26	92.2480	0.43606	9	21	9	3
26	25	92.0126	0.44929	1	40	1	5
27	24	91.8383	0.45910	20	45	20	3
28	23	91.2314	0.49324	7	33	7	4
29	22	90.1201	0.55575	37	51	37	2
30	21	89.4036	0.59605	18	38	18	5
31	20	88.4609	0.64908	1	5	1	9
32	19	87.3579	0.71113	16	49	16	4
33	18	86.9414	0.73455	23	29	23	2
34	17	86.7151	0.74728	35	42	35	2
35	16	86.5397	0.75715	3	7	3	7
36	15	86.3061	0.77029	14	18	14	8
37	14	85.9673	0.78935	4	6	4	5
38	13	85.3982	0.82136	1	12	1	12
39	12	83.6005	0.92248	20	27	20	4
40	11	81.4058	1.04593	9	19	9	4
41	10	77.6042	1.25978	2	37	2	3
42	9	76.9165	1.29846	1	3	1	19
43	8	76.5910	1.31677	4	16	4	9
44	7	70.2997	1.67066	1	14	1	27
45	6	62.1024	2.13176	4	9	4	13
46	5	61.8738	2.14462	1	23	1	29
47	4	60.8149	2.20418	2	35	2	5
48	3	42.4429	3.23762	2	20	2	9
49	2	35.8706	3.60731	1	4	1	42
50	1	0.0000	5.62505	1	2	1	51

Final Partition
Number of clusters: 10

	Number of observations	Within cluster sum of squares	Average distance from centroid	Maximum distance from centroid
Cluster1	12	1.11666	0.290464	0.453043
Cluster2	3	0.87905	0.505341	0.695040
Cluster3	7	0.69315	0.299938	0.409458
Cluster4	5	0.52495	0.312633	0.444184
Cluster5	4	0.70114	0.372880	0.667676
Cluster6	8	0.77921	0.296224	0.442508
Cluster7	4	0.36591	0.275915	0.475318
Cluster8	4	0.58764	0.349764	0.574625
Cluster9	2	0.26978	0.367276	0.367276
Cluster10	2	0.27922	0.373642	0.373642

Cluster Centroids

Variable	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5
Relative_Output_Weight	-0.666314	1.19556	-0.754495	-0.245411	-0.944597
%ChangeRealGDP_2009	-0.304256	2.57526	-0.908290	0.306715	0.838786

Variable	Cluster6	Cluster7	Cluster8	Cluster9	Cluster10
Relative_Output_Weight	0.103291	0.536210	1.92277	-0.57325	2.59011
%ChangeRealGDP_2009	-0.572314	0.373477	0.19140	-1.86203	1.71883

Variable	Grand centroid
Relative_Output_Weight	0.0000000
%ChangeRealGDP_2009	0.0000000

Distances Between Cluster Centroids

	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7
Cluster1	0.00000	3.42903	0.61044	0.74192	1.17643	0.81495	1.38036
Cluster2	3.42903	0.00000	3.99223	2.68751	2.75602	3.33171	2.29839
Cluster3	0.61044	3.99223	0.00000	1.31735	1.75739	0.92124	1.81902
Cluster4	0.74192	2.68751	1.31735	0.00000	0.87861	0.94567	0.78447
Cluster5	1.17643	2.75602	1.75739	0.87861	0.00000	1.75763	1.55219
Cluster6	0.81495	3.33171	0.92124	0.94567	1.75763	0.00000	1.04016
Cluster7	1.38036	2.29839	1.81902	0.78447	1.55219	1.04016	0.00000
Cluster8	2.63610	2.49232	2.89432	2.17125	2.93954	1.97326	1.39847
Cluster9	1.56055	4.77685	0.97081	2.19338	2.72622	1.45639	2.49567
Cluster10	3.83369	1.63654	4.25302	3.16769	3.64262	3.38136	2.45530

	Cluster8	Cluster9	Cluster10
Cluster1	2.63610	1.56055	3.83369
Cluster2	2.49232	4.77685	1.63654
Cluster3	2.89432	0.97081	4.25302
Cluster4	2.17125	2.19338	3.16769
Cluster5	2.93954	2.72622	3.64262
Cluster6	1.97326	1.45639	3.38136
Cluster7	1.39847	2.49567	2.45530
Cluster8	0.00000	3.23213	1.66685
Cluster9	3.23213	0.00000	4.77801
Cluster10	1.66685	4.77801	0.00000

MINITAB OUTPUT 5.4

Regression Analysis: ChangeRealGDP2009 versus Construction

```
The regression equation is
ChangeRealGDP2009 = 0.338 + 3.72 Construction

Predictor       Coef  SE Coef     T      P
Constant      0.3384   0.4184  0.81  0.423
Construction  3.7226   0.7437  5.01  0.000

S = 2.03079   R-Sq = 33.8%   R-Sq(adj) = 32.5%

Analysis of Variance

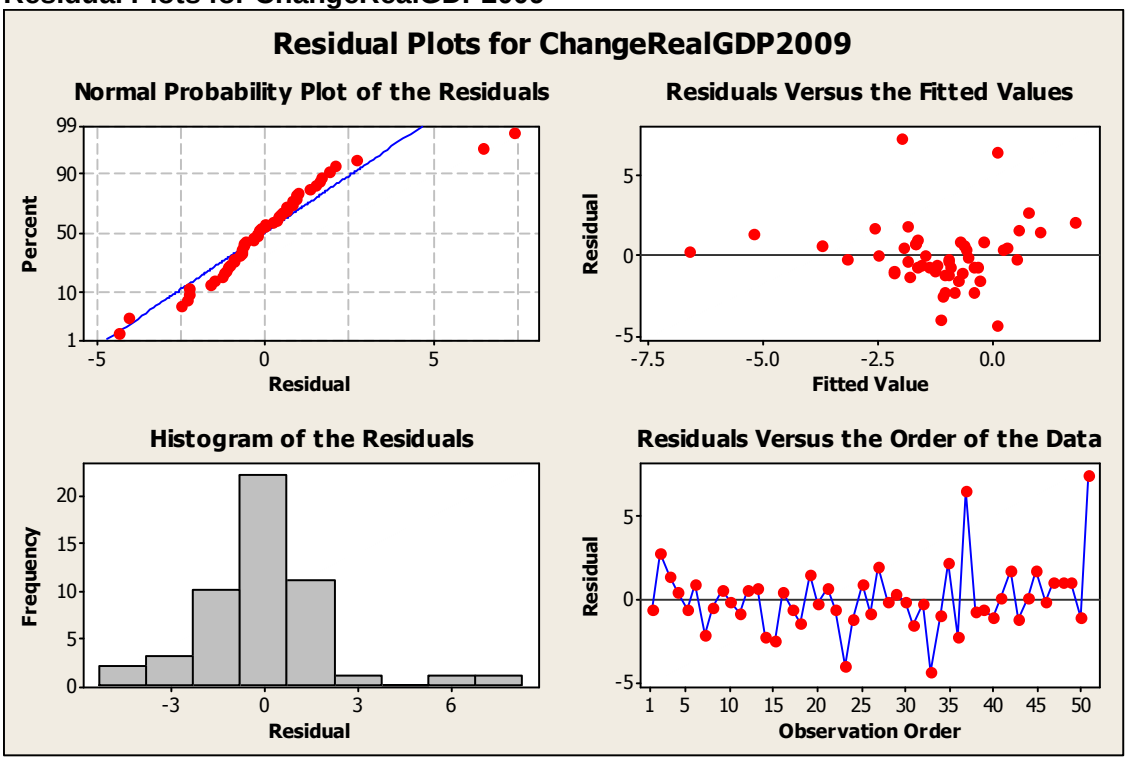
Source          DF      SS      MS      F      P
Regression       1  103.33  103.33  25.06  0.000
Residual Error  49  202.08    4.12
Total           50  305.41

Unusual Observations
Obs  Construction  ChangeRealGDP2009      Fit  SE Fit  Residual  St Resid
  3         -1.50              -3.900  -5.245   0.857     1.345      0.73 X
 23         -0.40              -5.200  -1.151   0.285    -4.049     -2.01R
 29         -1.88              -6.400  -6.660   1.128     0.260      0.15 X
 33         -0.07              -4.300   0.078   0.382    -4.378     -2.19R
 37         -0.07               6.600   0.078   0.382     6.522      3.27R
 51         -0.63               5.400  -2.007   0.327     7.407      3.70R

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.

Durbin-Watson statistic = 1.95683
```

Residual Plots for ChangeRealGDP2009



MINITAB OUTPUT 5.5

Regression Analysis: ChangeRealGD versus Construction, Durable-good, ...

```
The regression equation is
ChangeRealGDP2009 = 0.0622 + 0.997 Construction
                    + 1.01 Durable-goods manufacturing
                    + 0.968 Nondurable-goods manufacturing
                    + 1.09 Wholesale Trade + 0.985 Retail Trade
                    + 0.969 Transportation and warehousing + 0.949 Information
                    + 1.02 Finance and insurance
                    + 0.946 Agriculture, forestry, fishing, + 0.999 Mining
                    + 1.08 Utilities + 0.990 Real estate, rental, and leasin
                    + 0.989 Professional and technical serv
                    + 1.00 Management of companies
                    + 1.01 Administrative and waste servic
                    + 1.11 Educational services
                    + 0.903 Health care and social assistan
                    + 0.798 Arts, entertainment, and recrea
                    + 1.07 Accommodation and food services + 1.46 Other
services
                    + 0.998 Government


49 cases used, 2 cases contain missing values
```

Predictor	Coef	SE Coef	T	P	VIF
Constant	0.06222	0.04398	1.41	0.169	
Construction	0.99719	0.04285	23.27	0.000	9.6
Durable-goods manufacturing	1.01123	0.01851	54.63	0.000	3.0
Nondurable-goods manufacturing	0.96807	0.03117	31.05	0.000	4.7
Wholesale Trade	1.09043	0.07467	14.60	0.000	3.9
Retail Trade	0.9847	0.1279	7.70	0.000	9.3
Transportation and warehousing	0.96861	0.05441	17.80	0.000	2.0
Information	0.94878	0.03924	24.18	0.000	1.4
Finance and insurance	1.01950	0.01527	66.75	0.000	2.0
Agriculture, forestry, fishing,	0.94554	0.03920	24.12	0.000	2.7
Mining	0.998878	0.006145	162.55	0.000	2.4
Utilities	1.0808	0.1133	9.54	0.000	2.5
Real estate, rental, and leasin	0.98986	0.03557	27.83	0.000	3.9
Professional and technical serv	0.98946	0.04285	23.09	0.000	2.4
Management of companies	1.00097	0.03421	29.26	0.000	1.5
Administrative and waste servic	1.0089	0.1177	8.57	0.000	3.9
Educational services	1.1137	0.3607	3.09	0.005	1.7
Health care and social assistan	0.9025	0.1284	7.03	0.000	2.9
Arts, entertainment, and recrea	0.7984	0.2223	3.59	0.001	3.6
Accommodation and food services	1.06642	0.05695	18.73	0.000	3.7
Other services	1.4591	0.3397	4.29	0.000	4.6
Government	0.99847	0.02847	35.07	0.000	2.3

```
S = 0.0376652   R-Sq = 100.0%   R-Sq(adj) = 100.0%

PRESS = 0.170078   R-Sq(pred) = 99.94%
```

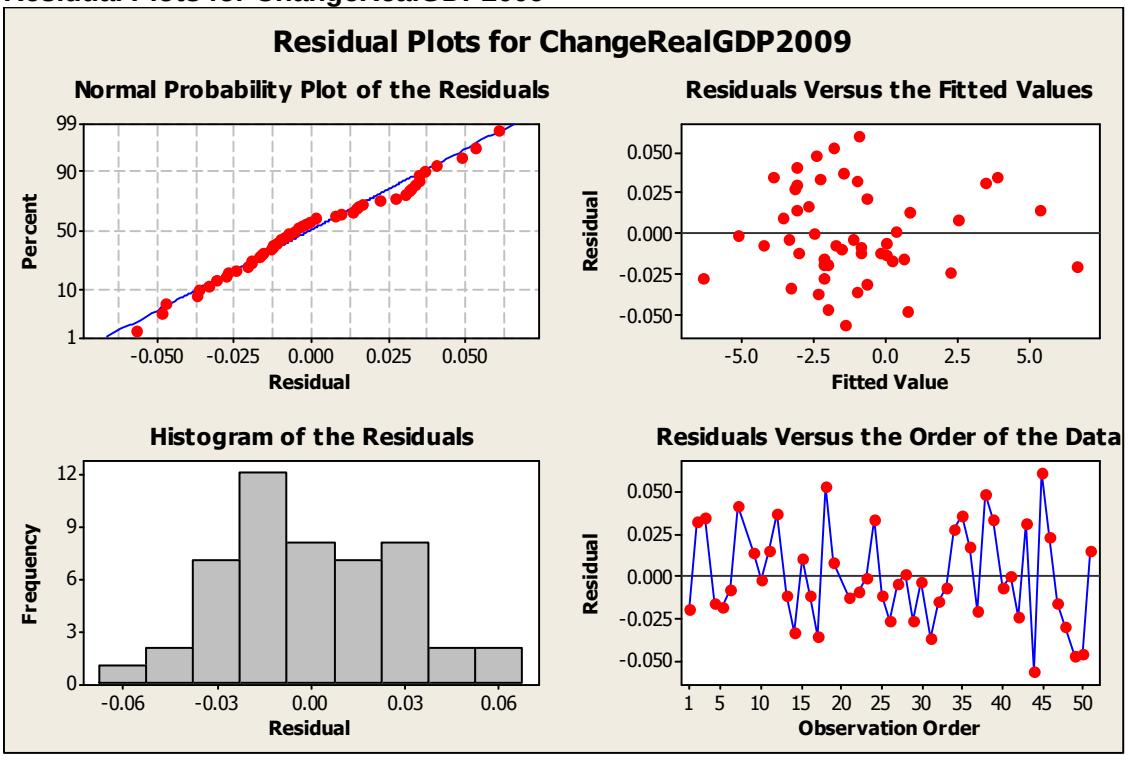
Analysis of Variance

Source	DF	SS	MS	F	P
Regression	21	304.989	14.523	10237.25	0.000
Residual Error	27	0.038	0.001		
Total	48	305.027			

Source	DF	Seq SS
Construction	1	103.407
Durable-goods manufacturing	1	31.674
Nondurable-goods manufacturing	1	34.028
Wholesale Trade	1	14.918
Retail Trade	1	13.647
Transportation and warehousing	1	1.547
Information	1	3.223
Finance and insurance	1	24.753
Agriculture, forestry, fishing,	1	0.671
Mining	1	65.389
Utilities	1	0.449
Real estate, rental, and leasin	1	2.066
Professional and technical serv	1	2.565
Management of companies	1	2.654
Administrative and waste servic	1	0.296
Educational services	1	0.029
Health care and social assistan	1	0.331
Arts, entertainment, and recrea	1	1.141
Accommodation and food services	1	0.349
Other services	1	0.106
Government	1	1.745

Durbin-Watson statistic = 1.95847

Residual Plots for ChangeRealGDP2009



MINITAB OUTPUT 5.6

Best Subsets Regression: ChangeRealGD versus Construction, Durable-good, ...

```
Response is ChangeRealGDP2009

49 cases used, 2 cases contain missing values
```

