An Intervention Analysis Model Examining the Effects of the Capital Purchase & Targeted Investment Programs on the Stock Prices of U.S. Banking Institutions

by

Alexander Charles Ruth

A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Science in Economics

Auburn, Alabama
May 7, 2012

Keywords: intervention, analysis, bank,
bailout, stock, prices

Approved by

Dr. John D. Jackson, Chair, Professor of Economics
Dr. T. Randolph Beard, Professor of Economics
Dr. Hyeongwoo Kim, Associate Professor of Economics

Abstract

This thesis uses an Intervention Analysis as an econometric procedure to determine what effect, if any, government capital injection had on stock prices. More specifically, we look at the effect that the initiation of the Capital Purchase Program and the Targeted Investment Program had on the share prices of U.S. banking institutions. The Intervention Analysis will suggest whether or not these bailouts had a significant effect on these stock prices. If there does seem to be a significant effect, the analysis will suggest the magnitude of the shock as well as the length of this shock's persistence. We can then look at how these results may give some insight into the U.S. economy as a whole.

This thesis evaluates a wide variety of different banks so that we can try and make generalizations towards the bailout's effect on share prices of the banking industry as a whole. As it turns out, the Intervention Analysis involving these many banks suggests that the introduction of the Capital Purchase Program as well as the Targeted Investment Program did cause a significant drop in the share prices of U.S. banking institutions. This model also suggests that the effected stocks will take an extremely long time to recover from this specific shock.

Table of Contents

List of Tables

List of Equations & Illustrations

List of Abbreviations

$	U.S. Dollars
911	September 11th, 2001
AR	Auto-Regressive
B	Billions
Corp	Corporation
CPP	Capital Purchase Program
CRA	Community Reinvestment Act
GLBA	Gramm-Leach-Bliley Act
Inc	Incorporated
IPO	Initial Public Offering
LN	Natural Logarithm
M	Millions
NASDAQ	National Association of Securities Dealers Automated Quotations
NYSE	New York Stock Exchange
S&P	Standard and Poor's
STAT	Test Statistic
TIP	Targeted Investment Program
U.S.	United States

I. INTRODUCTION
1.1 An Overview of the U.S. Banking Bailout

In 2008, the United States government injected capital into many U.S. companies, including entities in the financial sector, in an attempt to aid them at a time in which the United States was facing one of the worst economic downturns since the Great Depression. The Capital Purchase Program (CPP) was the name assigned to the government program that began injecting capital into many U.S. banks in October 2008. This initiative marked the beginning of what would be more commonly known as the "Bailout" of the U.S. banking industry. Soon following the initiation of the Capital Purchase Program also came further government aid in the form of the Targeted Investment Program (TIP). Banks of many different types, locations, and sizes received federal funds from these programs. The CPP was passed by congress and began injecting massive amounts of capital into many U.S. firms on October 28, 2008. Some firms would later receive a second installment of funds from the CPP. The TIP served as another capital supplement to the CPP and in general was only given to a couple of the larger U.S. banks. The TIP began injecting capital into U.S. banking institutions on December 31, 2008. Funds from the CPP as well as the TIP can be thought of as "free money with strings attached". In an attempt to prevent even more economic instability in the United States, the government was using the CPP and the TIP to try and prevent the failure of as well as runs on many U.S. banks. It is obvious that Henry Paulson, the U.S. Secretary of Treasury, Ben Bernanke, Chairman of the U.S. Federal Reserve, and other members of the U.S. government believed that a healthy banking system played a vital role in the well being of the U.S. economy as a whole. Thus, during the recession of 2008, they initiated the CPP and the TIP in an attempt to achieve these desired results.

The CPP and the TIP worked in the following manner: The government would give the banks massive amounts of capital in exchange for shares (some degree of partial ownership) of the participating institutions. The banks that received these funds were allowed to pay the government back for these funds by repurchasing the shares. However, like a loan, these funds were to accumulate small amounts of interest so that when the banks returned the government capital, the government would indeed be profiting from the exchange. The government also gave instructions on the desired use of the extra capital given to the banks. The hope was that institutions would continue making loans at a time in which they normally would not. The term "bailout" began to be used to describe this process and these programs. Currently, the 758 banks and credit unions that received bailout (CPP or TIP) funds have done one of three things. They have either paid back all of the capital, paid back some of the capital, or paid back none of the capital. Of the banks that have paid back all of their bailout money, some did this as soon as they were allowed to and others waited a little bit longer. Of the small amount of banks that have not fully repaid the bailout money, some have made promises or given a timetable in which they intend to do so. A portion of these banks may never repay the capital given to them through the CPP or the TIP. This includes some banks that have already or will fail. It is important to remember that most U.S. financial institutions (including many smaller banks) did not receive any bailout funds. Table 1.1 breaks down the U.S. banks that received bailout capital and their corresponding response to the injection of that capital:

TABLE 1.1:
BANKING PAYBACK RESPONSES TO CPP AND TIP CAPITAL

	Number of U.S. Banks	Percentage of U.S. Banks
Fully Repaid all Bailout Funds	266	35.09
Partially Repaid all Bailout Funds	24	3.17
Have Repaid No Bailout Funds	468	61.74

ProPublica.org, a non-profit journalism site, provides an easily interpretable list of firms that received bailout monies. From this site it is easy to derive tables detailing the full list of banks that received funds from the CPP and TIP and their payback status. We will tailor this list to fit our specific needs by consolidating it as well as adding to it in order to form the bulk of tables found in the following portions of Chapter I in this thesis.

1.2 Thesis Objective: Market Response to Capital Injections

Though the government gave massive financial aid to many different types of entities, this thesis will focus on the aid given to U.S. banking institutions. Specifically, this thesis will look at the effect the bailout had on the share (common stock) prices, and hence the market's evaluation of the riskiness, of U.S. banks. This thesis will also focus on how long the effects on the share prices of U.S. banks resulting from the bailout will persist. One would expect that the act of a firm receiving large amounts of seemingly free capital would be interpreted by market participants in a positive light. However, given the circumstances that these banks were receiving bailout money under, the lender of this capital was not seen as a benign source. It is for this reason that we expect the bailout to cause a negative shock to the share prices of participating banks. We also expect that the bailout process of selected banks may negatively shock the share prices of the whole U.S. banking industry. If indeed it can be determined that a significant shock did occur, we would like to see how quickly the stock prices of these banks recovered, or if they have recovered at all. If traces of this bailout shock are still present in the share prices of these banks, this thesis will use specific econometric techniques to determine a timetable for recovery. It may be the case that the shock to the share prices under evaluation never recover. These are the aspects of the bailout in which this thesis will concern itself with. It will also be of note to evaluate just how influential the banking system is to the U.S. economy as a whole. If we believe that the evaluation of the bailout shock on the share prices of U.S. banks may give us some perspective on the recovery status of the entire banking sector, we may be able to make some inferences about the duration of the recovery process for the entire U.S. economy.

1.3 Differing Views of the Bailout

There is much debate about the effectiveness of the bailout as it pertains to the prosperity of the U.S. economy. Because the bailout is one of the fundamental aspects of this thesis, it is important to note that the question of whether or not the bailout was a good idea does not matter in this case. Many differing opinions have been formed on whether or not the bailout of U.S. banking institutions was a smart move by the U.S. government. However, this paper will only concern itself with the results of the bailout on equity prices of U.S. banks rather than trying to answer that question regarding the legitimacy of the bailout. Even if we desired to formulate an opinion on whether or not to support or reject the appropriateness of the bailout, it may still be too early to make an informed decision on the matter. Additionally, searching for an absolute opinion on this issue may also cause one to arrive at the wrong conclusion with regards to the bailout. What this means is that many firms differing in influence and economic health were included in these bailout programs. Hence, it may be the case that the bailout of some firms was a good idea or necessity while the bailout of others was not. Again, this thesis will not concern itself with answering these questions. However, the results that will come forth in evaluating the bailout's effect on U.S. banking entities' equity prices may shed some light on these broader questions and issues. If the conclusions we draw in this analysis are predicated on our opinion about the bailout, then the interpretation of our results will be clouded and possibly misconstrued. Hence, we eschew judgment on its legitimacy; it simply happened.

1.4 Spectrum of Banking Institutions Selected for Analysis

In our analysis we desire to look at the effects of the bailout on the equity prices of U.S. banks in general. In order to do this, we must carefully consider which banks will adequately provide insight into our analysis. As mentioned earlier, most banks that received bailout funds have either paid back the bailout amount in full or have not paid back any of the allotted bailout funds. Also, there exists a handful of banks that have paid back a portion, but not all, of their bailout capital. It will be necessary to include banks from all three of these situations in this model.

In order to properly take a broad look at the response of the share prices of U.S. banks to the shock caused by the introduction of the bailout, this model must also include banks that did not receive federal bailout capital. Most of these banks tend to be smaller banks and tend to be followers in the banking sector as opposed to some larger firms that tend to act as dominant firms or market leaders. The implications of this will be discussed later. From these aforementioned categories belong banks which we can see are publicly traded companies. We are especially interested in looking at the firms that received the largest portions of bailout funds. We favor including more banks who received significantly large amounts of capital from the Capital Purchase Program, as well as the Targeted Investment Program in our analysis. We do this because we are interested in the effects of the bailout. Therefore, it makes sense to look at the banks that received the most federally injected capital. Also, another reason that these larger bailout recipients warrant inclusion in this model is because they are the entities that would later be the subjects of a financial stress test performed by U.S. government. As results of these stress tests are revealed, it may be interesting to examine whether or not there is any correlation between the results of these tests and the results found from using this Intervention Analysis. If we desire to place an added emphasis on evaluating these larger recipients, it may slightly affect which of the smaller banks we choose to select and include in the analysis.

When we look at the banks that received significantly larger amounts of bailout capital, we see that almost all of these banks have common stock listings on the New York Stock Exchange (NYSE). Therefore, all of the banks included in this model will have shares listed on the NYSE. One may be concerned with selection bias occurring in the model because of not being able to properly evaluate the smaller banks or any banks that did not receive capital injections. Incidentally, many of these smaller banks, as well as banks the received no bailout money, are also publicly traded firms listed on the NYSE. Thus, we can include share price data from these banks in our analysis as well. However, only 2 banks that have partially repaid their bailout funding are listed on the NYSE. Most of the banks in this position are listed on the NASDAQ or Pink Sheets. This may seem like a problem but we must remember that only 24 banks (3.17% of total banks receiving bailout funds) have partially repaid their bailout capital anyway.

We must also leave out banks from our analysis that do not have a sufficient amount of data. Our data for these banks will consist of monthly stock price data (this will be covered in detail later). We desire the data to be present around the month of December 1989 until the present period. For this reason, some other banks that were key participants in the bailout saga may be excluded from this model. For instance, Goldman Sachs, a firm that received $10 billion in bailout funds will be excluded because we only have monthly share price data for the firm dating back to their IPO in May 1999.

Also, within all these different factions there are entities which some suspect were essentially forced to participate in bailout programs. There is much evidence to support this, including documents and public statements from high ranking bank officials of bailout participating banks. We must also include banks that were seemingly stable at the time of the bailout, as well as some that were perceived as unhealthy. Taking all these aspects into consideration, the banks we will use in our model include the following 24 banking institutions which are listed in order of the amount of bailout funds they received: Bank of America, Citigroup, JP Morgan Chase, Wells Fargo, Morgan Stanley, PNC Financial, US Bancorp, Suntrust, Capital One Financial Corporation, Regions Financial Corporation, Fifth Third Bancorp, BB&T, Bank of New York Mellon Corporation, Keycorp, State Street, Synovus Financial Corporation, M&T Bancorp, TCF Financial Corporation, Central Pacific Financial, Auburn Bank, BancFirst Corporation, Bank of Hawaii, Community Bank System Incorporated, and BancorpSouth. All of these banks have corresponding common stock that is sold on the NYSE. Table 1.2 illustrates the different bailout characteristics exhibited by these individual banks.

TABLE 1.2:
CPP AND TIP REPAYMENT STATUS OF
INDIVIDUAL U.S. BANKING INSTITUTIONS

Fully Repaid all Bailout Funds	Bank of America Citigroup JP Morgan Chase Wells Fargo Morgan Stanley PNC Financial US Bancorp Suntrust Capital One Financial Corp. Fifth Third Bancorp. BB&T Bank of New York Mellon Keycorp State Street TCF Financial Corp.
Partially Repaid Bailout Funds	M&T Bancorp Central Pacific Financial
Have Repaid No Bailout Funds	Regions Financial Corp. Synovus Financial Corp.
Have Not Received Any Bailout Funds	Auburn Bank BancFirst Corporation Bank of Hawaii Community Bank System Inc. BancorpSouth

Though obvious, one must remember that many banks who would have been considered in this thesis either failed or were absorbed during the time period which we are looking at. For instance, a month before the bailout, Bank of America bought up Merrill Lynch. Whether or not this institution would have received bailout funds is a matter of speculation but it is certain that Merrill Lynch would have been worthy of evaluating in this analysis.

This model is looking at the effect the bailout had on the stock prices of these banks in a general sense. What is meant by this is that we have chosen a wide spectrum of banks to include in the analysis and we are looking at the effect of one event which is the initiation of capital injection programs to these banks. Therefore, we are generalizing many injections that occurred in different amounts and at differing times into one event. As we have mentioned, these injections began on October 28, 2008 (there were no bank bailout funds allotted before this time) but not all the banks we are analyzing received injections at this time. Because of this, I believe it is worthy of also looking at the bailout schedule of the banks in question so that we can have a better understanding of how the bailout as a whole was structured. Table 1.3 details the capital injection schedule of these banks.

TABLE 1.3:
CAPITAL INJECTION SCHEDULE (IN U.S. DOLLARS)

BANKING INSTITUTION	10/28/2008 CPP	11/14/2008 CPP	12/19/2008 CPP	12/23/2008 CPP	12/31/2008 CPP	12/31/2008 TIP	1/9/2009 CPP	1/16/2009 TIP
Bank of America	15B						10B	20B
Citigroup	25B					20B		
JP Morgan Chase	25B							
Wells Fargo	25B							
Morgan Stanley	10B							
PNC Financial					7.58B			
US Bancorp		6.60B						
Suntrust		3.5B			1.35B			
Capital One Financial Corp.		3.56B						
Regions Financial Corp.		3.5B						
Fifth Third Bancorp					3.41B			
BB&T		3.13B						
Bank of New York Mellon Corp.	3B							
KeyCorp		2.5B						
State Street	2B							
Synovus Financial Corporation			968M					
M&T Bank Corporation				600M				
TCF Financial Corporation		361M						
Central Pacific Financial							135M	

Values are rounded for clarity

As we can see, most of the bailout capital was issued on October 28, 2008 with remaining capital injections coming later. It should be noted that the banks in our model that did not receive bailout funds are not included in the above table for obvious reasons. This capital injection schedule will prove to be useful information later in our analysis.

II. DATA

2.1 Fundamental Data Required to Account for Market Behavior

As mentioned throughout the introduction of this thesis, we will use the share price data of different U.S. banks to evaluate the general effect of the U.S. government's bailout on banking stock prices. Before we do this, we know that in order to develop a successful intervention model, we will have to account for the effect that the market as a whole has on U.S. bank stock prices.

We will use monthly stock price data on the individual banks, and to represent the market as a whole, we will use monthly data from the S&P 500 Index. The S&P 500 serves as a good indicator of the U.S. economy by indexing the fluctuations of some the U.S.'s largest publicly traded companies listed on the NYSE and the NASDAQ. We can find the desired historical monthly S&P 500 data from many various sources including Yahoo Finance (the site which was used to procure most share pricing data found in this thesis). This monthly data comes in the form of monthly closing data as well as monthly adjusted data. Because the S&P 500 is an index and not an actual firm that pays dividends or performs stock splits, both the monthly closing price data and the monthly adjusted data for the S&P 500 index is the same. We retained the monthly S&P 500 Index data in both of these forms so that we could use the most suitable form later.

It is also useful to examine what the U.S. market was doing before and after the bailout. We know that the S&P 500 index will decrease around the time of the bailout which also coincides with a massive economic downturn. However, we may want to look at other things like the volatility and behavior of the market before and after the bailout. We can do this by examining the S&P 500 data with a Markov Chain for periods before and after the bailout. Table 2.1 shows the results of the Markov Chain process.

**TABLE 2.1:
MARKOV CHAIN PROBABILITIES FOR MARKET MOVEMENT
BEFORE AND AFTER THE CAPITAL INJECTIONS**

	Recession, Recession	Recession, Boom	Boom, Recession	Boom, Boom
Before Bailout	14.0969163	23.78854626	24.22907489	37.88546256
After Bailout	17.14285714	25.71428571	22.85714286	34.28571429

The above table shows the probabilities of the S&P 500 index declining when it experienced a decline in the previous period (Recession, Recession), increasing when experiencing a decline in the previous period (Recession, Boom), declining when experiencing an increase in the previous period (Boom, Recession), and increasing when an increase was observed in the previous period (Boom, Boom) respectively. Surprisingly, the post-bailout market seems to be behaving similarly to how it was behaving before the bailout; hence after the massive decline of the U.S. economy. This is good to know before we do our analysis because we can see that the market is not in constant decline, but rather just took a large hit and then leveled off again. This Markov Process can also serve as an indicator of just how random the stock market (evidenced by the S&P 500 index) can behave.

2.2 Share Price Data Procurement, Formulation, and Adjustments

We can easily gather historical monthly stock price data for the banks in question. The S&P 500 data shares many characteristics with the share price data we have retrieved for each of the banks being evaluated. That is, we can quickly find and record historical monthly stock price data in the form of monthly closing price data and monthly adjusted price data. It is not quite clear how the adjusted monthly data is formulated. I speculate that it is adjusted for splits, dividends, and possibly for volume as well as inflation. If we were to use this data, we would need to know exactly how it was formulated. This information is not readily available. Recall that for the S&P 500 monthly data (which is from the same source) the closing price data was exactly the same as the adjusted price data. This is why I believe the adjusted monthly share price data is formulated the way it seems to be. Since we need the S&P 500 data and the share price data for the individual banks to be formulated in the same manner, this model will concern itself with the monthly closing price stock data. It should be noted that all of the tests and analysis performed in this model were performed using both the adjusted monthly data and the closing price monthly data. These results were essentially the same. Thus, we feel strongly that using the closing price data instead of the adjusted price data is the correct choice. However, the individual monthly closing prices for these banks are not adjusted for stock splits. For instance, a stock price may jump from $40 a share to $20 a share in the data. This is not because the share price fundamentally decreased but because there was a stock split. This, coupled with the fact that the historically adjusted data does not fit the desired form, causes the need to introduce a “split multiplier” to achieve the appropriate measures of stock prices. This adjustment will give us the same results shown on pricing charts from sites like Yahoo Finance and will also fit the same form as the S&P 500 data.