Vars	R-Sq	R-Sq(adj)	Mallows C-p	S	Construction	Durable-goods	Nondurable-goods	Transportation	Agriculture, forestry, fishing	Real estate	Professional and technical services	Administrative and waste management services	Educational services	Construction	Wholesale trade	Retail trade	Information	Real estate, rental and leasing	Professional, scientific, and technical services	Management of companies and enterprises	Administrative and waste services	Educational services	Health care and social assistance	Arts, entertainment, and recreation	Accommodation and food services	Other services, except government	Government and government enterprises	Unclassified
1	40.5	39.2	127980.2	1.9658														X										
1	36.1	34.8	137256.8	2.0358					X																			
2	74.2	73.1	55325.9	1.3068				X										X										
2	73.4	72.3	57057.8	1.3270														X				X						
3	81.8	80.6	39059.8	1.1103				X										X										
3	81.0	79.7	40850.4	1.1354	X													X				X						
4	90.5	89.6	20400.9	0.81181	X	X					X							X										
4	87.5	86.4	26825.7	0.93069		X		X										X			X							
5	93.2	92.4	14511.5	0.69281	X	X		X			X							X										
5	92.9	92.1	15274.9	0.71076	X	X					X							X										
6	95.2	94.5	10227.1	0.58875	X	X		X			X							X										
6	94.6	93.8	11637.7	0.62792	X	X		X			X							X			X							
7	96.3	95.7	7913.1	0.52435	X	X		X			X							X										
7	96.3	95.6	7999.3	0.52719	X	X		X			X							X			X							
8	97.5	97.0	5331.3	0.43610	X	X	X	X			X							X			X							
8	97.5	96.9	5444.0	0.44066	X	X		X			X							X			X			X				
9	98.4	98.0	3492.8	0.35792	X	X		X			X							X			X			X				
9	98.2	97.8	3777.2	0.37209	X	X	X	X			X							X			X			X				
10	98.7	98.3	2781.8	0.32382	X	X	X	X			X							X			X			X				
10	98.7	98.3	2786.0	0.32406	X	X		X			X							X			X			X				X
11	99.0	98.7	2184.9	0.29109	X	X	X	X			X							X			X	X		X				
11	99.0	98.6	2227.1	0.29386	X	X	X	X		X	X							X			X	X		X				
12	99.2	99.0	1658.8	0.25744	X	X	X			X	X	X						X			X	X		X				

```
  12   99.2        98.9       1736.4   0.26331  X X X X     X X   X   X X X
  13   99.5        99.2       1155.8   0.21841  X X X     X X X X X   X X X
  13   99.4        99.2       1189.9   0.22155  X X X X     X X X X   X X X
  14   99.6        99.5        804.8   0.18540  X X X X     X X   X X X X X
  14   99.6        99.4        845.9   0.18997  X X X X   X X X X X   X X X
  15   99.8        99.7        411.6   0.13574  X X X X     X X X X X X X X
  15   99.8        99.7        444.6   0.14088  X X X X   X X X X X X X X X
  16   99.9        99.8        215.4   0.10107  X X X X   X X X X X X X X X
  16   99.9        99.8        247.1   0.10780  X X X X X X X X X X X X X X
  17   99.9        99.9        140.5  0.083821  X X X X X X X X X X X X X X
  17   99.9        99.9        141.3  0.084043  X X X X   X X X X X X X X X X
  18  100.0        99.9         65.5  0.060149  X X X X X X X X X X X X X X X
  18   99.9        99.9         97.0  0.071450  X X X X   X X X X X X X X X X
  19  100.0       100.0         42.3  0.050113  X X X X X X X X X X X X X X X
  19  100.0       100.0         48.1  0.052841  X X X X X X X X X X X X X X X X
  20  100.0       100.0         29.5  0.043025  X X X X X X X X X X X X X X X
  20  100.0       100.0         32.9  0.044960  X X X X X X X X X X X X X X X X
  21  100.0       100.0         22.0  0.037665  X X X X X X X X X X X X X X X X
```

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Vars  n a s s t
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   2
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   4
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   5          X
   6          X
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   7  X       X
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 7          X
 8          X
 8          X
 9  X       X
 9          X
10  X       X
10  X       X
11  X       X
11          X
12  X       X
12  X       X
13  X       X
13  X       X
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18  X   X X X
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19  X   X   X
20  X X X X X
20  X   X X X
21  X X X X X
```

MINITAB OUTPUT 5.7

1st Model of Best Subsets with 7 variables

Regression Analysis: ChangeRealGD versus Construction, Durable-good, ...

```
The regression equation is
ChangeRealGDP2009 = - 0.962 + 2.32 Construction
                    + 1.05 Durable-goods manufacturing + 3.39 Wholesale Trade
                    + 1.39 Finance and insurance + 1.07 Mining
                    + 4.13 Health care and social assistan + 1.40 Government


49 cases used, 2 cases contain missing values


Predictor                          Coef  SE Coef      T      P  VIF
Constant                        -0.9622   0.2938  -3.28  0.002
Construction                     2.3163   0.2479   9.34  0.000  1.7
Durable-goods manufacturing      1.0485   0.1838   5.70  0.000  1.5
Wholesale Trade                  3.3874   0.6988   4.85  0.000  1.8
Finance and insurance            1.3903   0.1707   8.14  0.000  1.3
Mining                          1.06870  0.05846  18.28  0.000  1.1
Health care and social assistan   4.135    1.196   3.46  0.001  1.3
Government                       1.4035   0.3065   4.58  0.000  1.4


S = 0.524354   R-Sq = 96.3%   R-Sq(adj) = 95.7%

PRESS = 19.1463   R-Sq(pred) = 93.72%
```

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	7	293.754	41.965	152.63	0.000
Residual Error	41	11.273	0.275		
Total	48	305.027			

Source	DF	Seq SS
Construction	1	103.407
Durable-goods manufacturing	1	31.674
Wholesale Trade	1	15.067
Finance and insurance	1	36.861
Mining	1	97.378
Health care and social assistan	1	3.601
Government	1	5.766

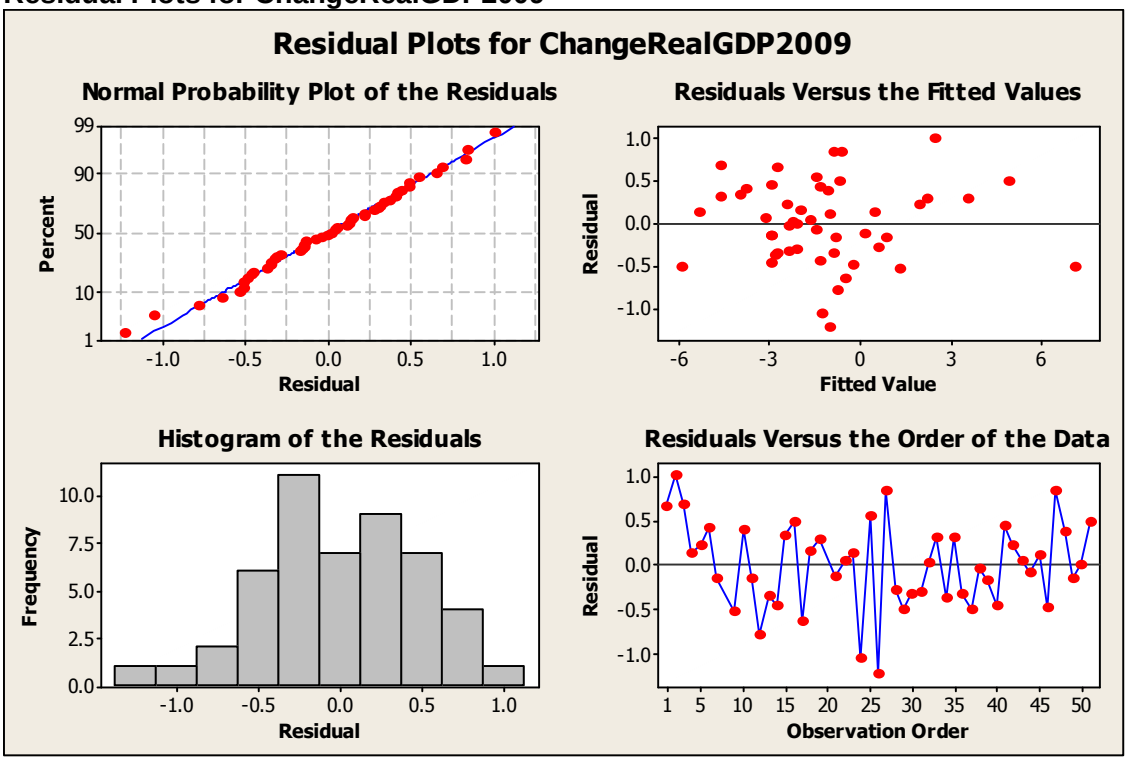
Unusual Observations

Obs	Construction	ChangeRealGDP2009	Fit	SE Fit	Residual	St Resid
2	0.12	3.5000	2.4899	0.1867	1.0101	2.06R
9	-0.01	0.8000	1.3314	0.4200	-0.5314	-1.69 X
24	-0.38	-2.3000	-1.2433	0.1611	-1.0567	-2.12R
26	-0.44	-2.2000	-0.9704	0.1016	-1.2296	-2.39R
33	-0.07	-4.3000	-4.6087	0.4503	0.3087	1.15 X
37	-0.07	6.6000	7.1119	0.3997	-0.5119	-1.51 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.

Durbin-Watson statistic = 2.14521

Residual Plots for ChangeRealGDP2009



MINITAB OUTPUT 5.8

2ed Model of Best Subsets with 7 variables

Regression Analysis: ChangeRealGD versus Construction, Durable-good, ...

```
The regression equation is
ChangeRealGDP2009 = - 0.124 + 1.75 Construction
                    + 1.47 Durable-goods manufacturing + 3.22 Wholesale Trade
                    + 1.31 Finance and insurance + 1.09 Mining
                    + 1.42 Real estate, rental, and leasin + 1.33 Government


49 cases used, 2 cases contain missing values


Predictor                           Coef  SE Coef      T      P  VIF
Constant                         -0.1242   0.2279  -0.55  0.589
Construction                      1.7463   0.3122   5.59  0.000  2.6
Durable-goods manufacturing       1.4742   0.1837   8.02  0.000  1.5
Wholesale Trade                   3.2189   0.7080   4.55  0.000  1.8
Finance and insurance             1.3145   0.1778   7.39  0.000  1.4
Mining                           1.09426  0.06114  17.90  0.000  1.2
Real estate, rental, and leasin   1.4206   0.4211   3.37  0.002  2.8
Government                        1.3344   0.3095   4.31  0.000  1.4


S = 0.527191   R-Sq = 96.3%   R-Sq(adj) = 95.6%

PRESS = 18.3472   R-Sq(pred) = 93.99%


Analysis of Variance

Source          DF       SS      MS       F      P
Regression       7  293.632  41.947  150.93  0.000
Residual Error  41   11.395   0.278
Total           48  305.027


Source                           DF   Seq SS
Construction                      1  103.407
Durable-goods manufacturing       1   31.674
Wholesale Trade                   1   15.067
Finance and insurance             1   36.861
Mining                            1   97.378
Real estate, rental, and leasin   1    4.080
Government                        1    5.165

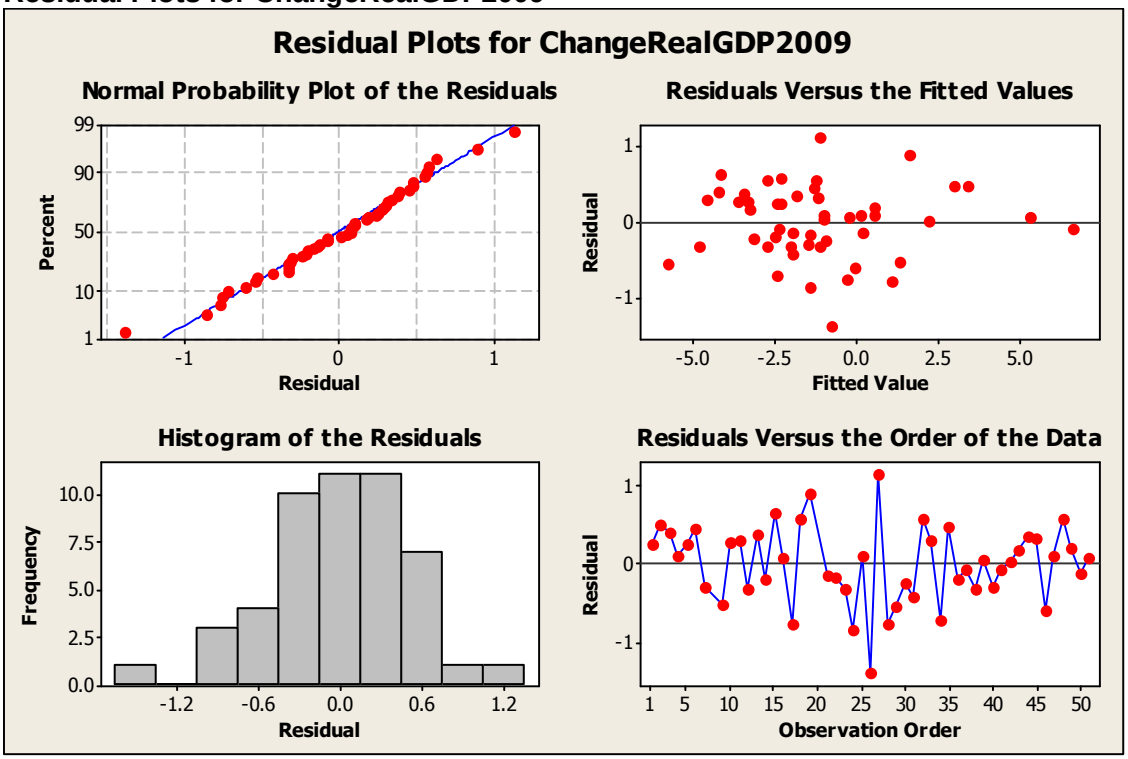

Unusual Observations

Obs  Construction  ChangeRealGDP2009      Fit  SE Fit  Residual  St Resid
  9         -0.01             0.8000   1.3334  0.4223   -0.5334     -1.69 X
 26         -0.44            -2.2000  -0.8085  0.1051   -1.3915     -2.69R
 27         -0.60             0.0000  -1.1378  0.1231    1.1378      2.22R
 33         -0.07            -4.3000  -4.6064  0.4528    0.3064      1.14 X
 37         -0.07             6.6000   6.6751  0.4096   -0.0751     -0.23 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

Durbin-Watson statistic = 2.41258

Residual Plots for ChangeRealGDP2009



MINITAB OUTPUT 5.9

Correlations: ChangeRealGD, Construction, Durable-good, Nondurable-g, ...