The "split multiplier" will be an integer that the aforementioned monthly closing share price data will be divided by in order to achieve adequate pricing data that coincides with the form of the monthly S&P 500 data. Thus, if no splits occurred in the time period of December 1989 to October 2011 for a bank, the multiplier would be 1 in all periods for that bank. Obviously, this would mean that the monthly closing price data for this bank with no splits would already be in the desired form. If there were, for instance, a 2 for 3 split, the multiplier would be 2 / 3 and would be applied to stock prices in the relevant periods. The relevant periods in this case would be the period that the split occurred in and all periods before this split. Remember that if this was the only split, all of the following periods would incur a "split multiplier" of 1. Most of these banks' share prices involve more than one stock split. So, starting with the most recent period, the multiplier is 1 and will stay 1 going back periods until we encounter a split. We will then multiply the type of split that we encounter next while counting back periods by the amount of the "split multiplier" in the period immediately following the split, which in this case is 1. So, if the split was a 5 for 3 split, the new split multiplier would be 1 x 5/3 or 1.66666 until we encounter the next split counting backwards. The process is then repeated for further stock splits. For example, if we next encounter a 2 for 1 stock split, the new multiplier would become 1 x 5/3 x 2/1 or 3.33333 for the period the split occurred in as well as the preceding periods. We continue formulating this multiplier all the way back to December of 1989 for each bank that we are evaluating. Then, we divide the corresponding month's closing price by the relevant split multiplier to get the appropriate stock price values for each bank. Equation 2.1 shows how each observation for the ***BANK SHARE PRICE*** variable is formulated for each bank:

$$\textit{BANK SHARE PRICE} = \frac{\textit{BANK MONTHLY CLOSING PRICE}}{(X_N / Y_N) \times (X_{N-1} / Y_{N-1}) \times (X_{N-2} / Y_{N-2}) \times (X_{N-3} / Y_{N-3}) \times (X_{N-T} / Y_{N-T})} \tag{2.1}$$

where X and Y denote a X for Y or X:Y split,
N denotes the Nth stock split,
T denotes the total number of stock splits

It can also be seen that dividends are generally too small and too random to systematically affect the final share prices we have formulated. Therefore, we do not bother with incorporating dividends into this formulation. In addition to the formulation of this ***BANK SHARE PRICE*** variable, we can later compare results achieved through using this newly formulated data as opposed to results obtained from using the adjusted data. We can do this as a precautionary measure to ensure that the transformation of this monthly share price data does not yield conflicting results when compared to the results yielded from using the adjusted monthly share price data.

Once we have obtained the desired monthly stock price data for each bank included in this analysis as well as the monthly S&P 500 observations, we will convert all of this data to its natural logarithmic form. We need do this because we are using financial data, and thus there is a need to correct for potential trends in variance. Once we have done this, we can use common statistical methods to create new filtered variables, and run the required tests on this data. It should be noted that even though the ***BANK SHARE PRICE*** and ***S&P 500*** variables have now been converted to their natural logarithmic form, they will retain the same variable name throughout the rest of this thesis so that we can express the process of this Intervention Analysis clearly without being repeatedly reminded that all data included in this model is of the natural log variety. This should not pose any issues as long as one remembers that all further price variables and results expressed are in the form of natural logs.

2.3 Creation of Dummy Variables

For our analysis we also need to create some other variables. The introduction section of this thesis covered the events attributed to what is now more commonly referred to as the bailout. First and foremost, we create a dummy variable which we will call the ***BAILOUT DUMMY***. This ***BAILOUT DUMMY*** variable will correspond to the capital injection programs, or bailout, that took place in many U.S. banking institutions. The ***BAILOUT DUMMY*** variable will be in binary form with 0's before the bailout and 1's after the bailout. Because the bailout occurred at the very end of October 2008, we will use 0's up until this period starting in December 1989. We will use 1's starting in November 2008 all the way up until the current period which is October 2011 in the case of this analysis. Thus, the ***BAILOUT DUMMY*** variable will contain 0's for the first 228 observations and 1's for the following 36 observations. This dummy variable will play an instrumental role in this analysis.

Additionally, we will want to compare the effects of the bailout to other significant events that could also possibly have an effect on the stock prices of U.S. banks. This will ensure that if we do see a shock that appears to stem from the government's capital injection programs, that this shock is not random. It will also allow us to see how intense the effect of the bailout was on the share prices of U.S. banks compared to other significant events that transpired during the time periods for which we have collected data. The addition of these extra dummy variables will allow the conclusions we draw from our results to be more robust. For this model, three more supplementary dummy variables will be added. We will add dummy variables that correspond to the unanticipated terrorist attacks that occurred in the U.S. on September

11, 2001, the amending and major overhauling of the Community Reinvestment Act on May 4, 1995, and the erosion of the Glass-Stegall Act by the enacting of the Gramm–Leach–Bliley (or Financial Services Modernization) Act on November 12, 1999.

The September 11th terrorist attacks in the United States shocked the entire world. This was an attack of an unprecedented magnitude. For this reason it may be interesting to see if there was any shock to U.S. banking stock prices as well as to compare these results with that of the bailout. Similar to the ***BAILOUT DUMMY*** variable, the dummy variable we create for these terrorist attacks will also be in binary form and will be called the ***911 DUMMY***. The ***911 DUMMY*** variable will contain 0's before the attacks and 1's after the attacks. Therefore, the first 141 for the ***911 DUUMY*** variable will be all 0's and the following 122 observations will contain all 1's.

The Community Reinvestment Act is a federal law which forces lending institutions such as banks to make housing loans to citizens that might otherwise not be approved for such loans. On May 4, 1995, President Clinton signed into affect significant changes to this law which made it more prevalent and broadened the Act's scope. This amendment also included provisions that allowed the federal government to check for and punish banks that were not making these loans. This may have some effect on the share prices of U.S. banks but we would still not expect these effects to be larger than ones caused by the bailout or the events of September 11th. This dummy variable will be denoted as the ***CRA DUMMY*** variable and will also contain 0's before the amending of the Community Reinvestment Act and 1's after congress amended this act. As one would imagine, the ***CRA DUMMY*** variable will contain all 0's for the first 62 observations and 1's for the remaining 201 observations.

The fourth dummy variable which will be created for this analysis will be labeled as the ***GLBA DUMMY***. The ***GLBA DUMMY*** variable will correspond to enactment of the Gramm-Leach-Bliley Act on November 12, 1999. This act is more commonly referred to as the Financial Services Modernization Act. This act allowed banking institutions in the U.S. to engage in many different types of financial business. Previously, banks could not involve themselves with many different aspects of commercial banking, insurance, and many other types of financial instruments due to the Glass-Stegall Act of 1933. This Financial Services Modernization Act eroded many aspects of the Glass-Stegall Act of 1933. In general, most view this as the beginning of bank deregulation in the United States. We can see that this is another event that we would like to consider using in our analysis. This ***GLBA DUMMY*** variable will also be another binary variable with 0's for the first 119 observations and 1's for the following 144 observations. Now that we have procured the necessary data, we can begin to look at how we will perform this Intervention Analysis.

III. Model

3.1 Overview of the Intervention Analysis Model

We can evaluate the effect of massive capital injections given to banks by the U.S. government such as the Capital Purchase Program and the Targeted Investment Program through the use of an Intervention Analysis as used by Box and Tiao in their 1975 paper "Intervention Analysis with applications to Economic and Environmental Problems". However, this thesis will follow the Intervention Analysis as detailed by Walter Enders (Enders 1995). This analysis can show the short and long run effects that this capital infusion had on the common stock share prices of the corresponding U.S. banking institutions. In Enders' 1995 book, Applied Econometric Time Series, Walter Enders details a process he calls an "Intervention Analysis" in the first section of the books' chapter on Multi-Equation Time-Series Models. Enders explains that an Intervention Analysis can be used to generalize the univariate (Box-Jenkins) methodology by allowing the time path of the relevant variable to be influenced by its past values and possibly other exogenous variables. Enders also explains that most issues encountered from using this Intervention Analysis can be dealt with later by using a vector autoregressive process. Enders uses an example that describes the effect that the introduction of metal detectors (the intervention) had on skyjackings (the time series variable in question). The intervention in our case will be the initiation of the government bailout of U.S. banks and the time series variable that we are concerned with will be the share prices of those U.S. banks that received federal bailout capital as well as some that did not.

Enders explains that we must do more than just take the mean value of our dependent variable (bank's stock prices) before and after the intervention and compare them. However, this is not to say that the mean comparison may not serve as a decent preliminary measure to undertake. It is for this reason that we will briefly examine the pre and post-intervention means of the time series in question. However, we must go beyond this simple comparison because we are dealing with a time series process and the share price data is serially correlated with itself. Thus, we do not want to only compare the mean values of this data before and after the bailout because observations after the bailout could be affected by observations occurring before the bailout. For the intervention analysis we can look at regression equation 3.1:

$$Y_t = A_o + A_1 Y_{t-1} + C_o Z_t + \varepsilon_t \tag{3.1}$$

In this equation, Z_t represents a binary dummy variable, which we will call for our purposes ***BAILOUT DUMMY***. Remember that the ***BAILOUT DUMMY*** variable will contain 0's before the bailout and 1's after the bailout. Y_t and Y_{t-1} refer to the time series in question, which is the individual share prices of the U.S. banks included in our model. ε_t represents a white noise disturbance term in this case. Enders details that because Z_t will be zero before the bailout, the intercept given by A_o will clearly reveal the mean of the bank's share price before the bailout. Thus, the long-run ($Y_t = Y_{t-1}$) pre-intervention mean of the series will be given by equation 3.2:

$$A_o / (1-A_1) \tag{3.2}$$

Subsequently, Z_t will become 1 after the bailout and so the new immediate intercept or mean of the equation will be given by equation 3.3:

$$A_o + C_o \tag{3.3}$$

Thus, we can see that the long-run mean will be represented by equation 3.4 in the following manner:

$$(A_o + C_o) / (1-A_1) \tag{3.4}$$

Walter Enders describes using the initial jump, or differing mean if you will, as the "impact effect" of the intervention. In our case this intervention will be the government bailout. It can be seen that the size of C_o will detail the magnitude of the impact effect that the government's capital infusion to U.S. banks had on the equity prices of individual U.S. banks. We can test C_o for being statistically significantly different from zero. We could conclude that the bailout caused an increase in share prices if C_o is positive and statistically significant and the opposite could consequently be said if C_o is negative as well as significant. In our case, C_o is called the ***BAILOUT DUMMY COEFFECIENT.***

It should be duly noted at this point that, in terms of his hijacking example, Enders is making an assumption that the introduction of metal detectors plays a very large role in decreasing the number of skyjackings when holding all else constant. However, in the case of the U.S. banking industry share prices, there was a large drop in values around the same time as the government's intervention or "bailout". We might attribute this to the recession and significant economic downturn that the U.S. markets were encountering at the time of the bailouts, rather than the bailout itself *per se*. Thus, if we do not adjust, or take into account, the effect of the market as a whole on the share prices of these banks, we might risk incorrectly suggesting that the bailouts were solely the cause of this massive decrease in bank's share prices. Therefore, we will have to take into account the effect of the market on bank share prices when performing this analysis.

The manner in which we use the previously discussed ***S&P 500*** variable to correct for these variations in the market and the state of the economy will be described later.

After testing C_o for significance, Enders shows that the "long-run effect of the intervention is equal to the new long run mean minus the value of the original long-run mean" which is shown here by equation 3.5:

$$[C_o / (1 - A_1)] = [(A_o + C_o) / (1 - A_1)] - [A_o / (1 - A_1)] \tag{3.5}$$

From this, Enders shows that we can use lag operators to rewrite our original regression equation in order to obtain an impulse response function, which can be used to analyze other transitional effects:

$$\begin{gathered} Y_t = A_o + A_1 Y_{t-1} + C_o Z_t + \varepsilon_t \text{ (impact effect)} \\ (1 - A_1 L) Y_t = A_o + C_o Z_t + \varepsilon_t \text{ (final – long run effect)} \\ Y_t = A_o / (1 - A_1) + C_o \sum A_1 Z_{t-i} + \sum A_1 \varepsilon_{t-i} \text{ (interim effect)} \end{gathered} \tag{3.6}$$

The final equation is the impulse response function. We can continually differentiate this function as well as limit the series to infinity to reveal the entire impact of the government bailout to U.S. banks on the share prices of those banks as well as others. Enders does indeed do this and shows that the long-run effect of the bailout will be given by:

$$C_o / (1 - A_1) \tag{3.7}$$

3.2 Filtration of U.S. Banking Share Prices

We are now ready to use statistical methods to create a couple more variables as well as run some tests. As mentioned throughout this thesis, we need to filter the ***BANK SHARE PRICE*** variable for each bank in order to account for the effect of the market as a whole before we can move forward with this Intervention Analysis. For each bank we regress the following:

$$\textit{BANK SHARE PRICE}_t = \beta_1(\textit{ONE}) + \beta_2(\textit{S\&P 500 PRICE})_t + \varepsilon_t \tag{3.8}$$

This regression results in a residual or filtered share price which factors out the effect of the overall market and economy as a whole on the individual bank's share price. Recall that prior to this regression the ***BANK SHARE PRICE*** and the ***S&P 500 PRICE*** variables have taken on a natural logarithmic form. Thus, the residual given by this regression will yield a new variable, the ***FILTERED BANK SHARE PRICE*** variable, that is also in the form desired for the remainder of the analysis. A graphical representation of these filtered variables can be seen in Appendix I. As was alluded to earlier, we can now take a preliminary look at the pre and post-intervention means of the time series. Table 3.1 illustrates the pre and post-intervention (or pre and post-bailout) means of the newly created ***FILTERED BANK SHARE PRICE*** variables:

TABLE 3.1:
FILTERED MEAN VALUES OF INDIVIDUAL BANKING INSITUTIONS BEFORE AND AFTER THE INTERVENTION

BANKING INSTITUTION	PRE-BAILOUT MEAN	POST-BAILOUT MEAN	DIFFERENCE
Bank of America	0.128322	-0.835927	0.964249
Citigroup	0.27095	-1.76505	2.036
JP Morgan Chase	-0.00372834	0.0242875	-0.02801584
Wells Fargo	-0.0226268	0.147397	-0.1700238
Morgan Stanley	0.0808296	-0.438789	0.5196186
PNC Financial	0.00162679	-0.0105974	0.01222419
US Bancorp	0.00638381	-0.041586	0.04796981
Suntrust	0.124284	-0.809621	0.933905
Capital One Financial Corp.	0.0211619	-0.102182	0.1233439
Regions Financial Corp.	0.208335	-1.3393	1.547635
Fifth Third Bancorp	0.166524	-1.07051	1.237034
BB&T	0.0243422	-0.156485	0.1808272
Bank of New York Mellon Corp.	0.0184356	-0.120095	0.1385306
KeyCorp	0.160061	-1.04268	1.202741
State Street	-0.00343407	0.0223705	-0.02580457
Synovus Financial Corporation	0.255683464	-1.6582899	1.913256
M&T Bank Corporation	-0.0163143	0.0960215	-0.1123358
TCF Financial Corporation	0.0239499	-0.156016	0.1799659
Central Pacific Financial	0.292276	-1.87892	2.171196
Auburn Bank	-0.0548403	0.249131	-0.3039713
BancFirst Corporation	-0.0668009	0.429434	-0.4962349
BancorpSouth Incorporated	0.00741309	-0.048291	0.05570409
Bank of Hawaii	-0.0502851	0.327571	-0.3778561
Community Bank System Inc.	-0.0403416	0.262797	-0.3031386

Mean values are in natural logarithmic form

As you can see from Table 3.1, it seems that the mean values of most of these time series seems to be of lesser value after the intervention or bailout. This is our first piece of evidence suggesting a decrease in the share prices of U.S. banking institutions resulting from the bailout although some of them seem to have risen. The reason why some of these means have actually risen is attributable to the growth of these share prices. The pre-intervention mean values contain prices dating back to 1989 when prices were a lot lower. These earlier low values can cause the mean of a bank's pre-intervention share price to seem quite lower than the post-intervention mean prices because all share price observations are weighted the same in this comparison. As we have mentioned throughout, this is why only looking at these mean values alone is not enough to adequately address the issues we are looking at. After looking at these mean values, we are now ready to use the ***FILTERED BANK SHARE PRICE*** variable in replace of the original ***BANK SHARE PRICE*** variable because we have taken out the affect of the market as a whole.

3.3 Regressing the Intervention Model

Now that the market effect has been filtered out, we can then lag this new ***FILTERED BANK SHARE PRICE*** variable by one period in order to obtain a new variable, which we call the ***FILTERED BANK SHARE PRICE [t-1].*** We do this because we believe an AR(1) process can adequately describe the time series process of share price data. We will later examine this assumption. Once this lagged variable has been created, another regression equation can be estimated that will now incorporate the binary ***BAILOUT DUMMY*** variable. Equation 3.9 shows the Intervention Analysis regression formula used for this model:

$$\textit{FILTERED BANK SHARE PRICE}_t = \beta_1(\textit{ONE}) + \beta_2(\textit{FILTERED BANK SHARE PRICE})_{t-1} + \beta_3(\textit{BAILOUT DUMMY})_t + \varepsilon_t \quad \textbf{(3.9)}$$

This regression can yield some important results. First, it can yield a coefficient associated with the ***FILTERED BANK SHARE PRICEt-1***. If this coefficient is statistically significant, it will be suggesting the decay rate of the impulse response function resulting from the bailout. The regression can also result in a negative coefficient associated with the ***BAILOUT DUMMY*** variable, indicating an instantaneous drop in bank share prices associated with the bailout. The subsequent empirical analysis indicates that in some cases, this coefficient is indeed statistically significant and in other cases it is not. Finally, we will also analyze the residual arising from this model, which can be thought of as a variable that we can call the ***PROCESS RESIDUAL***. We must check the ***PROCESS RESIDUAL*** to make sure it resembles white noise so that we know that we have estimated the correct time series process. We will do this by looking at the significance level of the Box-Pierce and Box-Ljung Q Test Statistics relating to this

PROCESS RESIDUAL. We will use 36 periods when we perform the identification of this residual. A white noise process on the ***PROCESS RESIDUAL*** variable for each bank will suggest that there is nothing left out of the intervention equation and that we have used the appropriate model specification when estimating time or ***t***.

IV. RESULTS

4.1 Overview of the Results

We can compile the results achieved by executing the previously mentioned regression into the following table which is illustrated below. With the banks listed in order of the total bailout amount they received individually, the table includes coefficients on $\boldsymbol{\beta_2}$ and $\boldsymbol{\beta_3}$ as well as the significance level of the Q-Statistics for each bank's corresponding ***PROCESS RESIDUAL***. Recall from the previous outline of Enders' intervention example that the $\boldsymbol{\beta_2}$ coefficient represents an AR(1) term that will serve as a decay rate stemming from the shock of the intervention, or bailout in this case. $\boldsymbol{\beta_3}$, which is the coefficient associated with the ***BAILOUT DUMMY*** variable for each bank, will describe the immediate reaction of banking share prices to the enactment of the capital injection programs. Additionally, the significance level of the Box-Pierce and Box-Ljung Q-Statistics will suggest whether or not we have modeled the correct time series process. These important aspects of our results are detailed in the following table:

TABLE 4.1:
INTERVENTION MODEL REGRESSION RESULTS

BANKING INSTITUTION	TOTAL BAILOUT AMOUNT ($)	DECAY RATE (β_2)	STOCK PRICE RESULT (β_3)	BOX-PIERCE / BOX-LJUNG Q-STAT SIGNIFICANCE
Bank of America	45,000,000,000	.92046502* *(38.658)*	-.1142315* *(-4.079)*	.2392 / .1861
Citigroup	45,000,000,000	.93877416* *(58.1)*	-.17190284* *(-4.823)*	.3545 / .2953
JP Morgan Chase	25,000,000,000	.89660684* *(31.662)*	-.01052947 *(-.741)*	.935 / .9157
Wells Fargo[1]	25,000,000,000	.94715726* *(43.43)*	-.01093432 *(-.737)*	.0296 / .0184
Morgan Stanley	10,000,000,000	.96795239* *(39.954)*	-.02546545 *(-1.304)*	.7425 / .6688
PNC Financial	7,579,200,000	.90966699* *(35.086)*	-.01500747 *(-1.179)*	.6741 / .5889
US Bancorp	6,599,000,000	.94172101* *(45.378)*	-.01610425 *(-1.165)*	.2049 / .1507
Suntrust[2]	4,850,000,000	.91581803* *(40.357)*	-.10280503* *(-4.047)*	0 / 0
Capital One Financial Corp.	3,555,199,000	.94145065* *(39.927)*	-.01994538 *(-.958)*	.1263 / .0695
Regions Financial Corp. [1]	3,500,000,000	.94911395* *(48.677)*	-.10807022* *(-3.203)*	.0005 / .0002
Fifth Third Bancorp	3,408,000,000	.96517236* *(53.523)*	-.04835266 *(-1.616)*	.175 / .1328
BB&T	3,133,640,000	.93298059* *(42.184)*	-.03353213* *(-2.316)*	.1382 / .1035