Cell Contents: Pearson correlation
P-Value

	ChangeRealGD	Construction	Durable-good	Nondurable-g	
Construction	0.582 0.000				
Durable-good	0.277 0.049	-0.066 0.643			
Nondurable-g	0.479 0.000	0.087 0.542	0.363 0.009		
Wholesale Tr	0.565 0.000	0.523 0.000	0.218 0.124	0.137 0.336	
Retail Trade	0.595 0.000	0.844 0.000	-0.042 0.772	-0.022 0.881	
Transportati	0.299 0.033	0.208 0.143	0.173 0.224	0.099 0.488	

Information	0.182	0.101	0.116	-0.116
	0.200	0.479	0.417	0.418
Finance and	0.342	0.032	-0.209	0.028
	0.014	0.823	0.141	0.847
Agriculture,	0.371	0.383	-0.116	-0.011
	0.009	0.007	0.428	0.938
Mining	0.636	0.098	0.046	0.347
	0.000	0.501	0.752	0.014
Utilities	0.247	-0.024	-0.040	0.285
	0.080	0.868	0.783	0.043
Real estate,	0.361	0.656	-0.298	-0.147
	0.009	0.000	0.033	0.304
Professional	0.442	0.258	0.242	-0.006
	0.001	0.067	0.088	0.969
Management o	0.271	0.195	0.016	0.252
	0.054	0.171	0.914	0.075
Administrati	0.488	0.473	0.343	0.084
	0.000	0.000	0.014	0.559
Educational	-0.057	-0.355	-0.114	0.114
	0.693	0.011	0.427	0.426
Health care	0.243	0.102	0.339	0.339
	0.086	0.474	0.015	0.015
Arts, entert	0.396	0.404	0.056	-0.291
	0.004	0.003	0.694	0.038
Accommodatio	0.407	0.708	-0.109	-0.025
	0.003	0.000	0.444	0.861
Other servic	0.487	0.495	0.319	0.148
	0.000	0.000	0.022	0.300
Government	0.565	0.344	0.255	0.221
	0.000	0.013	0.070	0.119

	Wholesale Tr	Retail Trade	Transportati	Information
Retail Trade	0.573			
	0.000			
Transportati	0.289	0.234		
	0.040	0.099		
Information	0.233	0.143	0.049	
	0.099	0.318	0.734	
Finance and	0.233	0.114	0.040	0.023
	0.100	0.426	0.782	0.875
Agriculture,	0.645	0.441	0.048	-0.009
	0.000	0.002	0.744	0.950

Mining	-0.023	0.127	0.004	-0.001
	0.877	0.385	0.979	0.995
Utilities	0.022	0.093	0.148	0.061
	0.879	0.516	0.301	0.672
Real estate,	0.446	0.621	0.330	0.129
	0.001	0.000	0.018	0.366
Professional	0.472	0.268	0.163	0.152
	0.000	0.057	0.253	0.287
Management o	0.150	0.068	0.079	-0.030
	0.292	0.636	0.581	0.837
Administrati	0.655	0.581	0.261	0.251
	0.000	0.000	0.064	0.076
Educational	-0.057	-0.249	-0.118	-0.034
	0.690	0.078	0.411	0.814
Health care	0.271	0.111	0.237	0.272
	0.055	0.436	0.094	0.053
Arts, entert	0.263	0.403	0.066	0.140
	0.062	0.003	0.646	0.326
Accommodatio	0.270	0.513	0.034	0.156
	0.056	0.000	0.811	0.275
Other servic	0.547	0.638	0.473	0.106
	0.000	0.000	0.000	0.459
Government	0.339	0.489	0.219	0.060
	0.015	0.000	0.123	0.673

	Finance and	Agriculture,	Mining	Utilities
Agriculture,	0.336			
	0.018			
Mining	0.034	-0.003		
	0.816	0.984		
Utilities	0.107	-0.063	0.222	
	0.454	0.668	0.125	
Real estate,	0.327	0.428	-0.172	0.021
	0.019	0.002	0.237	0.886
Professional	0.351	0.184	-0.009	-0.059
	0.012	0.205	0.953	0.679
Management o	0.029	0.039	0.038	0.006
	0.838	0.791	0.793	0.965
Administrati	0.173	0.295	-0.115	0.082
	0.224	0.039	0.433	0.568
Educational	0.118	0.047	0.093	0.112
	0.409	0.749	0.525	0.434

Health care	0.137	-0.015	-0.185	0.416
	0.337	0.918	0.204	0.002
Arts, entert	0.105	0.201	0.166	0.059
	0.464	0.166	0.255	0.683
Accommodatio	0.073	0.208	0.048	-0.064
	0.612	0.151	0.744	0.654
Other servic	-0.045	0.346	0.022	-0.144
	0.755	0.015	0.880	0.315
Government	0.117	0.159	0.170	0.188
	0.415	0.274	0.242	0.187

	Real estate,	Professional	Management o	Administrati
Professional	0.264			
	0.061			
Management o	0.087	0.213		
	0.543	0.134		
Administrati	0.461	0.544	0.059	
	0.001	0.000	0.680	
Educational	-0.264	0.111	0.056	-0.188
	0.061	0.438	0.698	0.186
Health care	0.160	0.204	0.007	0.382
	0.262	0.150	0.961	0.006
Arts, entert	0.312	0.244	0.175	0.215
	0.026	0.085	0.218	0.129
Accommodatio	0.511	0.212	0.208	0.200
	0.000	0.135	0.143	0.159
Other servic	0.328	0.325	0.181	0.568
	0.019	0.020	0.204	0.000
Government	0.227	0.262	0.187	0.488
	0.110	0.064	0.189	0.000

	Educational	Health care	Arts, entert	Accommodatio
Health care	-0.106			
	0.458			
Arts, entert	-0.169	0.113		
	0.236	0.431		
Accommodatio	-0.205	0.150	0.579	
	0.149	0.294	0.000	
Other servic	-0.071	0.228	0.225	0.258
	0.621	0.108	0.113	0.068

```
Government          -0.120         0.188         0.356         0.155
                     0.401         0.186         0.010         0.278


              Other servic
Government            0.459
                      0.001
```

MINITAB OUTPUT 5.10

Regression Analysis: ChangeRealGD versus Construction, Nondurable-g, ...

```
The regression equation is
ChangeRealGDP2009 = - 0.816 + 1.84 Construction
                    + 1.35 Nondurable-goods manufacturing
                    + 3.76 Wholesale Trade
                    + 0.911 Finance and insurance + 0.928 Mining
                    + 1.98 Professional and technical serv + 1.76 Government


49 cases used, 2 cases contain missing values


Predictor                          Coef  SE Coef      T      P  VIF
Constant                        -0.8157   0.2123  -3.84  0.000
Construction                     1.8353   0.2730   6.72  0.000  1.5
Nondurable-goods manufacturing   1.3505   0.2576   5.24  0.000  1.2
Wholesale Trade                  3.7598   0.8231   4.57  0.000  1.8
Finance and insurance            0.9112   0.1910   4.77  0.000  1.2
Mining                          0.92769  0.07027  13.20  0.000  1.2
Professional and technical serv  1.9811   0.5377   3.68  0.001  1.4
Government                       1.7574   0.3464   5.07  0.000  1.3


S = 0.612584   R-Sq = 95.0%   R-Sq(adj) = 94.1%

PRESS = 24.3532   R-Sq(pred) = 92.02%


Analysis of Variance

Source          DF       SS      MS       F      P
Regression       7  289.641  41.377  110.26  0.000
Residual Error  41   15.386   0.375
Total           48  305.027


Source                           DF   Seq SS
Construction                      1  103.407
Nondurable-goods manufacturing    1   56.697
Wholesale Trade                   1   20.608
Finance and insurance             1   19.776
Mining                            1   72.657
Professional and technical serv   1    6.839
Government                        1    9.657
```

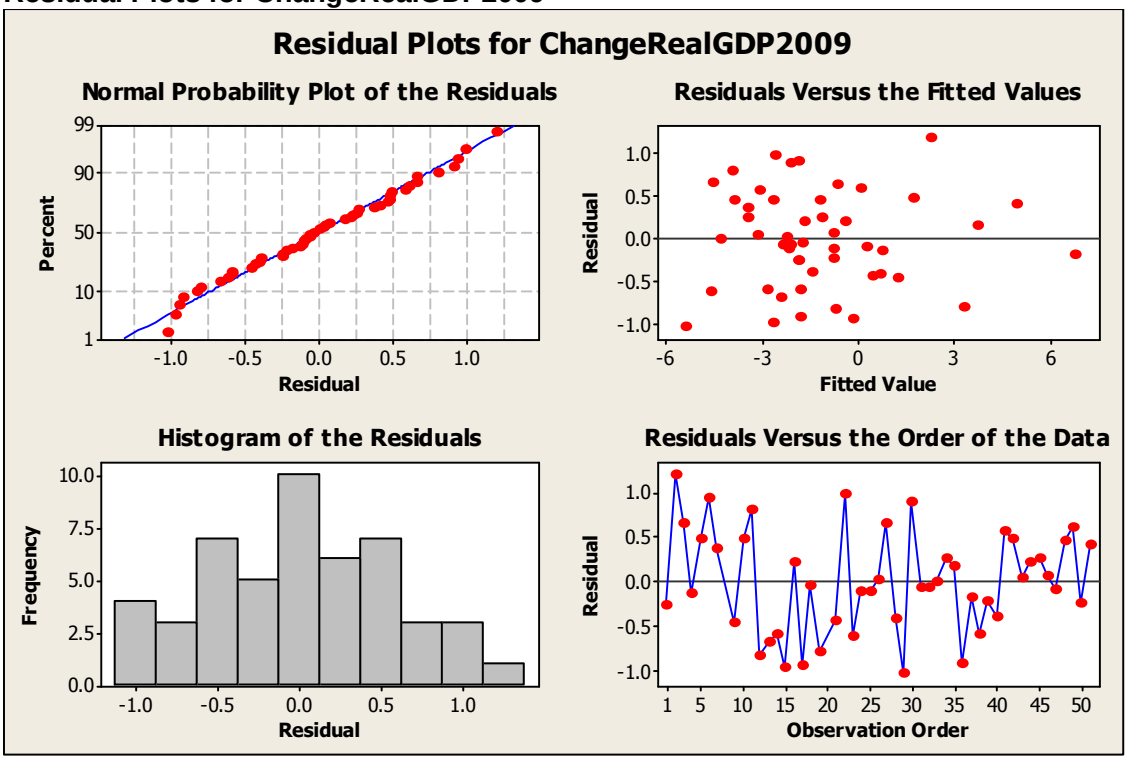
Unusual Observations

Obs	Construction	ChangeRealGDP2009	Fit	SE Fit	Residual	St Resid
2	0.12	3.5000	2.2998	0.2120	1.2002	2.09R
9	-0.01	0.8000	1.2619	0.5082	-0.4619	-1.35 X
29	-1.88	-6.4000	-5.3691	0.3681	-1.0309	-2.11R
33	-0.07	-4.3000	-4.2960	0.5227	-0.0040	-0.01 X
37	-0.07	6.6000	6.7872	0.4719	-0.1872	-0.48 X

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.

Durbin-Watson statistic = 1.89135

Residual Plots for ChangeRealGDP2009



MINITAB OUTPUT 5.11

Stepwise Regression: ChangeRealGD versus Construction, Nondurable-g, ...

```
Forward selection.  Alpha-to-Enter: 0.05


Response is ChangeRealGDP2009 on 7 predictors, with N = 49
N(cases with missing observations) = 2 N(all cases) = 51


Step                             1       2       3       4       5       6
Constant                    -1.496  -1.461  -2.256  -1.483  -1.399  -1.002

Mining                       1.172   1.196   1.098   1.062   1.044   0.929
T-Value                       5.65    8.67    9.20    9.99   11.68   11.60
P-Value                      0.000   0.000   0.000   0.000   0.000   0.000

Wholesale Trade                      10.23    8.36    6.35    5.28    4.80
T-Value                               7.77    6.98    5.30    5.09    5.44
P-Value                              0.000   0.000   0.000   0.000   0.000


Government                                    2.62    2.25    2.11    1.90
T-Value                                       4.33    4.10    4.58    4.84
P-Value                                      0.000   0.000   0.000   0.000

Construction                                          1.58    1.78    1.86
T-Value                                               3.64    4.84    5.98
P-Value                                              0.001   0.000   0.000

Finance and insurance                                         1.09    1.11
T-Value                                                       4.39    5.31
P-Value                                                      0.000   0.000

Nondurable-goods manufacturing                                        1.25
T-Value                                                               4.29
P-Value                                                              0.000

S                            1.97    1.31    1.11   0.984   0.828   0.698
R-Sq                        40.46   74.25   81.81   86.02   90.35   93.29
R-Sq(adj)                   39.19   73.13   80.60   84.75   89.22   92.33
Mallows C-p                 439.0   166.3   106.8    74.6    41.5    19.6


Step                             7
Constant                   -0.8157

Mining                       0.928
T-Value                      13.20
P-Value                      0.000

Wholesale Trade               3.76
T-Value                       4.57
P-Value                      0.000

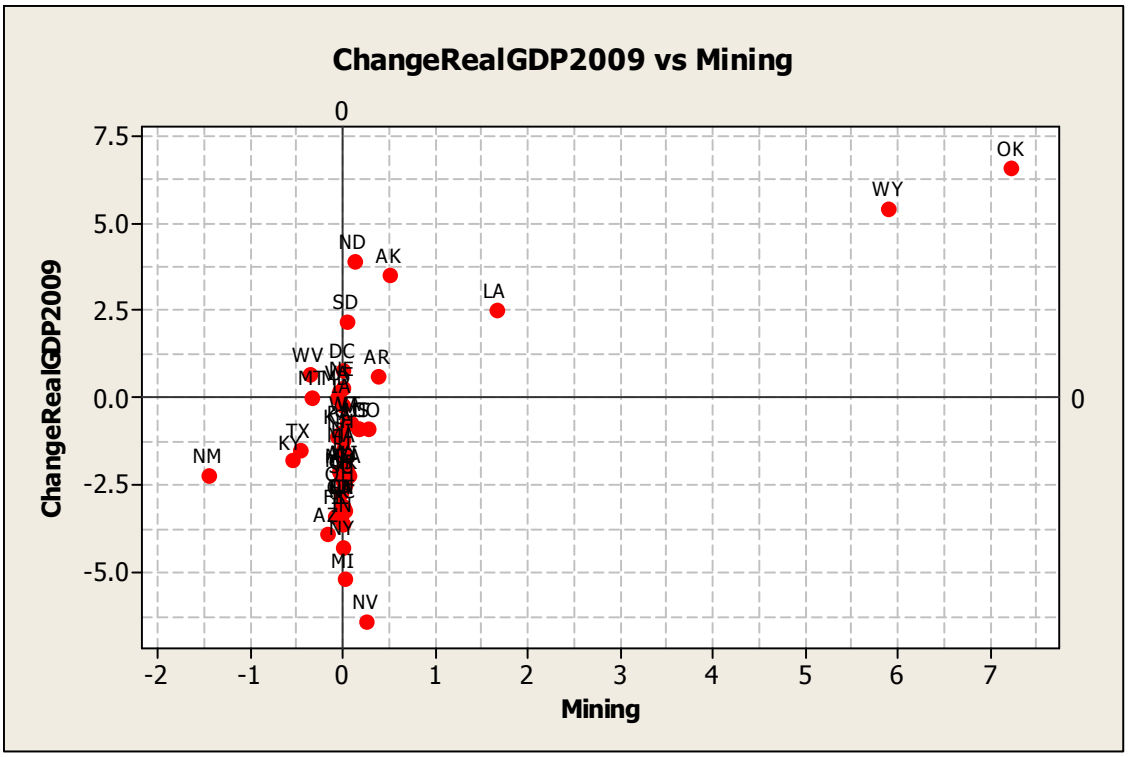
Government                    1.76
T-Value                       5.07
P-Value                      0.000

Construction                  1.84
T-Value                       6.72
```