TABLE 4.1 (Continued):
INTERVENTION MODEL REGRESSION RESULTS

BANKING INSTITUTION	TOTAL BAILOUT AMOUNT ($)	DECAY RATE (β_2)	STOCK PRICE RESULT (β_3)	BOX-PIERCE / BOX-LJUNG Q-STAT SIGNIFICANCE
Bank of New York Mellon	3,000,000,000	.94776781* *(44.762)*	-.03213922* *(-2.36)*	.8122 / .7701
KeyCorp	2,500,000,000	.94762867* *(48.118)*	-.08056086* *(-2.893)*	.0774 / .0524
State Street	2,000,000,000	.94504624* *(44.981)*	-.01342033 *(-.982)*	6929 / .6354
Synovus Financial Corp.[1]	967,870,000	.94599251* *(59.762)*	-.16104261* *(-4.798)*	.0206 / .0089
M&T Bank Corporation	600,000,000	.97254006* *(62.623)*	-.01308955 *(-.943)*	.4307 / .3374
TCF Financial Corporation	361,172,000	.97073546* *(62.549)*	-.03304947 *(-1.882)*	.9781 / .9674
Central Pacific Financial[1]	135,000,000	.95503310* *(70.984)*	-.18713818* *(-5.401)*	.0019 / .001
Auburn Bank	0	.97174535* *(48.802)*	-.0070981 *(-.461)*	.6868 / .5692
BancFirst Corporation	0	.98353505* *(64.154)*	-.01379618 *(-.839)*	.6599 / .5981
BancorpSouth Incorporated	0	.96879679* *(50.285)*	-.0338268* *(-2.619)*	.7858 / .7195
Bank of Hawaii[1]	0	.98398629* *(73.551)*	-.00896991 *(-.655)*	.0344 / .0196
Community Bank System Inc.	0	.96492386* *(54.075)*	.00069147 *(.044)*	.7819 / .73

* Statistically significant

[1]*BANK SHARE PRICE RESIDUAL* variable can be differenced before running the second regression in order for the *PROCESS RESIDUAL* to exhibit a white noise process. This is exhibited in the next section as well as Appendix II.

[2]Could not obtain a white noise process on the *PROCESS RESIDUAL* through differencing the *BANK SHARE PRICE RESIDUAL* (ie Box-Pierce and Box-Ljung significance levels always remain less than .05).

4.2 Testing for Estimation of the Correct Time Series Process

As mentioned earlier, the previous regression yields a new residual, which we are calling the ***PROCESS RESIDUAL***. I have given the variable this name because we can use it to check and be sure we have estimated the correct time series process needed for this intervention model. In this case, we would expect this residual to exhibit a white noise process if we have modeled the time series process correctly. We can check for this by looking at the significance level of the Box-Pierce and Box-Ljung test statistics associated with the ***PROCESS RESIDUAL***. We will use a significance level of at least .05 in order to claim that the ***PROCESS RESIDUAL*** follows the desired white noise process. The reported Box-Pierce and Box-Ljung test statistics reported in the above table are P-values which are computed using 36 lags can tell us if this residual exhibits a white noise process. If this is the case, we can feel confident that we have indeed estimated the correct process. In this model, we have assumed that these banks follow an AR(1) process. This assumption seems legitimate for most of the banks analyzed. However, the ***PROCESS RESIDUAL*** associated with the banks Wells Fargo, Regions Financial, Synovus Financial Corporation, Central Pacific Financial, and Bank of Hawaii did yield marginally significant Box-Pierce and Box-Ljung test statistics. Nevertheless, the decay rate and coefficient on the dummy variables for these banks are very similar in magnitude to the results given from the other banks whose ***PROCESS RESIDUAL*** did reveal white noise when identified. For these banks (Wells Fargo, Regions Financial, Synovus Financial Corporation, Central Pacific Financial, and Bank of Hawaii), we can try to further difference the data in order to achieve significant white noise on the ***PROCESS RESIDUAL***. Indeed, further differencing the ***FILTERED BANK SHARE***

PRICE variable for these institutions did yield a white noise process on the ***PROCESS RESIDUAL*** for the corresponding banks. More specifically, Wells Fargo, Regions Financial, Synovus Financial Corporation, Central Pacific Financial, and Bank of Hawaii can be 4^{th}, 5^{th}, 3^{rd}, 2^{nd}, and 3^{rd} differenced, respectively, to produce a white noise process with regards to identifying the ***PROCESS RESIDUAL***. The other results stemming from further differencing these banks does mimic the original results from when we assumed that Wells Fargo, Regions Financial, Synovus Financial Corporation, Central Pacific Financial, and Bank of Hawaii all followed an AR(1) process. Furthermore, the ***BAILOUT DUMMY COEFFICIENT*** did become less significant in some cases but in some instances (i.e. Bank of Hawaii) the ***BAILOUT DUMMY COEFFICIENT*** actually became more significant. This process of differencing as well as the results from doing so are further expounded upon in Appendix II of this thesis.

In the case of Suntrust however, we could not achieve a white noise process on the ***PROCESS RESIDUAL*** through differencing. In all likelihood, this is because the share price data for Suntrust follows a more complicated time series process. Though other results given by this model for Suntrust seem to be in-line with the results from the other banks, the results this model has yielded for Suntrust should be viewed with caution.

We can see that the ***PROCESS RESIDUAL*** on the overwhelming majority of the banks analyzed looks like white noise when we assume the time series follows an AR(1) process. We have also examined validity of the notion that we can difference the ***FILTERED BANK SHARE PRICE*** by the desired number of time periods for the few remaining banks whose ***PROCESS RESIDUAL*** did not meet the previously stated criteria for revealing a white noise process. This can be done without significantly changing the results given by the ***BAILOUT DUMMY COEFFICIENT*** as well as the ***FILTERED BANK SHARE PRICE COEFFICIENT***. Taking both of these observations into account, we can feel confident that we have correctly identified the time series for all of these banks. Because of this, in what follows, we will analyze the results given from the original non-differenced model even if the time series needed to be further differenced for some to achieve significant Box-Pierce and Box-Ljung test statistics on the ***PROCESS RESIDUAL***. Now that we have substantial evidence that this model is using the correct time series process, we can begin to really look at the effect that the Capital Purchase Program and the Targeted Investment Program had on the share prices of U.S. banking institutions.

4.3 Interpretation of Bailout Dummy Coefficients

We can see that all but one of the coefficients the bailout dummies in Table 4.1 are negative, though they are not all significant. This seems to suggest that the capital infusion to these banks by the government did not help the equity prices of these banks when we adjust for the market and hold everything else constant. As mentioned earlier, this does not mean the bailout, as a whole, was a bad idea necessarily, but that it may have put some downward pressure on the share prices of U.S. banking institutions. This is interesting because you would normally expect to see a positive affect on an asset's value when it is receiving massive amounts of seemingly free capital. However, given the circumstances and reasons that the capital was given to the banks, it seems that this was not the case. Also, the fact that the lender of this capital was the government most likely sent a bad signal to the market which in turn caused a decline in share prices. This decline does not seem to discriminate between the amount of bailout funds these individual banks received (or if they received any at all). We cannot say for sure that we are 100% certain that the capital infusion by the government had a negative effect on all of these bank's stock prices because all of the ***BAILOUT DUMMY COEFFICIENTS*** are not significant. However, we do feel confident in saying that the data suggests that it most certainly did not have a positive influence on the share prices of these financial institutions. In fact, assuming independence among regressions, we can use the binomial distribution to check what the probability is of our results actually being insignificant when they seem to be significant. The probability of finding as many as 9 out of 24 significant ***BAILOUT DUMMY COEFFICIENTS*** by chance (when the probability of finding one significant by chance is 0.05) is 0.00018131155% or .0000018131155.

Given this extremely low probability it is not unreasonable to allege, based on these results, that the bailout resulted in a system wise drop in the stock prices of U.S. banks. This is evident because all of the signs on these coefficients are negative. But again, only a little over 1/3rd of them are significant.

As we have stated throughout this thesis, the data and thus the results which we are interpreting through the use of this intervention model are in the natural logarithmic form. It is because of this that when the ***BAILOUT DUMMY COEFFICIENT*** is interpreted as the amount of a decline in share prices, it should be viewed as a percentage drop in the filtered share price of the associated financial institution attributable strictly to the bailout. This is true even though we are dealing with the filtered price, since the filtering process only removed the market effect on stock prices alone. Hence the change in the filtered price attributable to the bailout is the change in the market price attributable to the bailout. When we take this into account, you can see that some of stock prices of these banks took negative hits after the capital injections began in late October of 2008. It may be desirable to look at the impact effect of the bailout on banking share prices in a way other than percentage decreases. Keep in mind that we are looking at the effect of the filtered share price of these banks so these drops represent the minimal amount that the share price dropped due to the bailout. Table 4.2 illustrates the minimal dollar amount of the decrease in equity prices on U.S. banks that have a statistically significant ***BAILOUT DUMMY COEFFICIENT***:

TABLE 4.2:
SIGNIFICANT SHARE PRICE REACTIONS

BANKING INSTITUTION	IMMEDIATE STOCK PRICE REACTION ($ß_3$)	OCTOBER 2008 SHARE PRICE ($)	IMMEDIATE STOCK PRICE REACTION ($)
Bank of America	-0.1142315	24.17	-2.76
Citigroup	-0.17190284	136.5	-23.46
Suntrust	-0.10280503	40.14	-4.13
Regions Financial Corp.	-0.10807022	11.09	-1.20
BB&T	-0.03353213	35.85	-1.20
Bank of New York Mellon Corp.	-0.03213922	32.99	-1.06
KeyCorp	-0.08056086	12.41	-1.00
Synovus Financial Corporation	-0.16092731	10.33	-1.66
Central Pacific Financial	-0.18713818	312	-58.39
BancorpSouth Incorporated	-0.0338268	24.27	-.082

Table 4.2 illustrates the minimal dollar amount of the decrease in equity prices on U.S. banks that have did not have a statistically significant ***BAILOUT DUMMY COEFFICIENT***:

TABLE 4.3:
INSIGNIFICANT SHARE PRICE REACTIONS

BANKING INSTITUTION	IMMEDIATE STOCK PRICE REACTION (β_3)	OCTOBER 2008 SHARE PRICE ($)	IMMEDIATE STOCK PRICE REACTION ($)
JP Morgan Chase	-0.01052947	41.25	-0.43
Wells Fargo	-0.01093432	34.05	-0.37
Morgan Stanley	-0.02546545	17.47	-0.44
PNC Financial	-0.01500747	66.67	-1.00
US Bancorp	-0.01610425	29.81	-0.48
Capital One Financial Corp.	-0.01994538	39.12	-0.78
Fifth Third Bancorp	-0.04835266	10.85	-0.52
State Street	-0.01342033	43.35	-0.58
M&T Bank Corporation	-0.01308955	81.1	-1.06
TCF Financial Corporation	-0.03304947	17.74	-0.59
Auburn Bank	-0.0070981	22.41	-0.16
BancFirst Corporation	-0.01379618	50.4	-0.70
Bank of Hawaii	-0.00896991	50.71	-0.45
Community Bank System Inc.	0.00069147	24.95	0.02

As one would expect, the financial institutions which have a significant ***BAILOUT DUMMY COEFFICIENT*** seem to have experienced larger negative shocks to their share prices percentage wise as well as dollar wise. The results seem to suggest that all immediate minimal shocks of more than one dollar are being interpreted as statistically significant drops.

We can see that there seems to be no correlation between a bank's total bailout amount received and the corresponding significance level of the bank's ***BAILOUT DUMMY COEFFICIENT***. However, we must realize that the total bailout amounts given in this analysis do not take into account the size of the banking institution. Hence, we need to also check to see if there is any correlation between a bank's bailout amount relative to the size of the bank and the significance level of the ***BAILOUT DUMMY COEFFICIENT***. The Bank Holding Company Act as well as Regulation Y both require bank holding companies to file quarterly Y-9LP forms to the U.S. Federal Reserve. We can use these financial statements to determine the total amount of assets these banks had as of June 2008 (the nearest quarterly report preceding the bailout). Once we have retrieved June 2008 total asset information for these banks, we can divide this amount by the total amount of bailout capital the corresponding bank received. This will give us a "bailout ratio" that we can check for correlation with the significance level of the ***BAILOUT DUMMY COEFFICIENTS***. Table 4.4 shows that there seems to be no correlation between the significance of a bank's ***BAILOUT DUMMY COEFFICIENT*** and this newly formulated "bailout ratio" for that same bank.

**TABLE 4.4:
BAILOUT RATIO CORRELATION WITH
BAILOUT DUMMY SIGNIFICANCE**

BANKING INSTITUTION	TOTAL BAILOUT AMOUNT	JUNE 2008 TOTAL ASSETS	BAILOUT RATIO	SIGNIFICANT BAILOUT DUMMY
Morgan Stanley	10,000,000,000	283,140,000,000*	28.31	No
Bank of New York Mellon Corp.	3,000,000,000	44,931,000,000	14.98	Yes
JP Morgan Chase	25,000,000,000	345,646,000,000	13.823	No
M&T Bank Corporation	600,000,000	8,068,542,000	13.45	No
State Street	2,000,000,000	23,309,081,000	11.65	No
Capital One Financial Corp.	3,555,199,000	33,429,104,000	9.40	No
Bank of America	45,000,000,000	368,684,845,000	8.19	Yes
Citigroup	45,000,000,000	339,703,000,000	7.55	Yes

**TABLE 4.4 (Continued):
BAILOUT RATIO CORRELATION WITH
BAILOUT DUMMY SIGNIFICANCE**

BANKING INSTITUTION	TOTAL BAILOUT AMOUNT	JUNE 2008 TOTAL ASSETS	BAILOUT RATIO	SIGNIFICANT BAILOUT DUMMY
Regions Financial Corp.	3,500,000,000	25,737,490,000	7.35	Yes
BB&T	3,133,640,000	19,978,622,000	6.38	Yes
Wells Fargo	25,000,000,000	156,493,000,000	6.256	No
KeyCorp	2,500,000,000	14,183,611,000	5.67	Yes
Fifth Third Bancorp	3,408,000,000	18,382,392,000	5.39	No
Suntrust	4,850,000,000	26,005,949,000	5.36	Yes
US Bancorp	6,599,000,000	35,008,728,000	5.31	No
Central Pacific Financial	135,000,000	617,175,000	4.57	Yes
Synovus Financial Corp.	967,870,000	4,279,576,000	4.42	Yes
TCF Financial Corporation	361,172,000	1,102,413,000	3.05	No
PNC Financial	7,579,200,000	18,271,731,000	2.41	No
Auburn Bank	0	61,365,000	0	No
BancFirst Corp.	0	417,870,000	0	No
BancorpSouth Inc.	0	1,396,194,000	0	Yes
Bank of Hawaii	0	806,938,000	0	No
Community Bank System Inc.	0	593,989,000	0	No

* June 2008 Y-9LP not available so March 2009 Y-9LP was used

We can see that there seems to be no correlation between the "bailout ratio" which we have just created and the ***BAILOUT DUMMY COEFFICIENTS***. It may also be wise to regress the banks with an insignificant ***BAILOUT DUMMY COEFFICIENT*** in a model which includes a ***BAILOUT DUMMY*** which corresponds to that bank only. Recall from the earlier table detailing the capital injection schedule that different banks were given bailouts at different times. For the banks that did not initially return a significant ***BAILOUT DUMMY COEFFICIENT***, we can see that some of them received bailout capital later than October 28, 2008. It is for these few banks that the earlier steps for this model are repeated but this time the ***BAILOUT DUMMY*** variable corresponds only to the time of that bank's bailout. Hence, we will need to create three more ***BAILOUT DUMMY*** variables with 0's on all observations before the bailout and 1's on all observations after the bailout. Once this has been completed and the earlier model steps are performed on these select banks, we still find the same results. Even after running the model including the creation of these bank specific ***BAILOUT DUMMY*** variables, the ***BAILOUT DUMMY COEFFICIENTS*** for these specific banks still remains insignificant.

4.4 Interpretation of the Lagged and Filtered Share Price Coefficients

The most interesting results given are the extremely high coefficients on the ***FILTERED BANK SHARE PRICE [t-1]*** variables, which are labeled as Decay Rates on the above table. The closer to 1 these coefficients are, the longer it will take the share prices of these banks to recover or return to normal. Thus, the closer the coefficient is to 1, the longer it will take the shock on share prices from the bailout to die out. If the coefficients would have been 1, this would have meant that the shock would have resulted in a permanent and constant change in the share prices and we would have a random walk occurring from this point on in the time series. If these coefficients would have been greater than 1, we could see that the bailout would have resulted in causing the share prices of these banks to be exploding and never reverting back to their position before the bailout. However, since these coefficients are so close to 1, we can look at the shock from the government bailout on share prices of U.S. banks as having a very long lasting (but not quite permanent) effect. We can see that the AR(1) terms are so large due to an autonomous increase in riskiness, that it will take an extremely long time for the effect of the bailout to die out on the corresponding share prices of these banks. We might have expected to see banks that had less to do with the government's capital infusion have a smaller decay rate. However, we can see that banks like Bank of America and Citigroup were some of the largest recipients of government funds and yet these banks have some of the fastest decay rates of all 24 banks analyzed. Meanwhile, banks like BancorpSouth Incorporated and others that received no bailout funds face some of the longest recovery periods out of all the banks analyzed. Thus, it is easy to see that the bailout of a couple hundred banks caused a long lasting shock throughout the entire banking industry with respect to the common stock share prices of U.S. banks. Again, the market participants did not seem to differentiate between who took government funds and who did not, as well as how much the individual banks took. This is quite interesting when we consider that some banks did not particularly desire a capital injection from the government and that most banks did not even receive one. It appears the effect of the bailout on banking share prices is here for a very long time. These coefficients are so high on some of these banking entities that we may even view this a semi-permanent effect or shock.

The reason these decay rates are so high may be due to the nature of the banking industry. Banks in general have dramatically changed the way that they operate following the recent financial collapse. Even though the bailout was an attempt by the U.S. government to stabilize the banking industry by giving capital to banks specifically for loaning purposes, there is still a shortage of available capital in U.S. loan markets. Until the behavior and perception of these banks change, it appears the recovery periods will be very long. This is not to say that these decay rates must remain this high forever. If we continue to keep updating the banking data in the future and there are significant financial developments (like an influx of loan market capital) in the future, these decay rates may begin to decrease. However, until something of this nature occurs, the recovery period of U.S. banking share prices resulting from government capital injections will take a very long time.