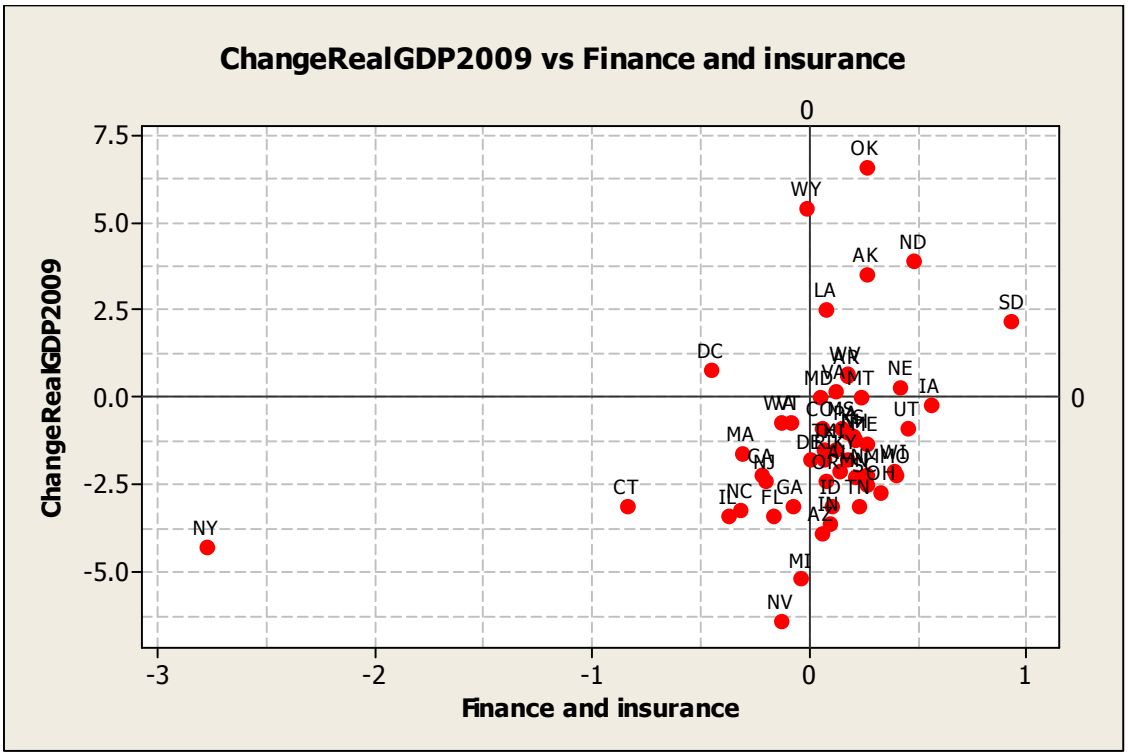
P-Value	0.000
Finance and insurance	0.91
T-Value	4.77
P-Value	0.000
Nondurable-goods manufacturing	1.35
T-Value	5.24
P-Value	0.000
Professional and technical serv	1.98
T-Value	3.68
P-Value	0.001
S	0.613
R-Sq	94.96
R-Sq(adj)	94.09
Mallows C-p	8.0