It is of interest for us to ask just how long this analysis is suggesting that it will take the stock prices of these banks to recover. James Hamilton shows (though he did not introduce) in his text Time Series Analysis (1994) that the ***FILTERED BANK SHARE***

PRICE [t-1] COEFFICIENT from this intervention model will determine the rate of decay of the shock due to the intervention, which in this case is the bailout. The effect of the shock can be expressed by the following:

(4.1)

$$\mathbf{\Phi^{T} = 0}$$

where Φ denotes β_2,
where T denotes number of time periods

We can see that a larger value of ***Φ*** will require a larger number of recovery periods in order for the left hand side of the equation to equal zero. Thus, the larger the value is on the ***FILTERED BANK SHARE PRICE [t-1] COEFFICIENT*** or $\boldsymbol{\beta_2}$, the longer it will take for the effect of the shock to die out. It can also be seen that any value of ***Φ*** that is less than 1 in absolute value (which is what we encounter in this model) will require limiting ***T*** to infinity in order for the effect or above equation to reach absolute zero. For practical purposes, we may want to rewrite the equation as follows:

(4.2)

$$\mathbf{\Phi^{T} = 0.004999999....}$$

If we concede for our purposes that .004999999 is close enough to essentially being zero, we can solve for ***T*** (which in our case is denominated in months) for each of the 24 banks we have included in this analysis. The following table shows the results from doing this for each bank and their following estimated recovery periods:

TABLE 4.5:
ESTIMATED RECOVERY PERIODS

BANKING INSTITUTION	DECAY RATE (β_2)	ESTIMATED RECOVERY PERIOD (MONTHS)
JP Morgan Chase	0.89660684	49
PNC Financial	0.90966699	56
Suntrust	0.91581803	60
Bank of America	0.92046502	64
BB&T	0.93298059	76
Citigroup	0.93877416	84
Capital One Financial Corp.	0.94145065	88
US Bancorp	0.94172101	88
State Street	0.94504624	94
Synovus Financial Corporation	0.94599251	96
Wells Fargo	0.94715726	98
KeyCorp	0.94762867	99
Bank of New York Mellon Corp.	0.94776781	99
Regions Financial Corp.	0.94911395	102
Central Pacific Financial	0.9550331	115
Community Bank System Inc.	0.96492386	148
Fifth Third Bancorp	0.96517236	150
Morgan Stanley	0.96795239	163
BancorpSouth Incorporated	0.96879679	167
TCF Financial Corporation	0.97073546	178
Auburn Bank	0.97174535	185
M&T Bank Corporation	0.97254006	190
BancFirst Corporation	0.98353505	319
Bank of Hawaii	0.98398629	328

As we can see in Table 4.5, a small movement in the ***FILTERED BANK SHARE PRICE [t-1] COEFFICIENT*** or $\boldsymbol{\beta_2}$ can lead to a very dramatic change in the estimated monthly recovery period. We can also see that this recovery period is very long with the average recovery period being about 10.75 years.

We can also see from the earlier table that the smaller banks (including ones that received no bailout funds) face longer recovery periods. This is perhaps because the larger banks have access to many more financial tools and are more diversified in many aspects. These larger firms tend to act as leaders or first movers in the banking industry while the smaller firms (comprised mostly of banks that did not receive any bailout capital) tend to act as followers or second movers. Hence, the recovery period of the share prices of the smaller banks may be lengthier and occur after the recovery of the share prices of the larger entities. Again, it appears that the share prices of the industry as a whole face a long recovery period resulting from the capital injection shocks.

V. COMPARING CAPITAL INJECTION SHOCKS TO OTHER EVENTS
5.1 Multi-Dummy Model Formulation

We have successfully looked at the effect of the bailout alone on U.S. banking share prices but it is important that we compare these results to other results obtained from also looking at the effect that other significant events may have had on these same stock prices. This is important because we want to make sure our significant results are indeed just that when compared to other interventions or shocks. Recall that in addition to the creation of the ***BAILOUT DUMMY*** variable, we also created three other binary dummy variables which are the ***911 DUMMY***, ***CRA DUMMY***, and the ***GLBA DUMMY*** variables. The reasoning behind including these additional dummy variables as well as descriptions of the events which they represent has been covered earlier in this thesis; thus there is no need to re hash this aspect of the model.

Because we have already created the ***FILTERED BANK SHARE PRICE*** variable for each bank, which accounts for market movement, we can append the three new dummy variables to the previous intervention model regression. The following equation shows the new regression model:

$$\begin{gathered} \textit{FILTERED BANK SHARE PRICE}_t = \\ \beta_1(\textit{ONE}) + \beta_2(\textit{FILTERED BANK SHARE PRICE})_{t-1} + \beta_3(\textit{BAILOUT DUMMY})_t + \\ \beta_4(\textit{GLBA DUMMY})_t + \beta_5(\textit{CRA DUMMY})_t + \beta_3(\textit{911 DUMMY})_t + \varepsilon_t \end{gathered} \tag{5.1}$$

This model will give us coefficient estimates which will suggest the level of significance of these four events on U.S. bank's stock prices as well as the level of impact effect that these differing events had on these same share prices. From these results we can analyze the validity of our earlier discoveries with regards to the bailout's effect on

U.S. banks' share prices. If these results are in agreement with our findings from the single dummy intervention model, it will reassure our previously stated inferences.

5.2 Multi-Dummy Model Results

The resulting dummy variable coefficients and their corresponding significance level from running the previous regression equation 5.1 with four binary dummy variables are illustrated on Table 5.1 which includes associated t-statistics in parenthesis.

TABLE 5.1:
MULTI-DUMMY INTERVENTION MODEL REGRESSION RESULTS

BANKING INSTITUTION	BAILOUT EFFECT (β_3)	GBLA EFFECT (β_4)	CRA EFFECT (β_5)	9/11 EFFECT (β_6)
Bank of America[1]	-0.20147694* *(-4.925)*	-0.05418105 *(-1.938)*	0.02623079 *(1.396)*	0.07855831* *(2.602)*
Citigroup	-0.21797384* *(-4.687)*	0.03432627 *(1.477)*	0.01578846 *(0.906)*	-0.02210562 *(-1.005)*
JP Morgan Chase	0.00157341 *(0.097)*	-0.03362359 *(-1.638)*	0.03129882 *(1.955)*	-0.00174601 *(-0.092)*
Wells Fargo[1]	-0.02245859 *(-1.443)*	-0.00315467 *(-0.154)*	-0.01662031 *(-1.135)*	0.04316454 *(1.861)*
Morgan Stanley	-0.02904106 *(-1.178)*	0.02913847 *(1.25)*	-0.00905399 *(-0.432)*	-0.02523601 *(-1.28)*
PNC Financial	-0.01978283 (*-1.396*)	0.0075218 *(0.415)*	-0.00555585 *(-0.424)*	0.00385498 *(0.218)*
US Bancorp	-0.02713483 *(-1.765)*	-0.06199001* *(-2.358)*	0.02224565 *(1.395)*	0.05866792* *(2.494)*
Suntrust[2]	-0.13656965* *(-4.231)*	-0.03149289 *(-1.33)*	0.03098092 *(1.712)*	0.02371172 *(1.07)*
Capital One Financial Corp.	-0.04568248 *(-1.874)*	0.03095891 *(1.108)*		0.02260027 *(0.751)*
Regions Financial[1]	-0.11473504* *(-2.793)*	-0.02008115 *(-0.816)*	0.01723202 *(0.873)*	0.00183969 *(0.08)*

TABLE 5.1 (Continued):
MULTI-DUMMY INTERVENTION MODEL REGRESSION RESULTS

BANKING INSTITUTION	BAILOUT EFFECT (β_3)	GBLA EFFECT (β_4)	CRA EFFECT (β_5)	9/11 EFFECT (β_6)
Fifth Third Bancorp	-0.03333175 *(-0.977)*	0.0196031 *(0.696)*	0.00111906 *(0.053)*	-0.03488936 *(-1.303)*
BB&T	-0.0481056* *(-2.811)*	-0.00802152 *(-0.38)*	0.0052457 *(0.352)*	0.02376213 *(1.104)*
Bank of New York Mellon	-0.03213285* *(-2.125)*	0.01744933 *(0.923)*	0.00381071 *(0.267)*	-0.0170677 *(-0.945)*
KeyCorp[1]	-0.09444555* *(-2.828)*	-0.02011577 *(-0.877)*	0.01822747 *(1.072)*	0.01110335 *(0.508)*
State Street	-0.02875576 *(-1.889)*	0.03961966* *(2.095)*	-0.03110665 *(-2.008)*	0.00918313 *(0.456)*
Synovus Financial[1]	-0.18181173* *(-4.32)*	0.02035745 *(0.837)*	0.02181231 *(1.134)*	-0.02240914 *(-0.953)*
M&T Bank Corporation	-0.02725589 *(-1.765)*	0.02264463 *(1.118)*	-0.02420859 *(-1.489)*	0.02226477 *(0.819)*
TCF Financial Corporation	-0.03849613 *(-1.885)*	0.03790742 *(1.485)*	-0.01289238 *(-0.715)*	-0.01719113 *(-0.657)*
Central Pacific Financial[1]	-0.29902445* *(-5.779)*	0.03221628 *(1.079)*	-0.0071703 *(-0.323)*	0.03982539 *(1.255)*

TABLE 5.1 (Continued):
MULTI-DUMMY INTERVENTION MODEL REGRESSION RESULTS

BANKING INSTITUTION	BAILOUT EFFECT (β_3)	GBLA EFFECT (β_4)	CRA EFFECT (β_5)	9/11 EFFECT (β_6)
Auburn Bank	-0.00853315 *(-0.552)*	-0.02267152 *(-1.048)*		0.05650561* *(2.221)*
BancFirst Corporation	-0.01776441 *(-1.043)*	0.01239081 *(0.547)*	-0.02479669 *(-1.621)*	0.0321798 *(1.172)*
BancorpSouth Incorporated	-0.04580858* *(-3.113)*	-0.01232715 *(-0.6)*	-0.00095103 *(-0.071)*	0.02982157 *(1.392)*
Bank of Hawaii[1]	-0.01446675 *(-1.027)*	-0.00743808 *(-0.353)*	-0.02157511 *(-1.545)*	0.05618853 *(1.95)*
Community Bank System	-0.00765655 *(-0.467)*	-0.00534304 *(-0.233)*	-0.01420269 *(-0.96)*	0.03705651 *(1.497)*

** Statistically significant coefficient*

[1] *As in the earlier single dummy regression, this bank's share price data must and can be differenced to achieve a white noise process on the associated bank's* ***PROCESS RESIDUAL***

[2] *Could not achieve a white noise process on the* ***PROCESS RESIDUAL*** *through differencing*

As indicated by the results of this multi-dummy regression, the previous observation that the bailout caused a systematic decrease in stock prices of U.S. banks holds. As well as substantiating earlier claims, this new regression actually yields even better results. We can see that the model now suggests 10 (instead of 9) out of 24 banks received a significant drop in share prices due to the bailout. Furthermore, every single ***BAILOUT DUMMY COEFFICIENT*** for every bank is negatively signed. Thus, we still feel quite confident that the capital injections to U.S. banks put downward pressure on U.S. banking share prices as this multi-dummy analysis has reinforced those beliefs.