Additional Scatter Plots

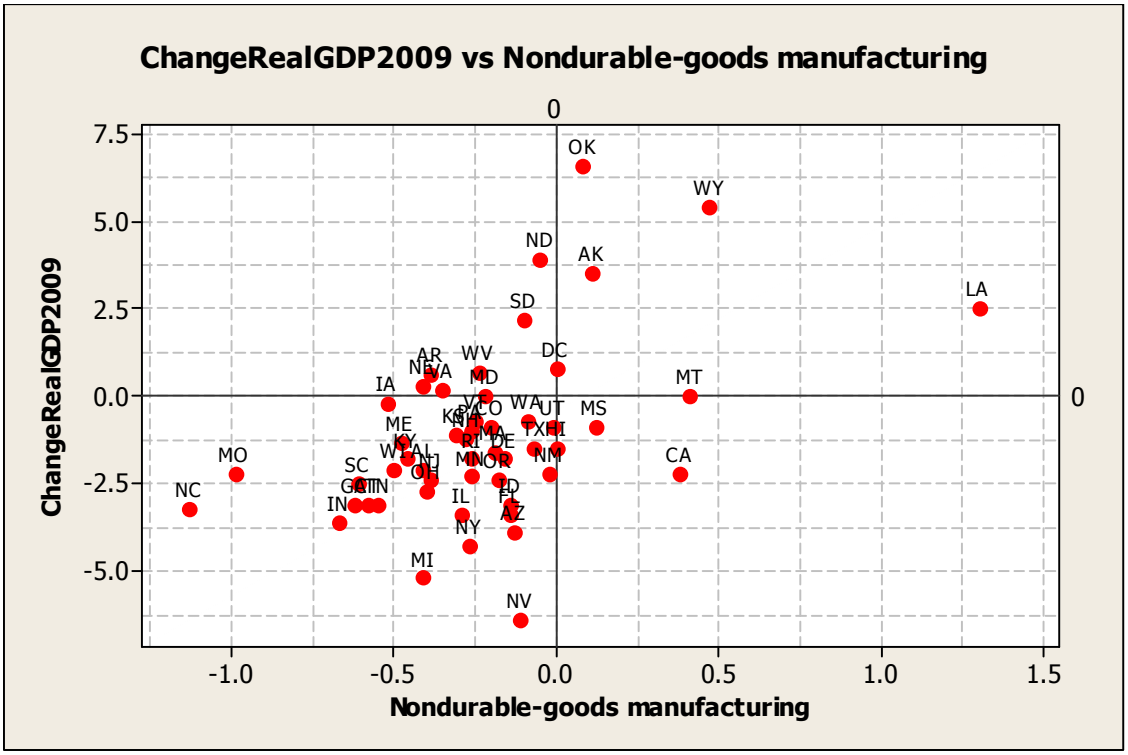
Scatter Plot A.1



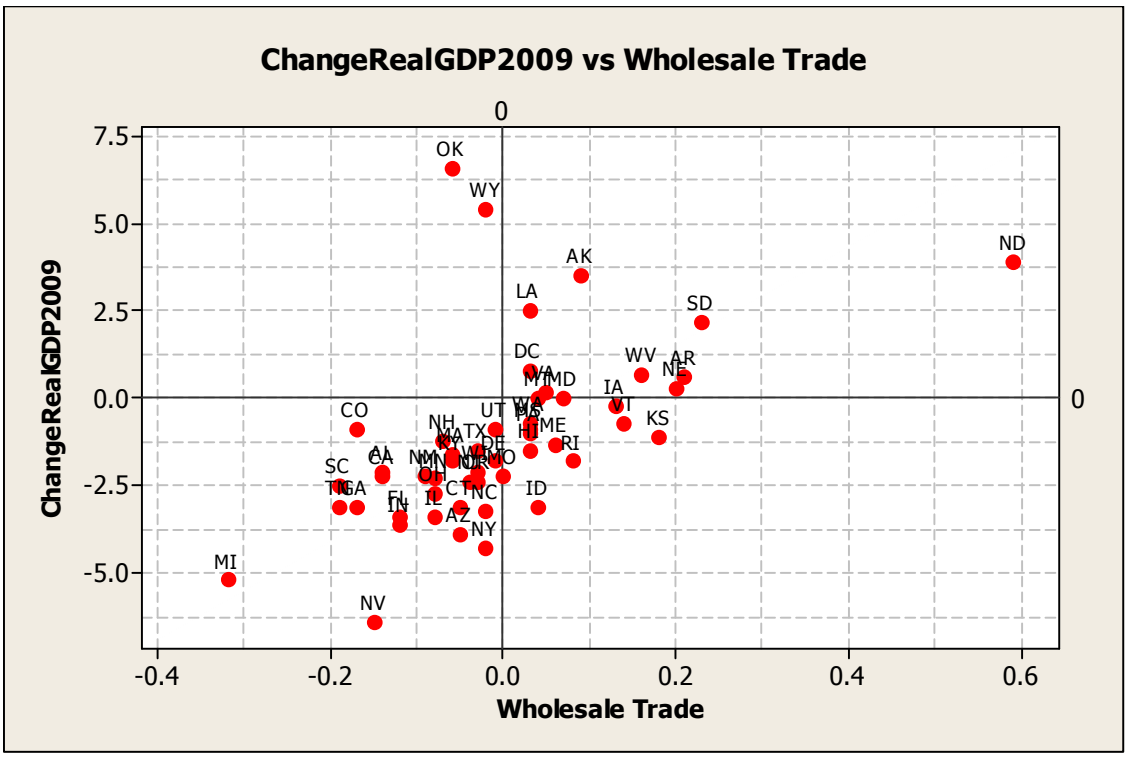
Scatter Plot A.2



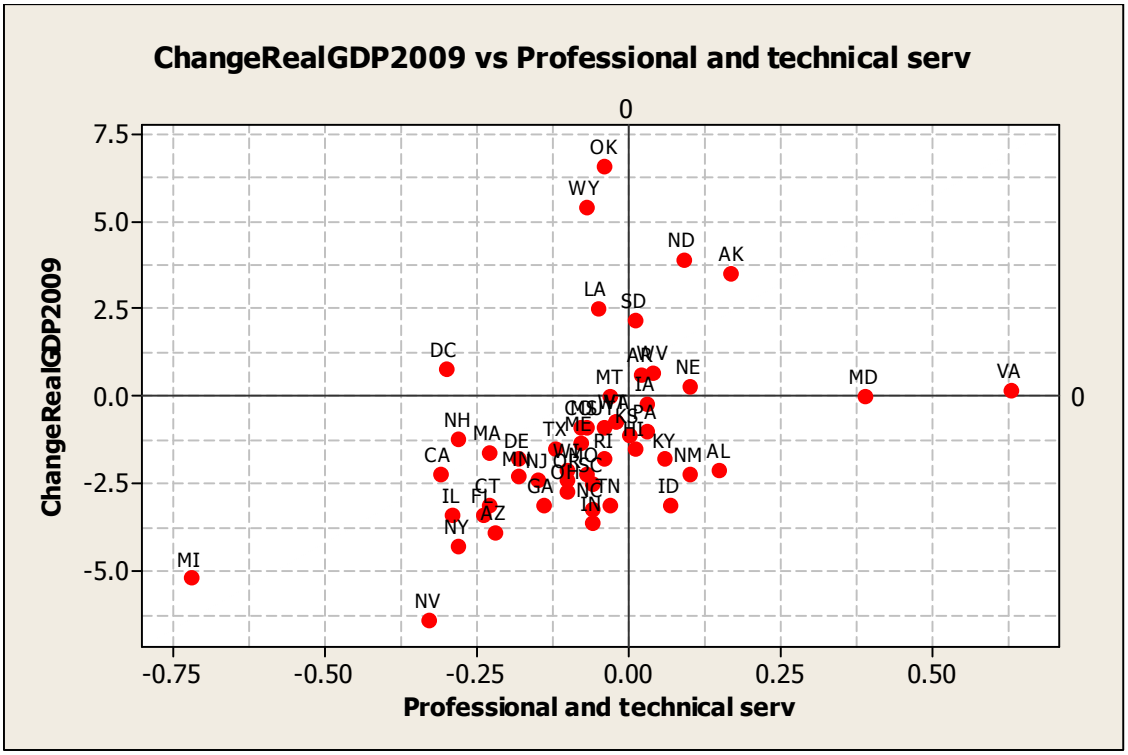
Scatter Plot A.3



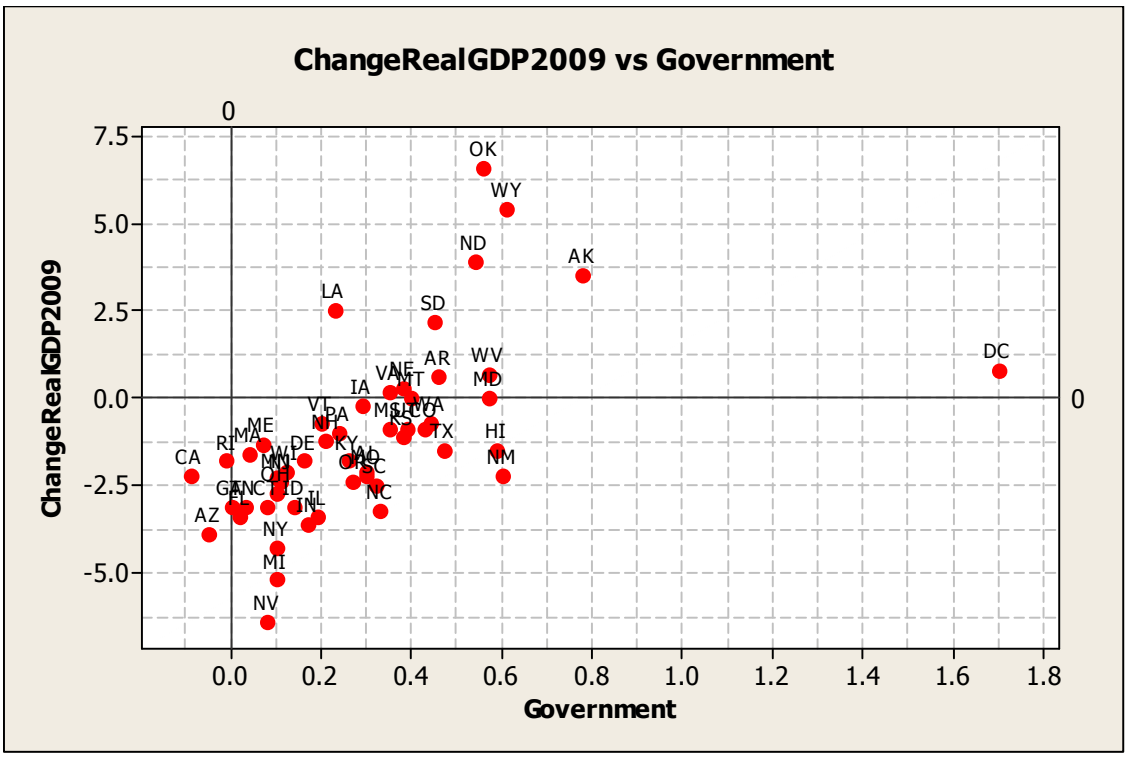
Scatter Plot A.4



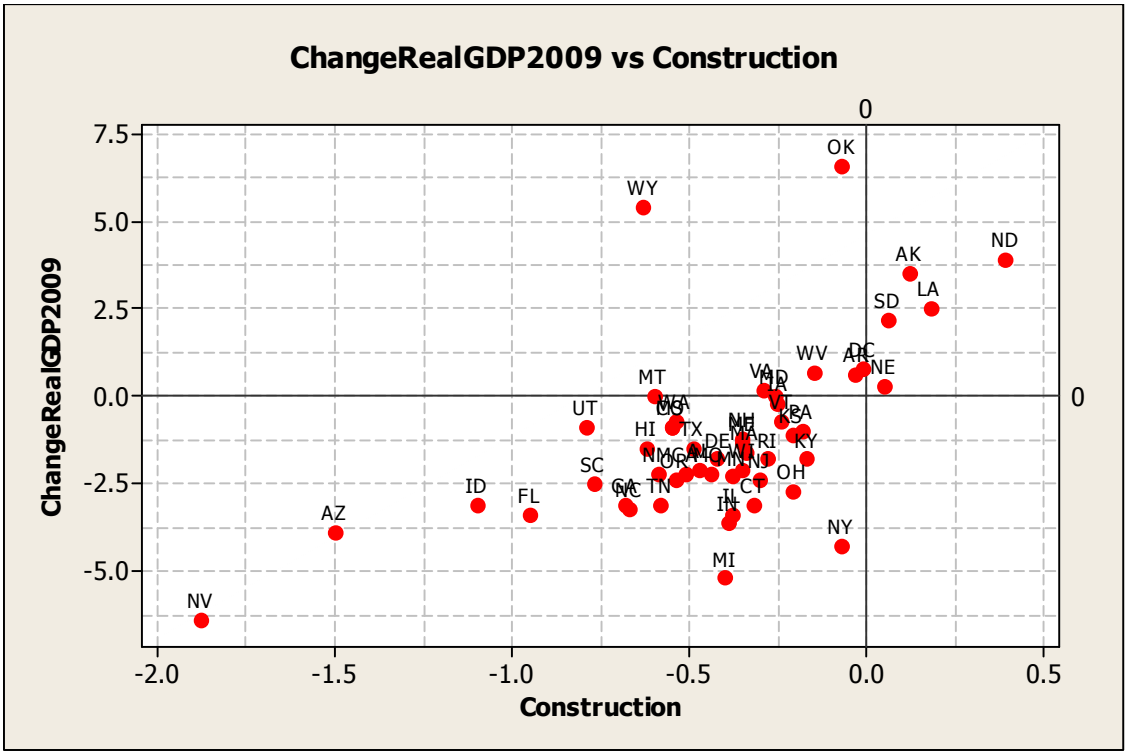
Scatter Plot A.5



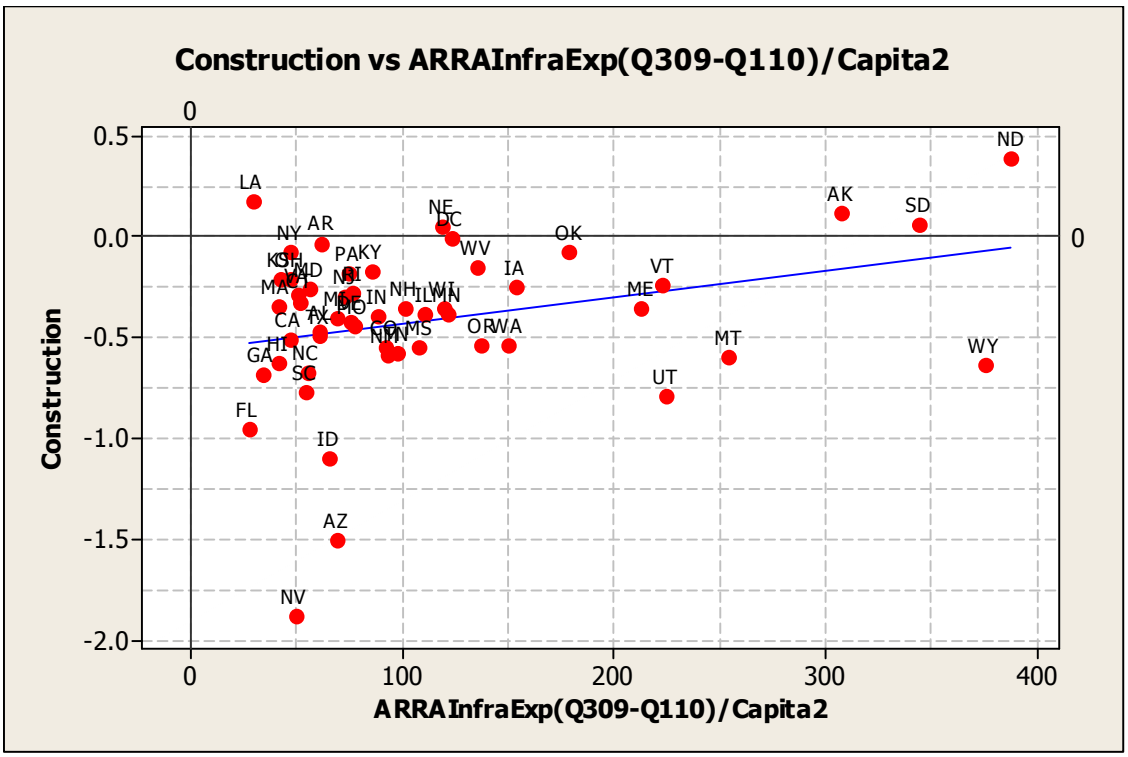
Scatter Plot A.6



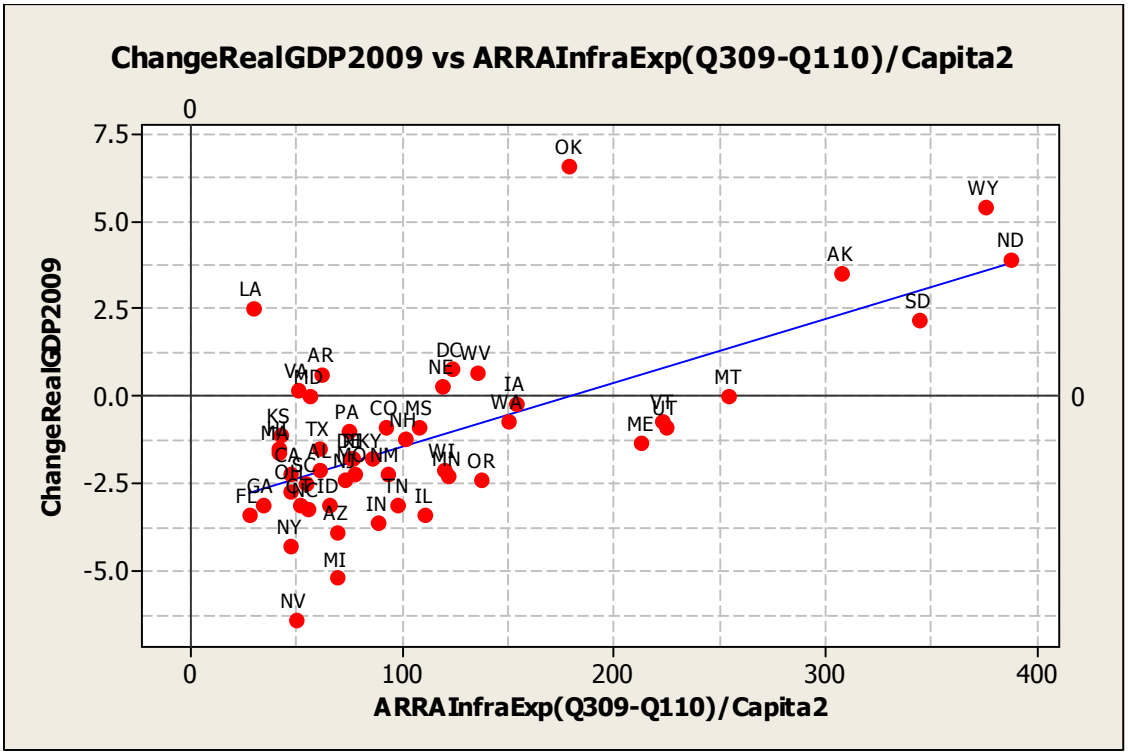
Scatter Plot A.7



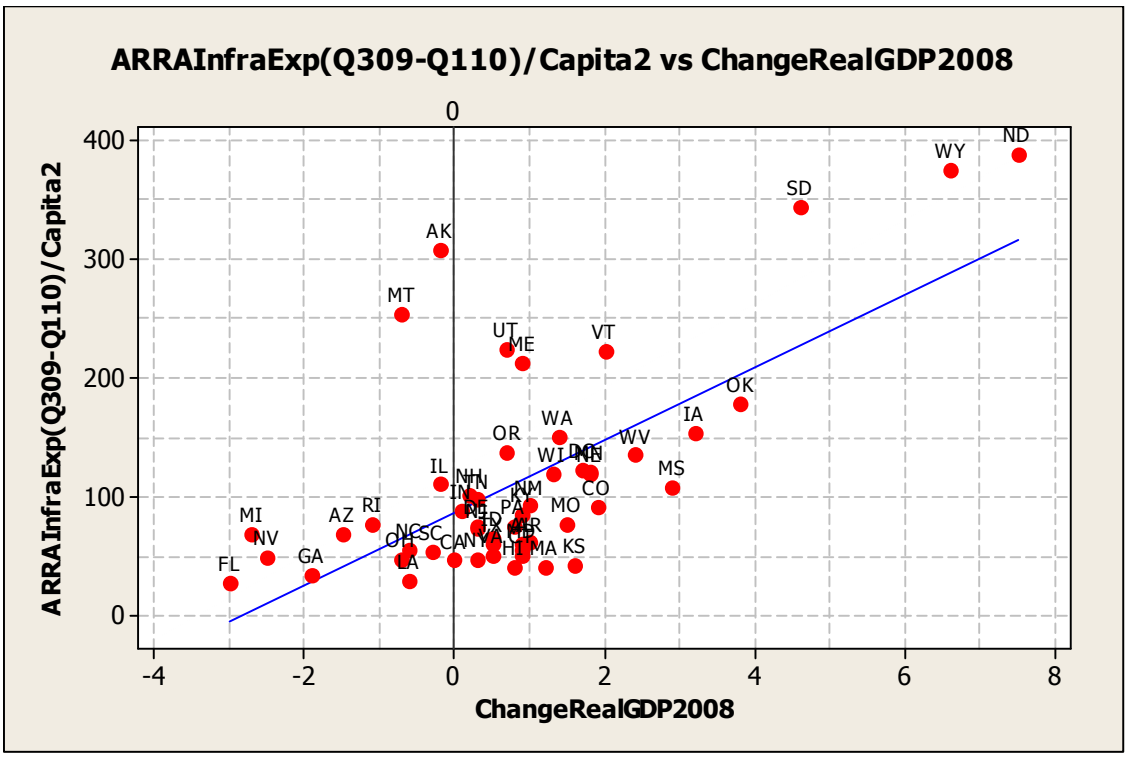
Scatter Plot A.8



Scatter Plot A.9



Scatter Plot A.10



APPENDIX

Appendix 1: Economic Multipliers

Appendix 2: Cluster Analysis

Appendix 3: Linear Models and Stepwise Regression

Appendix 4: Data Tables

Appendix 5: Data Ranks

Appendix 6: Sources and Formulas

Appendix 1: Economic Multipliers

Economic Multipliers

As explained in chapter 2, output = demand = consumption + investment. The change in output divided by the change in investment is called the **multiplier** and is always greater than one. A multiplier summarizes the total impact that can be expected from change in a given economic activity. There are different types of multipliers: output multipliers, employment multipliers, income multiplier, value added multipliers, and others. In this study we used the output multiplier. The **output multiplier** estimates the total change in local sales, including the initial $1 of sales outside the area, resulting from a $1 increase in sales outside of the study area (final demand). Multiplying the increase in sales of the exporting industry by the output multiplier provides an estimate of the total increase in sales for the study area, including the $1 export sales [27]. The output multiplier is used to assess the interdependence of sectors in the local economy.

For example, an output multiplier of 1.6 indicates that for every $1 of a product exported to Japan, an additional $0.60 of output is produced in the local economy. If X Company sells $1 million of x product to Japan, then $600,000 of additional output is produced locally to supply X Inc., other affected industries and consumers. If most of the supplies and services are purchased outside the local community, the output multiplier would be considerably lower, such as 1.4, or 40 cents for every dollar of export sales [27].

Appendix 2: Cluster Analysis

Cluster Analysis

Cluster Analysis is a statistical method used to classify data that share common characteristics into groups that has not been previously classified. Cluster Analysis measures the distances among the observations using mathematical techniques, and the distance among clusters by a link statistic that represents the cluster.

Procedure

Cluster analysis uses an agglomerative hierarchical method that begins with all observations being separate, each forming its own **cluster**. In the first step, the two observations closest together are joined forming a cluster. In the next step, either a third observation joins the first two, or two other observations are joined together into a different cluster. This process will continue until all clusters are joined into one cluster; however this single cluster is not useful for classification purposes. We must decide how many groups are logical for our data and classify accordingly.

At each stage there is a **distance matrix**. The entry, d(m,j), in row m and column j of this matrix is the distance from cluster m to cluster j. At the beginning, when each observation constitutes a cluster, the distance from cluster m to cluster j is the corresponding value in **D**, giving the distance from observation m to observation j. On each step of the amalgamation algorithm, the two rows (and columns) of the distance matrix corresponding to the two clusters to be joined are replaced by a new row (and column) corresponding to the new cluster created by joining the two clusters. The linkage method determines how the elements, d(m,j), of the new row, m, are calculated from the elements, d(k,j) and d(l,j), of the deleted rows, k and l.

If the data set has different scales and/or different units, we **standardize** all variables to minimize the effect of scale differences. All variables are adjusted on a common scale,

so that none influences the analysis disproportionately. This is done by subtracting the means and dividing by the standard deviation before the distance matrix is calculated. If we standardize, cluster centroids and distance measures are in standardized variable space.

To proceed with the algorithm we must choose a final partition. The final grouping of clusters (also called the final partition) is the grouping of clusters which will, hopefully, identify groups whose observations or variables share common characteristics. The decision about final grouping is also called cutting the **dendrogram**. The complete dendrogram (tree diagram) is a graphical depiction of the amalgamation of observations or variables into one cluster. Cutting the dendrogram is like drawing a line across the diagram to specify the final grouping.

The first time the program is executed the final partition is chosen arbitrarily. By examine the similarity and distance levels in the session window results and in the dendrogram. We can view the similarity levels by a horizontal line in the dendrogram. The similarity level at any step is the percent of the minimum distance at that step relative to the maximum inter-observation distance in the data. The pattern of how similarity or distance values change from step to step can help us choose the final grouping. The step where the values change abruptly is a good point for cutting the dendrogram, if it suits the data.

After choosing where to make the partition, rerun the clustering procedure, using either **mumber of clusters** or **similarity level** to give either a set number of groups or a similarity level for cutting the dendrogram. Examine the resulting clusters in the final partition to see if the grouping seems logical. Looking at dendrograms for different final groupings can also help to decide which one makes the most sense for the data.

Distance Measures

Minitab provides five different methods to measure distance:

The Euclidean method: is a standard mathematical measure of distance (square root of the sum of squared differences).

The Pearson method: is a square root of the sum of square distances divided by variances. This method is for standardizing.

The Manhattan distance: is the sum of absolute distances, so that outliers receive less weight than they would if the Euclidean method were used.

The Squared Euclidean and Squared Pearson methods: they use the square of the Euclidean and Pearson methods, respectfully. Therefore, the distances that are large under the Euclidean and Pearson methods will be even larger under the squared Euclidean and squared Pearson methods.

Linkage methods

The linkage method determines how the distance between two clusters is defined. At each amalgamation stage, the two closest clusters are joined. At the beginning, when each observation constitutes a cluster, the distance between clusters is simply the inter-observation distance. Subsequently, after observations are joined together, a linkage rule is necessary for calculating inter-cluster distances when there are multiple observations in a cluster. Is better to try several linkage methods and compare the results. Depending on the characteristics of the data, some methods may provide "better" results than others.

Minitab provides seven linkage methods:

With ***single linkage***, or "***nearest neighbor***," the distance between two clusters is the minimum distance between an observation in one cluster and an observation in the other cluster. Single linkage is a good choice when clusters are clearly separated. When observations lie close together, single linkage tends to identify long chain-like clusters that can have a relatively large distance separating observations at either end of the chain [33].

With ***average linkage***, the distance between two clusters is the mean distance between an observation in one cluster and an observation in the other cluster. Whereas the single or complete linkage methods group clusters based upon single pair distances, average linkage uses a more central measure of location.

With ***centroid linkage***, the distance between two clusters is the distance between the cluster centroids or means. Like average linkage, this method is another averaging technique.

With ***complete linkage***, or "***furthest neighbor***," the distance between two clusters is the maximum distance between an observation in one cluster and an observation in the other cluster. This method ensures that all observations in a cluster are within a maximum

distance and tends to produce clusters with similar diameters. The results can be sensitive to outliers [34].

With ***median linkage***, the distance between two clusters is the median distance between an observation in one cluster and an observation in the other cluster. This is another averaging technique, but uses the median rather than the mean, thus down weighting the influence of outliers.

With ***McQuitty's linkage***, when two clusters are be joined, the distance of the new cluster to any other cluster is calculated as the average of the distances of the soon to be joined clusters to that other cluster. For example, if clusters 1 and 3 are to be joined into a new cluster, say 1*, then the distance from 1* to cluster 4 is the average of the distances from 1 to 4 and 3 to 4. Here, distance depends on a combination of clusters rather than individual observations in the clusters.

With ***Ward's linkage***, the distance between two clusters is the sum of squared deviations from points to centroids. The objective of Ward's linkage is to minimize the within-cluster sum of squares. It tends to produce clusters with similar numbers of observations, but it is sensitive to outliers [34]. In Ward's linkage, it is possible for the distance between two clusters to be larger than *d(max)*, the maximum value in the original distance matrix. If this happens, the similarity will be negative.

Definitions

Dendrogram:

The dendrogram displays the information in the amalgamation table in the form of a tree diagram. The complete dendrogram (**tree diagram**) is a graphical depiction of the amalgamation of observations into one cluster. For some data sets, average, centroid, median and Ward's linkage methods do not produce a hierarchical dendrogram, meaning amalgamation distances do not always increase with each step. In the dendrogram, such a step produces a join that goes downward rather than upward.

Similarities (Cluster Observations):

The similarity, *s(i ,j)*, between two clusters *i* and *j* is given by

$$s(i, j) = \left(\frac{1 - d(i, j)}{d(\max)} \right) * 100$$

where *d(max)* is the maximum value in the original distance matrix, **D**.

Final partition:

Is the final grouping of clusters which identifies groups whose observations share common characteristics. The final grouping can be specify by drawing a line across the dendrogram, by choosing either the number of clusters or the similarity level, this is called **cutting the dendrogram**.

Appendix 3: Linear Models and Stepwise Regression

Linear Models

Modeling refers to the development of mathematical expressions that describes in some sense the behavior of a random variable of interest. This variable is called the **dependent variable** and is denoted with *Y*. Other variables which are thought to provide information on the behavior of the dependent variable are incorporated into the model as predictors or explanatory variables. These variables are called the **independent variables** and are denoted by $X_1, X_2, X_3, ..., X_p$ where *p* is total number of predictors, *X* is suffice for models with only one predictor.

A multiple linear regression model has the form

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip} + \varepsilon_i,\ i = 1,2,\ldots,n$$

Where

β_j is the regression coefficient of the x_j variable

n is the number of observations

And

ε_i is the random error and is normally and independently distribute with mean cero and constant variance

$\varepsilon_i \sim \text{NID}(0, \sigma^2)$.

The β_j's are estimate commonly using the least squares method. The least square estimation procedure uses the criterion that the solution must give the smallest possible

sum of squared deviations of the observed y_i from the estimates of their true means provided by the solution.

The approximated $\hat{\beta}_j$ using matrix notation is computed by the formula

$$\hat{B}=(X^T X)^{-1} X^T Y$$

Where

$\hat{B}$ is a vector with $p + 1$ parameters

X is a p by n matrix of all the observations of the independent variables

Y is the vector of all n observations of the dependent variable

For a model of only one predictor the parameters are estimate by

$\hat{\beta}_1 = \frac{\sum (X_i - \overline{X})(Y_i - \overline{Y})}{\sum (X_i - \overline{X})^2}$, and $\hat{\beta}_0 = \overline{Y} - \hat{\beta}_1 \overline{X}$, where $\overline{Y}$ and $\overline{X}$ are the sample means.

These estimates of the parameters give the regression equation

$\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 X_i$.

Reference: [13]

Stepwise Regression

Stepwise regression removes and adds variables to the regression model for the purpose of identifying a useful subset of the predictors.

Methods

- **Forward Selection**
  - Forward selection starts by choosing as the one-variable subset the independent variable that accounts for the largest amount of variation in the dependent variable, that is, the variable having the highest simple correlation with *Y*.

- **Backward Elimination**
  - Backward elimination chooses the subset models by starting with the full model and then eliminating at each step the one variable whose deletion will cause the residual sum of squares to increase the least.

- **Stepwise Selection**
  - Stepwise regression is a forward selection process that rechecks at each step the importance of all previously included variables using backward elimination.

For all cases we must choose the level of significance (alpha) for the variable to enter or to leave the model. The common level is .05.

Reference: [13]

Appendix 4

Data Tables

T.1 #	State	State Abbreviation	Size (Land & Water) Miles Squared	Population 2008	ARRAInfraExp (Q309-Q110)	ARRAInfraExp (Q309-Q110)/Capita
1	Alabama	AL	52,419	4,677,464	$287,021,140	$61.00
2	Alaska	AK	663,267	688,125	$214,488,256	$307.10
3	Arizona	AZ	113,998	6,499,377	$454,986,225	$69.00
4	Arkansas	AR	53,179	2,867,764	$177,148,988	$61.30
5	California	CA	163,696	36,580,371	$1,721,872,347	$46.60
6	Colorado	CO	104,094	4,935,213	$460,869,314	$91.70
7	Connecticut	CT	5,543	3,502,932	$179,723,027	$51.10
8	Delaware	DE	2,489	876,211	$66,619,511	$75.30
9	District of Columbia	DC	68	590,074	$73,725,526	$122.90
10	Florida	FL	65,755	18,423,878	$501,943,183	$27.10
11	Georgia	GA	59,425	9,697,838	$333,707,958	$34.00
12	Hawaii	HI	10,931	1,287,481	$53,592,363	$41.40
13	Idaho	ID	83,570	1,527,506	$100,885,192	$65.30
14	Illinois	IL	57,914	12,842,954	$1,424,975,538	$110.40
15	Indiana	IN	36,418	6,388,309	$564,578,701	$87.90
16	Iowa	IA	56,272	2,993,987	$463,475,286	$154.10
17	Kansas	KS	82,277	2,797,375	$118,473,746	$42.00
18	Kentucky	KY	40,409	4,287,931	$368,558,910	$85.40
19	Louisiana	LA	51,840	4,451,513	$130,848,603	$29.10
20	Maine	ME	35,385	1,319,691	$280,370,580	$212.70
21	Maryland	MD	12,407	5,658,655	$319,235,464	$56.00
22	Massachusetts	MA	10,555	6,543,595	$269,439,572	$40.90
23	Michigan	MI	96,716	10,002,486	$683,600,593	$68.60
24	Minnesota	MN	86,939	5,230,567	$640,609,296	$121.60
25	Mississippi	MS	48,430	2,940,212	$318,938,180	$108.00
26	Missouri	MO	69,704	5,956,335	$461,801,995	$77.10
27	Montana	MT	147,042	968,035	$247,788,211	$254.10
28	Nebraska	NE	77,354	1,781,949	$213,671,516	$118.90
29	Nevada	NV	110,561	2,615,772	$130,101,446	$49.20
30	New Hampshire	NH	9,350	1,321,872	$133,897,675	$101.10
31	New Jersey	NJ	8,721	8,663,398	$634,116,000	$72.80
32	New Mexico	NM	121,589	1,986,763	$185,697,389	$92.40
33	New York	NY	54,556	19,467,789	$921,479,174	$47.20
34	North Carolina	NC	53,819	9,247,134	$514,721,356	$54.90
35	North Dakota	ND	70,700	641,421	$250,635,605	$387.50
36	Ohio	OH	44,825	11,528,072	$543,906,668	$47.10
37	Oklahoma	OK	69,898	3,644,025	$659,242,627	$178.80
38	Oregon	OR	98,381	3,782,991	$525,487,075	$137.40
39	Pennsylvania	PA	46,055	12,566,368	$942,754,466	$74.80
40	Rhode Island	RI	1,545	1,053,502	$80,507,090	$76.40
41	South Carolina	SC	32,020	4,503,280	$249,105,688	$54.60
42	South Dakota	SD	77,116	804,532	$279,473,729	$344.00
43	Tennessee	TN	42,143	6,240,456	$612,756,012	$97.30
44	Texas	TX	268,581	24,304,290	$1,505,339,628	$60.70
45	Utah	UT	84,899	2,727,343	$626,036,931	$224.80
46	Vermont	VT	9,614	621,049	$138,682,093	$223.00
47	Virginia	VA	42,774	7,795,424	$396,747,556	$50.30
48	Washington	WA	71,300	6,566,073	$1,000,478,763	$150.10
49	West Virginia	WV	24,230	1,814,873	$245,738,525	$135.00
50	Wisconsin	WI	65,498	5,627,610	$674,065,885	$119.20
51	Wyoming	WY	97,814	532,981	$204,321,185	$375.40
52	Puerto Rico	PR	5,325	3,954,553	$80,648,663	$20.30
53	Virgin Islands	VI			$4,132,674	$37.60

T.2 #	State	State Abbreviation	GDP per Capita 2008	Personal Income per Capita 2008	Unemployment 2008
1	Alabama	AL	$36,718	$33,655	5.2
2	Alaska	AK	$70,555	$43,922	6.5
3	Arizona	AZ	$40,373	$34,339	5.9
4	Arkansas	AR	$35,193	$32,257	5.2
5	California	CA	$52,528	$43,852	7.2
6	Colorado	CO	$51,657	$43,021	4.9
7	Connecticut	CT	$65,688	$56,245	5.6
8	Delaware	DE	$69,086	$40,375	4.9
9	District of Columbia	DC	$162,534	$66,316	6.6
10	Florida	FL	$40,696	$39,064	6.3
11	Georgia	GA	$41,394	$34,849	6.2
12	Hawaii	HI	$51,371	$42,078	4
13	Idaho	ID	$36,435	$32,994	4.9
14	Illinois	IL	$50,024	$42,540	6.4
15	Indiana	IN	$42,112	$34,543	5.8
16	Iowa	IA	$47,456	$37,509	4.4
17	Kansas	KS	$44,998	$38,886	4.4
18	Kentucky	KY	$36,668	$31,936	6.6
19	Louisiana	LA	$47,473	$36,091	4.5
20	Maine	ME	$38,653	$36,368	5.3
21	Maryland	MD	$49,742	$48,164	4.4
22	Massachusetts	MA	$55,752	$50,897	5.3
23	Michigan	MI	$38,256	$34,953	8.3
24	Minnesota	MN	$50,573	$42,953	5.4
25	Mississippi	MS	$32,760	$30,383	6.8
26	Missouri	MO	$40,553	$36,356	6.1
27	Montana	MT	$37,057	$34,622	4.6
28	Nebraska	NE	$48,317	$39,182	3.3
29	Nevada	NV	$50,509	$40,936	6.7
30	New Hampshire	NH	$44,733	$43,423	3.9
31	New Jersey	NJ	$56,162	$51,473	5.5
32	New Mexico	NM	$39,188	$33,389	4.5
33	New York	NY	$57,504	$48,809	5.3
34	North Carolina	NC	$43,751	$35,249	6.2
35	North Dakota	ND	$48,714	$39,874	3.2
36	Ohio	OH	$41,399	$35,889	6.6
37	Oklahoma	OK	$41,549	$35,969	3.7
38	Oregon	OR	$44,800	$36,365	6.5
39	Pennsylvania	PA	$43,878	$39,762	5.3
40	Rhode Island	RI	$45,343	$41,261	7.6
41	South Carolina	SC	$35,715	$32,495	6.9
42	South Dakota	SD	$46,970	$38,644	3.1
43	Tennessee	TN	$39,800	$34,833	6.7
44	Texas	TX	$49,212	$37,809	4.9
45	Utah	UT	$41,336	$32,050	3.7
46	Vermont	VT	$40,617	$38,700	4.5
47	Virginia	VA	$51,326	$44,075	3.9
48	Washington	WA	$51,193	$42,747	5.4
49	West Virginia	WV	$33,981	$31,634	4.3
50	Wisconsin	WI	$43,763	$37,770	4.8
51	Wyoming	WY	$72,383	$48,580	3.2
52	Puerto Rico	PR	$23,498	$14,080	11
53	Virgin Islands	VI			

T.3 #	State	State Abbreviation	Contribution to GDP 2002-07	Contribution to the Recession of 2002-07	Construction Multiplier Type I Final Demand Output
1	Alabama	AL	1.26	-0.04	1.6157
2	Alaska	AK	0.43	0.00	1.3399
3	Arizona	AZ	2.18	-0.07	1.4901
4	Arkansas	AR	0.70	0.00	1.5302
5	California	CA	14.09	-0.03	1.5562
6	Colorado	CO	1.64	0.01	1.5455
7	Connecticut	CT	1.52	-0.02	1.4440
8	Delaware	DE	0.44	-0.02	1.4136
9	District of Columbia	DC	0.77	*	1.1708
10	Florida	FL	6.21	-0.17	1.4867
11	Georgia	GA	2.73	-0.10	1.6427
12	Hawaii	HI	0.53	-0.01	1.3690
13	Idaho	ID	0.43	-0.02	1.4203
14	Illinois	IL	3.77	-0.11	1.6220
15	Indiana	IN	1.30	-0.06	1.5970
16	Iowa	IA	0.95	-0.01	1.4402
17	Kansas	KS	0.84	0.00	1.4922
18	Kentucky	KY	1.02	-0.03	1.5810
19	Louisiana	LA	2.26	0.02	1.4935
20	Maine	ME	0.29	-0.01	1.4464
21	Maryland	MD	1.95	-0.04	1.4548
22	Massachusetts	MA	2.08	0.00	1.4806
23	Michigan	MI	1.05	-0.19	1.5590
24	Minnesota	MN	1.72	-0.06	1.5397
25	Mississippi	MS	0.62	-0.01	1.5366
26	Missouri	MO	1.28	-0.05	1.5989
27	Montana	MT	0.31	-0.01	1.4289
28	Nebraska	NE	0.60	0.00	1.3666
29	Nevada	NV	1.29	-0.06	1.4397
30	New Hampshire	NH	0.34	0.00	1.5270
31	New Jersey	NJ	2.86	-0.04	1.5376
32	New Mexico	NM	0.69	-0.01	1.3905
33	New York	NY	8.42	0.04	1.3818
34	North Carolina	NC	3.08	-0.08	1.5879
35	North Dakota	ND	0.23	0.00	1.3563
36	Ohio	OH	2.40	-0.13	1.6363
37	Oklahoma	OK	1.23	-0.01	1.5367
38	Oregon	OR	1.23	-0.11	1.5651
39	Pennsylvania	PA	3.32	-0.24	1.6664
40	Rhode Island	RI	0.31	-0.02	1.4064
41	South Carolina	SC	0.96	-0.06	1.6191
42	South Dakota	SD	0.23	0.00	1.3594
43	Tennessee	TN	1.60	-0.01	1.6218
44	Texas	TX	10.35	0.20	1.6624
45	Utah	UT	0.95	0.00	1.5994
46	Vermont	VT	0.15	0.00	1.4138
47	Virginia	VA	2.91	0.03	1.5580
48	Washington	WA	2.39	-0.15	1.5580
49	West Virginia	WV	0.39	0.00	1.4715
50	Wisconsin	WI	1.36	-0.01	1.5497
51	Wyoming	WY	0.33	0.01	1.3378

T.4 #	State	State Abbreviation	Impact on GDP per Capita	GDP per Capita 2009	Relative Output Weight
1	Alabama	AL	98.56	36,073.00	0.27
2	Alaska	AK	411.48	65,441.00	0.63
3	Arizona	AZ	102.82	38,868.00	0.26
4	Arkansas	AR	93.80	35,238.00	0.27
5	California	CA	72.52	51,171.00	0.14
6	Colorado	CO	141.72	50,283.00	0.28
7	Connecticut	CT	73.79	64,635.00	0.11
8	Delaware	DE	106.44	68,452.00	0.16
9	District of Columbia	DC	143.89	165,310.00	0.09
10	Florida	FL	40.29	39,758.00	0.10
11	Georgia	GA	55.85	40,206.00	0.14
12	Hawaii	HI	56.68	51,291.00	0.11
13	Idaho	ID	92.75	34,937.00	0.27
14	Illinois	IL	179.07	48,829.00	0.37
15	Indiana	IN	140.38	40,891.00	0.34
16	Iowa	IA	221.93	47,303.00	0.47
17	Kansas	KS	62.67	44,318.00	0.14
18	Kentucky	KY	135.02	36,289.00	0.37
19	Louisiana	LA	43.46	46,388.00	0.09
20	Maine	ME	307.65	38,908.00	0.79
21	Maryland	MD	81.47	50,320.00	0.16
22	Massachusetts	MA	60.56	55,384.00	0.11
23	Michigan	MI	106.95	36,952.00	0.29
24	Minnesota	MN	187.23	49,503.00	0.38
25	Mississippi	MS	165.95	32,488.00	0.51
26	Missouri	MO	123.28	40,042.00	0.31
27	Montana	MT	363.08	36,876.00	0.98
28	Nebraska	NE	162.49	48,112.00	0.34
29	Nevada	NV	70.83	47,862.00	0.15
30	New Hampshire	NH	154.38	44,845.00	0.34
31	New Jersey	NJ	111.94	55,464.00	0.20
32	New Mexico	NM	128.48	37,221.00	0.35
33	New York	NY	65.22	55,944.00	0.12
34	North Carolina	NC	87.18	42,431.00	0.21
35	North Dakota	ND	525.57	49,273.00	1.07
36	Ohio	OH	77.07	40,828.00	0.19
37	Oklahoma	OK	274.76	41,708.00	0.66
38	Oregon	OR	215.04	43,299.00	0.50
39	Pennsylvania	PA	124.65	44,013.00	0.28
40	Rhode Island	RI	107.45	45,420.00	0.24
41	South Carolina	SC	88.40	35,001.00	0.25
42	South Dakota	SD	467.63	47,155.00	0.99
43	Tennessee	TN	157.80	38,834.00	0.41
44	Texas	TX	100.91	46,190.00	0.22
45	Utah	UT	359.55	40,560.00	0.89
46	Vermont	VT	315.28	40,913.00	0.77
47	Virginia	VA	78.37	51,816.00	0.15
48	Washington	WA	233.86	50,769.00	0.46
49	West Virginia	WV	198.65	34,809.00	0.57
50	Wisconsin	WI	184.72	43,215.00	0.43
51	Wyoming	WY	502.21	68,980.00	0.73

T.5 #	State	Percentage Change in Real GDP 2008	Percentage Change in Real GDP 2009	Change in Percentage Points in Construction 2009
1	Alabama	0.9	-2.10	-0.47
2	Alaska	-0.2	3.50	0.12
3	Arizona	-1.5	-3.90	-1.50
4	Arkansas	1.0	0.60	-0.03
5	California	0.0	-2.20	-0.51
6	Colorado	1.9	-0.90	-0.55
7	Connecticut	0.9	-3.10	-0.32
8	Delaware	0.3	-1.80	-0.42
9	District of Columbia	1.7	0.80	-0.01
10	Florida	-3.0	-3.40	-0.95
11	Georgia	-1.9	-3.10	-0.68
12	Hawaii	0.8	-1.50	-0.62
13	Idaho	0.5	-3.10	-1.10
14	Illinois	-0.2	-3.40	-0.38
15	Indiana	0.1	-3.60	-0.39
16	Iowa	3.2	-0.20	-0.25
17	Kansas	1.6	-1.10	-0.21
18	Kentucky	0.9	-1.80	-0.17
19	Louisiana	-0.6	2.50	0.18
20	Maine	0.9	-1.30	-0.35
21	Maryland	0.9	0.00	-0.26
22	Massachusetts	1.2	-1.60	-0.34
23	Michigan	-2.7	-5.20	-0.40
24	Minnesota	1.8	-2.30	-0.38
25	Mississippi	2.9	-0.90	-0.55
26	Missouri	1.5	-2.20	-0.44
27	Montana	-0.7	0.00	-0.60
28	Nebraska	1.8	0.30	0.05
29	Nevada	-2.5	-6.40	-1.88
30	New Hampshire	0.2	-1.20	-0.35
31	New Jersey	0.3	-2.40	-0.30
32	New Mexico	1.0	-2.20	-0.59
33	New York	0.3	-4.30	-0.07
34	North Carolina	-0.6	-3.20	-0.67
35	North Dakota	7.5	3.90	0.39
36	Ohio	-0.7	-2.70	-0.21
37	Oklahoma	3.8	6.60	-0.07
38	Oregon	0.7	-2.40	-0.54
39	Pennsylvania	0.8	-1.00	-0.18
40	Rhode Island	-1.1	-1.80	-0.28
41	South Carolina	-0.3	-2.50	-0.77
42	South Dakota	4.6	2.20	0.06
43	Tennessee	0.3	-3.10	-0.58
44	Texas	0.5	-1.50	-0.49
45	Utah	0.7	-0.90	-0.79
46	Vermont	2.0	-0.70	-0.24
47	Virginia	0.5	0.20	-0.29
48	Washington	1.4	-0.70	-0.54
49	West Virginia	2.4	0.70	-0.15
50	Wisconsin	1.3	-2.10	-0.35
51	Wyoming	6.6	5.40	-0.63
	United States	**0.1**	**-2.1**	**-0.44**

T.6 #	State	Professional and Tech Services	Nondurable-goods Manufacturing	Government	Finance and Insurance
1	Alabama	0.15	-0.41	0.30	0.14
2	Alaska	0.17	0.11	0.78	0.26
3	Arizona	-0.22	-0.13	-0.05	0.06
4	Arkansas	0.02	-0.39	0.46	0.17
5	California	-0.31	0.38	-0.09	-0.22
6	Colorado	-0.08	-0.20	0.43	0.06
7	Connecticut	-0.23	-0.58	0.08	-0.84
8	Delaware	-0.18	-0.16	0.16	0.00
9	District of Columbia	-0.30	0.00	1.70	-0.45
10	Florida	-0.24	-0.14	0.02	-0.17
11	Georgia	-0.14	-0.62	0.00	-0.08
12	Hawaii	0.01	0.00	0.59	0.12
13	Idaho	0.07	-0.14	0.14	0.10
14	Illinois	-0.29	-0.29	0.19	-0.37
15	Indiana	-0.06	-0.67	0.17	0.09
16	Iowa	0.03	-0.52	0.29	0.56
17	Kansas	0.00	-0.31	0.38	0.20
18	Kentucky	0.06	-0.46	0.26	0.17
19	Louisiana	-0.05	1.30	0.23	0.08
20	Maine	-0.08	-0.48	0.07	0.26
21	Maryland	0.39	-0.22	0.57	0.05
22	Massachusetts	-0.23	-0.19	0.04	-0.31
23	Michigan	-0.72	-0.41	0.10	-0.04
24	Minnesota	-0.18	-0.26	0.10	0.21
25	Mississippi	-0.07	0.12	0.35	0.15
26	Missouri	-0.07	-0.99	0.30	0.40
27	Montana	-0.03	0.41	0.40	0.24
28	Nebraska	0.10	-0.41	0.38	0.42
29	Nevada	-0.33	-0.11	0.08	-0.13
30	New Hampshire	-0.28	-0.28	0.21	0.21
31	New Jersey	-0.15	-0.39	0.11	-0.20
32	New Mexico	0.10	-0.02	0.60	0.26
33	New York	-0.28	-0.27	0.10	-2.78
34	North Carolina	-0.06	-1.13	0.33	-0.32
35	North Dakota	0.09	-0.05	0.54	0.48
36	Ohio	-0.10	-0.40	0.10	0.33
37	Oklahoma	-0.04	0.08	0.56	0.26
38	Oregon	-0.10	-0.18	0.27	0.08
39	Pennsylvania	0.03	-0.26	0.24	0.17
40	Rhode Island	-0.04	-0.26	-0.01	0.07
41	South Carolina	-0.06	-0.61	0.32	0.26
42	South Dakota	0.01	-0.10	0.45	0.93
43	Tennessee	-0.03	-0.55	0.03	0.23
44	Texas	-0.12	-0.07	0.47	0.07
45	Utah	-0.04	-0.01	0.39	0.45
46	Vermont	-0.02	-0.25	0.20	-0.09
47	Virginia	0.63	-0.35	0.35	0.12
48	Washington	-0.02	-0.09	0.44	-0.13
49	West Virginia	0.04	-0.24	0.57	0.17
50	Wisconsin	-0.10	-0.50	0.12	0.39
51	Wyoming	-0.07	0.47	0.61	-0.01
	United States	**-0.13**	**-0.20**	**0.20**	**-0.23**

T.6 cont. #	State	Agriculture forestry, fishing, …	Mining	Utilities	Wholesale Trade	Retail Trade	Transportation & warehousing
1	Alabama	0.09	-0.04	0.01	-0.14	-0.28	-0.11
2	Alaska	0.02	0.50	0.13	0.09	-0.08	0.67
3	Arizona	0.00	-0.17	0.09	-0.05	-0.56	-0.04
4	Arkansas	-0.01	0.37	0.06	0.21	-0.12	-0.23
5	California	0.02	0.07	0.10	-0.14	-0.49	-0.08
6	Colorado	0.05	0.27	0.05	-0.17	-0.29	-0.06
7	Connecticut	0.01	-0.01	-0.03	-0.05	-0.18	-0.09
8	Delaware	(d)	(d)	0.08	-0.01	-0.18	-0.04
9	District of Columbia	0.00	0.00	0.07	0.03	-0.02	0.00
10	Florida	0.04	-0.08	0.10	-0.12	-0.35	-0.08
11	Georgia	0.06	-0.01	0.08	-0.17	-0.32	-0.14
12	Hawaii	0.07	0.00	0.21	0.03	-0.21	-0.28
13	Idaho	-0.14	-0.03	0.03	0.04	-0.50	0.00
14	Illinois	0.15	-0.03	0.00	-0.08	-0.30	-0.12
15	Indiana	0.16	0.00	0.11	-0.12	-0.20	-0.10
16	Iowa	0.45	-0.01	0.03	0.13	-0.02	-0.01
17	Kansas	0.42	-0.07	0.14	0.18	-0.23	-0.12
18	Kentucky	0.10	-0.55	0.15	-0.06	-0.11	-0.12
19	Louisiana	0.00	1.66	0.08	0.03	-0.14	-0.14
20	Maine	(d)	(d)	-0.02	0.06	-0.16	0.00
21	Maryland	0.01	-0.06	-0.09	0.07	-0.25	-0.03
22	Massachusetts	0.00	0.00	0.09	-0.06	-0.14	-0.04
23	Michigan	0.02	0.01	0.09	-0.32	-0.28	-0.14
24	Minnesota	0.03	-0.03	0.05	-0.08	-0.21	-0.20
25	Mississippi	0.05	0.16	0.07	0.03	-0.26	-0.02
26	Missouri	0.15	-0.02	0.08	0.00	-0.14	-0.12
27	Montana	0.32	-0.33	0.17	0.04	-0.29	-0.12
28	Nebraska	0.70	-0.01	-0.20	0.20	-0.14	-0.28
29	Nevada	0.02	0.26	0.05	-0.15	-0.54	-0.01
30	New Hampshire	0.00	-0.01	0.03	-0.07	-0.30	-0.02
31	New Jersey	0.01	0.00	-0.01	-0.04	-0.27	-0.09
32	New Mexico	0.06	-1.46	0.14	-0.09	-0.29	-0.22
33	New York	-0.01	0.00	0.03	-0.02	-0.17	-0.05
34	North Carolina	0.11	0.01	-0.01	-0.02	-0.29	-0.09
35	North Dakota	1.10	0.12	0.16	0.59	0.04	0.17
36	Ohio	0.04	-0.02	0.05	-0.08	-0.23	-0.18
37	Oklahoma	0.05	7.23	0.22	-0.06	-0.12	0.07
38	Oregon	-0.05	0.01	0.05	-0.03	-0.30	-0.14
39	Pennsylvania	0.00	-0.03	-0.02	0.03	-0.13	0.00
40	Rhode Island	0.01	0.01	0.06	0.08	-0.25	-0.04
41	South Carolina	0.02	0.01	0.12	-0.19	-0.34	-0.11
42	South Dakota	0.77	0.04	0.03	0.23	-0.04	0.02
43	Tennessee	0.06	-0.01	0.05	-0.19	-0.37	-0.23
44	Texas	0.01	-0.47	0.02	-0.03	-0.21	-0.03
45	Utah	-0.03	0.16	0.05	-0.01	-0.33	-0.06
46	Vermont	-0.09	0.08	0.11	0.14	-0.26	-0.02
47	Virginia	0.01	-0.05	0.04	0.05	-0.19	-0.02
48	Washington	0.01	0.04	0.13	0.03	-0.29	-0.03
49	West Virginia	0.01	-0.36	0.25	0.16	-0.02	-0.02
50	Wisconsin	-0.04	0.03	0.07	-0.03	-0.18	-0.05
51	Wyoming	0.18	5.90	0.10	-0.02	-0.22	-0.32
	United States	**0.05**	**0.07**	**0.06**	**-0.06**	**-0.27**	**-0.08**

T.7 #	State	State Abbreviation	GDP per Capita 2009	Personal Income per Capita 2009	Unemployment 2009
1	Alabama	AL	$36,073	$33,096	10.1
2	Alaska	AK	$65,441	$42,603	8.0
3	Arizona	AZ	$38,868	$32,935	9.1
4	Arkansas	AR	$35,238	$31,946	7.3
5	California	CA	$51,171	$42,325	11.4
6	Colorado	CO	$50,283	$41,344	7.7
7	Connecticut	CT	$64,635	$54,397	8.2
8	Delaware	DE	$68,452	$39,817	8.1
9	District of Columbia	DC	$165,310	$66,000	10.2
10	Florida	FL	$39,758	$37,780	10.5
11	Georgia	GA	$40,206	$33,786	9.6
12	Hawaii	HI	$51,291	$42,009	6.8
13	Idaho	ID	$34,937	$31,632	8.0
14	Illinois	IL	$48,829	$41,411	10.1
15	Indiana	IN	$40,891	$33,725	10.1
16	Iowa	IA	$47,303	$36,751	6.0
17	Kansas	KS	$44,318	$37,916	6.7
18	Kentucky	KY	$36,289	$31,883	10.5
19	Louisiana	LA	$46,388	$35,507	6.8
20	Maine	ME	$38,908	$36,745	8.0
21	Maryland	MD	$50,320	$48,285	7.0
22	Massachusetts	MA	$55,384	$49,875	8.4
23	Michigan	MI	$36,952	$34,025	13.6
24	Minnesota	MN	$49,503	$41,552	8.0
25	Mississippi	MS	$32,488	$30,103	9.6
26	Missouri	MO	$40,042	$35,676	9.3
27	Montana	MT	$36,876	$34,004	6.2
28	Nebraska	NE	$48,112	$38,081	4.6
29	Nevada	NV	$47,862	$38,578	11.8
30	New Hampshire	NH	$44,845	$42,831	6.3
31	New Jersey	NJ	$55,464	$50,313	9.2
32	New Mexico	NM	$37,221	$32,992	7.2
33	New York	NY	$55,944	$46,957	8.4
34	North Carolina	NC	$42,431	$34,453	10.6
35	North Dakota	ND	$49,273	$39,530	4.3
36	Ohio	OH	$40,828	$35,381	10.2
37	Oklahoma	OK	$41,708	$35,268	6.4
38	Oregon	OR	$43,299	$35,667	11.1
39	Pennsylvania	PA	$44,013	$39,578	8.1
40	Rhode Island	RI	$45,420	$41,003	11.2
41	South Carolina	SC	$35,001	$31,799	11.7
42	South Dakota	SD	$47,155	$36,935	4.8
43	Tennessee	TN	$38,834	$34,089	10.5
44	Texas	TX	$46,190	$36,484	7.6
45	Utah	UT	$40,560	$30,875	6.6
46	Vermont	VT	$40,913	$38,503	6.9
47	Virginia	VA	$51,816	$43,874	6.7
48	Washington	WA	$50,769	$41,751	8.9
49	West Virginia	WV	$34,809	$32,219	7.9
50	Wisconsin	WI	$43,215	$36,822	8.5
51	Wyoming	WY	$68,980	$45,705	6.4
52	Puerto Rico	PR	$24,124	$14,905	13.4

Appendix 5

Data Ranks

T.8 Rank	State	Abbreviation	ARRA Infra Exp per Capita Q3 2009 - Q1 2010
1	North Dakota	ND	387.5
2	Wyoming	WY	375.4
3	South Dakota	SD	344
4	Alaska	AK	307.1
5	Montana	MT	254.1
6	Utah	UT	224.8
7	Vermont	VT	223
8	Maine	ME	212.7
9	Oklahoma	OK	178.8
10	Iowa	IA	154.1
11	Washington	WA	150.1
12	Oregon	OR	137.4
13	West Virginia	WV	135
14	District of Columbia	DC	122.9
15	Minnesota	MN	121.6
16	Wisconsin	WI	119.2
17	Nebraska	NE	118.9
18	Illinois	IL	110.4
19	Mississippi	MS	108
20	New Hampshire	NH	101.1
21	Tennessee	TN	97.3
22	New Mexico	NM	92.4
23	Colorado	CO	91.7
24	Indiana	IN	87.9
25	Kentucky	KY	85.4
26	Missouri	MO	77.1
27	Rhode Island	RI	76.4
28	Delaware	DE	75.3
29	Pennsylvania	PA	74.8
30	New Jersey	NJ	72.8
31	Arizona	AZ	69
32	Michigan	MI	68.6
33	Idaho	ID	65.3
34	Arkansas	AR	61.3
35	Alabama	AL	61
36	Texas	TX	60.7
37	Maryland	MD	56
38	North Carolina	NC	54.9
39	South Carolina	SC	54.6
40	Connecticut	CT	51.1
41	Virginia	VA	50.3
42	Nevada	NV	49.2
43	New York	NY	47.2
44	Ohio	OH	47.1
45	California	CA	46.6
46	Kansas	KS	42
47	Hawaii	HI	41.4
48	Massachusetts	MA	40.9
49	Virgin Islands	VI	37.6
50	Georgia	GA	34
51	Louisiana	LA	29.1
52	Florida	FL	27.1
53	Puerto Rico	PR	20.3

T.9 Rank	State	Abbreviation	Relative Output Weight
1	North Dakota	ND	1.07
2	South Dakota	SD	0.99
3	Montana	MT	0.98
4	Utah	UT	0.89
5	Maine	ME	0.79
6	Vermont	VT	0.77
7	Wyoming	WY	0.73
8	Oklahoma	OK	0.66
9	Alaska	AK	0.63
10	West Virginia	WV	0.57
11	Mississippi	MS	0.51
12	Oregon	OR	0.50
13	Iowa	IA	0.47
14	Washington	WA	0.46
15	Wisconsin	WI	0.43
16	Tennessee	TN	0.41
17	Minnesota	MN	0.38
18	Illinois	IL	0.37
19	Kentucky	KY	0.37
20	New Mexico	NM	0.35
21	Indiana	IN	0.34
22	Nebraska	NE	0.34
23	New Hampshire	NH	0.34
24	Missouri	MO	0.31
25	Michigan	MI	0.29
26	Colorado	CO	0.28
27	Pennsylvania	PA	0.28
28	Alabama	AL	0.27
29	Arkansas	AR	0.27
30	Idaho	ID	0.27
31	Arizona	AZ	0.26
32	South Carolina	SC	0.25
33	Rhode Island	RI	0.24
34	Texas	TX	0.22
35	North Carolina	NC	0.21
36	New Jersey	NJ	0.20
37	Ohio	OH	0.19
38	Delaware	DE	0.16
39	Maryland	MD	0.16
40	Nevada	NV	0.15
41	Virginia	VA	0.15
42	California	CA	0.14
43	Georgia	GA	0.14
44	Kansas	KS	0.14
45	New York	NY	0.12
46	Connecticut	CT	0.11
47	Hawaii	HI	0.11
48	Massachusetts	MA	0.11
49	Florida	FL	0.10
50	District of Columbia	DC	0.09
51	Louisiana	LA	0.09

T.10 Rank	State	Abbreviation	Change in Unemployment 2008-09
1	Michigan	MI	5.3
2	Nevada	NV	5.1
3	Alabama	AL	4.9
4	South Carolina	SC	4.8
5	Oregon	OR	4.6
6	North Carolina	NC	4.4
7	Indiana	IN	4.3
8	California	CA	4.2
9	Florida	FL	4.2
10	Kentucky	KY	3.9
11	Tennessee	TN	3.8
12	Illinois	IL	3.7
13	New Jersey	NJ	3.7
14	Wisconsin	WI	3.7
15	District of Columbia	DC	3.6
16	Ohio	OH	3.6
17	Rhode Island	RI	3.6
18	West Virginia	WV	3.6
19	Washington	WA	3.5
20	Georgia	GA	3.4
21	Arizona	AZ	3.2
22	Delaware	DE	3.2
23	Missouri	MO	3.2
24	Wyoming	WY	3.2
25	Idaho	ID	3.1
26	Massachusetts	MA	3.1
27	New York	NY	3.1
28	Utah	UT	2.9
29	Colorado	CO	2.8
30	Hawaii	HI	2.8
31	Mississippi	MS	2.8
32	Pennsylvania	PA	2.8
33	Virginia	VA	2.8
34	Maine	ME	2.7
35	New Mexico	NM	2.7
36	Oklahoma	OK	2.7
37	Texas	TX	2.7
38	Connecticut	CT	2.6
39	Maryland	MD	2.6
40	Minnesota	MN	2.6
41	New Hampshire	NH	2.4
42	Vermont	VT	2.4
43	Puerto Rico	PR	2.4
44	Kansas	KS	2.3
45	Louisiana	LA	2.3
46	Arkansas	AR	2.1
47	South Dakota	SD	1.7
48	Iowa	IA	1.6
49	Montana	MT	1.6
50	Alaska	AK	1.5
51	Nebraska	NE	1.3
52	North Dakota	ND	1.1
	United States	**9.3(2009), 5.8(2008)**	**3.5**

T.11 Rank	State	Abbreviation	Total ARRA per Capita Received Feb17 2009 - Dec 31 2009
1	District of Columbia	DC	$786.58
2	North Dakota	ND	$621.66
3	Alaska	AK	$471.17
4	South Dakota	SD	$459.55
5	Montana	MT	$400.68
6	Idaho	ID	$371.91
7	Vermont	VT	$321.62
8	South Carolina	SC	$291.65
9	Utah	UT	$286.64
10	Washington	WA	$281.00
11	Iowa	IA	$275.29
12	New Mexico	NM	$263.30
13	Oklahoma	OK	$242.73
14	Indiana	IN	$242.52
15	Maine	ME	$228.84
16	Mississippi	MS	$225.23
17	Wisconsin	WI	$224.12
18	Illinois	IL	$224.03
19	Wyoming	WY	$222.70
20	Rhode Island	RI	$220.87
21	New Hampshire	NH	$218.15
22	Michigan	MI	$211.75
23	Georgia	GA	$208.88
24	Kansas	KS	$207.25
25	Minnesota	MN	$206.52
26	California	CA	$205.65
27	Oregon	OR	$194.56
28	Arkansas	AR	$193.42
29	New Jersey	NJ	$189.76
30	Colorado	CO	$182.99
31	Hawaii	HI	$180.56
32	Louisiana	LA	$180.09
33	North Carolina	NC	$179.55
34	Kentucky	KY	$179.52
35	Tennessee	TN	$177.05
36	Maryland	MD	$172.16
37	Alabama	AL	$171.35
38	Nebraska	NE	$169.39
39	West Virginia	WV	$167.09
40	Arizona	AZ	$164.08
41	Virgin Islands	VI	$156.54
42	Missouri	MO	$155.48
43	Nevada	NV	$155.00
44	Delaware	DE	$150.55
45	Ohio	OH	$144.82
46	Massachusetts	MA	$143.14
47	Connecticut	CT	$142.63
48	Virginia	VA	$133.17
49	Florida	FL	$131.13
50	Texas	TX	$110.77
51	Puerto Rico	PR	$103.72
52	New York	NY	$100.18
53	Pennsylvania	PA	$76.26

T.12 Rank	State	Abbreviation	ARRA Infra Exp per Capita April 1 - Dec 31 2009	Total ARRA Exp Feb17 - Dec 31 2009	Percentage of ARRA for Infra	Rank
1	North Dakota	ND	387.5	$402,114,219	62.33	13
2	Wyoming	WY	375.4	$121,208,598	168.57	1
3	South Dakota	SD	344	$373,329,582	74.86	6
4	Alaska	AK	307.1	$329,097,403	65.17	11
5	Montana	MT	254.1	$390,654,599	63.43	12
6	Utah	UT	224.8	$798,166,345	78.43	5
7	Vermont	VT	223	$199,969,179	69.35	10
8	Maine	ME	212.7	$301,673,341	92.94	3
9	Oklahoma	OK	178.8	$894,955,760	73.66	7
10	Iowa	IA	154.1	$828,035,053	55.97	15
11	Washington	WA	150.1	$1,872,626,253	53.43	18
12	Oregon	OR	137.4	$744,316,076	70.6	8
13	West Virginia	WV	135	$304,070,631	80.82	4
14	District of Columbia	DC	122.9	$471,680,862	15.63	53
15	Minnesota	MN	121.6	$1,087,592,680	58.9	14
16	Wisconsin	WI	119.2	$1,267,368,404	53.19	19
17	Nebraska	NE	118.9	$304,329,975	70.21	9
18	Illinois	IL	110.4	$2,892,319,475	49.27	23
19	Mississippi	MS	108	$664,881,042	47.97	24
20	New Hampshire	NH	101.1	$288,958,956	46.34	27
21	Tennessee	TN	97.3	$1,114,719,781	54.97	16
22	New Mexico	NM	92.4	$529,139,319	35.09	34
23	Colorado	CO	91.7	$919,484,447	50.12	20
24	Indiana	IN	87.9	$1,557,704,298	36.24	31
25	Kentucky	KY	85.4	$774,465,701	47.59	25
26	Missouri	MO	77.1	$930,918,222	49.61	22
27	Rhode Island	RI	76.4	$232,624,480	34.61	35
28	Delaware	DE	75.3	$133,252,914	49.99	21
29	Pennsylvania	PA	74.8	$961,203,673	98.08	2
30	New Jersey	NJ	72.8	$1,652,412,230	38.38	29
31	Arizona	AZ	69	$1,082,237,657	42.04	28
32	Michigan	MI	68.6	$2,111,067,181	32.38	38
33	Idaho	ID	65.3	$574,890,689	17.55	50
34	Arkansas	AR	61.3	$558,879,877	31.7	40
35	Alabama	AL	61	$806,840,365	35.57	33
36	Texas	TX	60.7	$2,745,214,274	54.84	17
37	Maryland	MD	56	$981,203,540	32.54	37
38	North Carolina	NC	54.9	$1,684,345,055	30.56	41
39	South Carolina	SC	54.6	$1,330,291,218	18.73	49
40	Connecticut	CT	51.1	$501,814,339	35.81	32
41	Virginia	VA	50.3	$1,049,755,828	37.79	30
42	Nevada	NV	49.2	$409,686,067	31.76	39
43	New York	NY	47.2	$1,957,677,519	47.07	26
44	Ohio	OH	47.1	$1,671,571,410	32.54	37
45	California	CA	46.6	$7,601,136,839	22.65	45
46	Kansas	KS	42	$584,197,109	20.28	47
47	Hawaii	HI	41.4	$233,858,997	22.92	44
48	Massachusetts	MA	40.9	$943,796,337	28.55	42
49	Virgin Islands	VI	37.6	$17,191,808	24.04	43
50	Georgia	GA	34	$2,053,107,782	16.25	51
51	Louisiana	LA	29.1	$808,969,350	16.17	52
52	Florida	FL	27.1	$2,430,839,801	20.65	46
53	Puerto Rico	PR	20.3	$411,489,910	19.6	48

Appendix 6: Sources and Formulas

T.13

Data	Sources
T.1 C.4	www.census.gov
T.1 C.5	www.census.gov
T.1 C.6	www.recovery.gov
T.2 C.4	www.bea.gov, www.jp.gobierno.pr
T.2 C.5	www.bea.gov, www.jp.gobierno.pr
T.2 C.6	www.fns.usda.gov/fns
T.3 C.4	[12]
T.3 C.5	[12]
T.3 C.6	www.bea.gov/regional/rims/rimsii
T.4 C.6	www.bea.gov
T.5	www.bea.gov
T.6	www.bea.gov
T.7 C.4	www.bea.gov, www.jp.gobierno.pr
T.7 C.5	www.bea.gov, www.jp.gobierno.pr
T.7 C.6	www.fns.usda.gov/fns, www.jp.gobierno.pr
T.11	www.recovery.gov
T.12 C.5	www.recovery.gov

T.14

Data	Formula
T.1 C.7	(T.1 C.6) / (T.1 C.5)
T.4 C.4	(T.1 C.6) * (T.3 C.6)
T.4 C.7	((T.4 C.4) / (T.7 C.4))*100
T.10 C.4	(T.7 C.6) - (T.2 C.6)
T.12 C.6	(T.1 C.6) / (T.12 C.5)

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