VI. CONCLUSION

6.1 The Effect of Government Sponsored Capital Injections on Share Prices

The results from this intervention analysis seem to strongly suggest that the U.S. government's injection of massive amounts of capital into U.S. banking institutions through the Capital Purchase Program as well as the Targeted Investment Program caused an immediate drop in the stock prices of the U.S. banking industry and that traces of this shock will be found in the share prices of U.S. banks for a long time. The negative shock to share prices seems to have been an industry wide occurrence that affected banks of all sizes, regardless of how much bailout money was received by that institution. However, it does seem to be the case that the stock prices of the larger banks (who typically received more bailout capital) look like they will recover from this bailout shock somewhat faster than smaller banking institutions (who typically received less bailout capital). As mentioned earlier, this makes sense because of the structure of these different types of banks as well as the differing roles they play in the U.S. banking market. Although these massive capital injections did seem to cause a drop in stock prices for these banks, it is important to remember that some of these banks may have gone the route that many other financial institutions did at the time and failed without this capital injection. Whether or not the government should have allowed these banks to fail or not is up for much debate. However, we seem to have a better understanding of what happened in relation to banking share prices as a result of the bailout. Although this is just one aspect of the bailout which we have examined, our results can help serve as a piece to the puzzle of understanding the effect that the Capital Purchase Program and the Targeted Investment Program had on the U.S. economy as a whole.

6.2 Extensions of the Intervention Analysis Results

Though this model only deals with the stock prices of U.S. banking institutions which is only one aspect of the U.S. economy as a whole, we may be able to make some inferences about the economy in its entirety based on the results as well as the conclusions we have drawn from this thesis. By granting the following premises, it seems plausible that we can make inferences on the state of the economy as a whole by drawing from the results outlined in this thesis. First, this model suggests that the stock prices of U.S. banks took a hit around October 2008 when all these capital injections began and that the banks are recovering from this extremely slowly. Second, it may be reasonable to assume that the share price of a bank is an indication of how it is performing based on the fact that the market is efficiently valuating these banks individually. Last, it is also natural to accept the general notion that the performance of the banking industry plays an integral and fundamental role in the health of an economy as a whole. Thus, it is plausible that the evidence uncovered through this intervention analysis may shed some light on a timetable for the recovery of the U.S. economy as a whole when holding all other exogenous influences constant. This may seem like a conclusion that is reaching for validity, but it is definitely something worth considering.

If we go by the recovery rates previously mentioned in this model, it seems the average timetable for all banks is a little less than 11 years. However, the larger banks have a mean recovery period of about 8 years. This would put share prices of these banks recovering around the years 2016-2019 ceteris paribus. We assume that at this later point in time, the share prices have recovered because the banks are being perceived as less risky, healthy, and more stable. At this point the prosperity of the banking industry may reflect or influence the state of the U.S. economy and financial markets as a whole in a positive manner. If we are assuming the positive perception of the banking industry by the market is a fundamental catalyst for growth in all sectors of the market, then we must account for a period in which the prosperity of the banking industry translates into economic growth through the entire economy. How long it would take for one to effect the other is a matter of debate and beyond the scope of this paper but even if this time frame was relatively short, we would still be looking at a long recovery period for the U.S. economy. However, recall that we earlier stated that a change in the market or shift in the behavior of larger banking institutions (such as the un-freezing of credit) could lead to a faster recovery. A faster recovery by the larger banking firms is then followed by a swifter recovery by the small U.S. banks. This could possibly render or produce a faster return to prosperity for the U.S. economy. There is much hope that something of this nature will occur sooner rather than later. Nonetheless, if the decay periods of U.S. banking equity prices as portrayed in this intervention model serve as any indication to the recovery speed of the U.S. economy from the recent financial downturn, it appears that it may take a few years at best before we see a progressing banking industry intertwined with a positively functioning U.S. economy.

REFRENCES

Box, G. E. P. and Tiao, G. C. (1975). Intervention Analysis with Applications to Economic and Environmental Problems. Journal of American Statistical Association. 70(349):70-79.

Enders, W. (1995). Applied Econometric Time Series. John Wiley & Sons, New York, NY.

Greene, W.H. (2008). Econometric Analysis (6^{th} Ed.). Pearson-Prentice Hall, Upper Saddle River, NJ.

Hamilton, J.D. (1994). Time Series Analysis. Princeton University Press, Princeton, NJ.

National Information Center. (2011). A Repository of Financial Data and Institution Characteristics Collected by the Federal Reserve System. http://www.ffiec.gov/nicpubweb/nicweb/NicHome.aspx. Accessed on 8/27/2011.

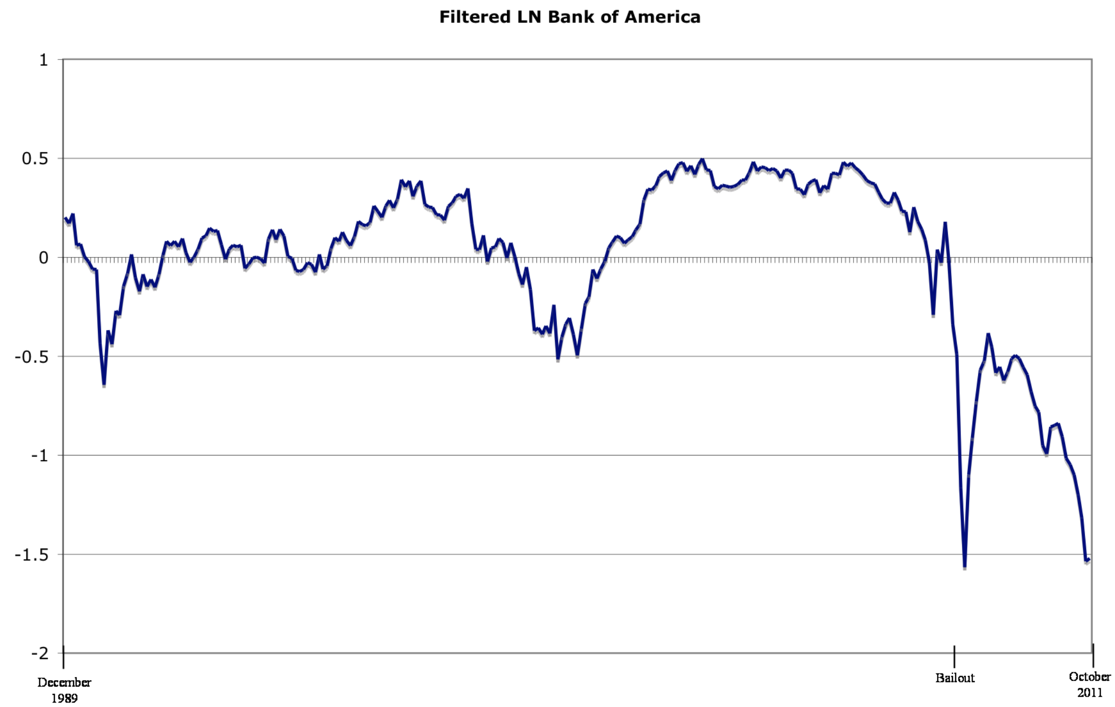
Pro Publica Inc. (2011). Eye on the Bailout. http://www.propublica.org/ion/bailout. Accessed on 8/27/2011.

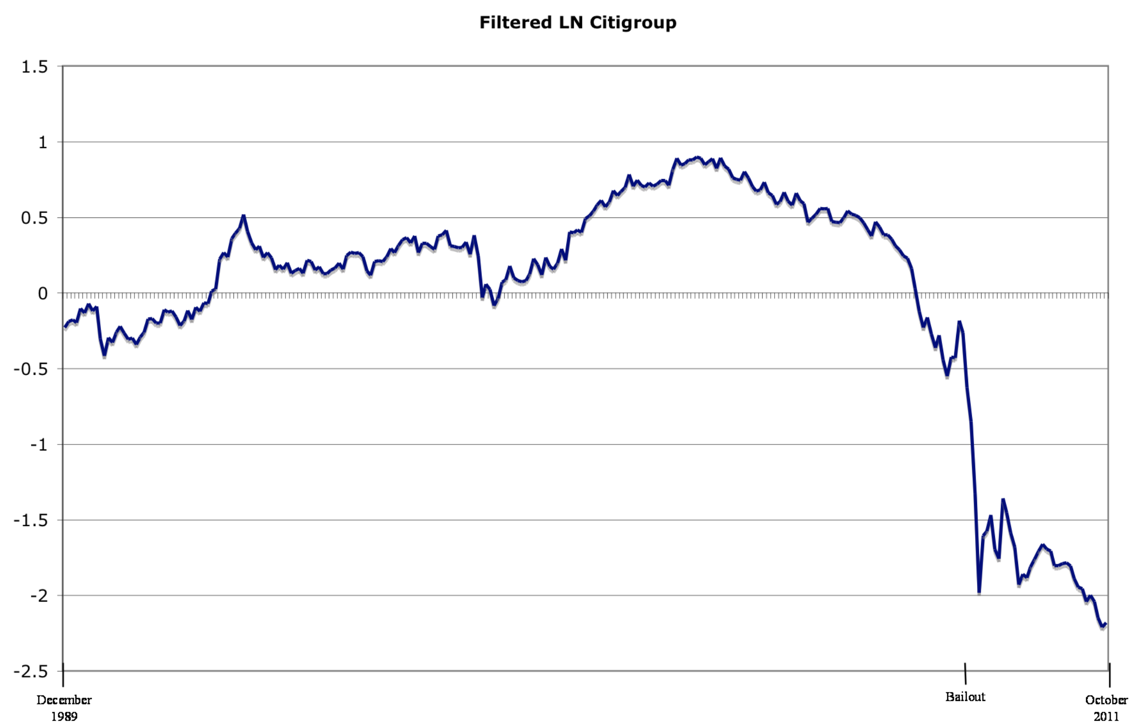
Skinner, S.J. (2006). Estimating the Real Effects of Blockbuster Art Exhibits: A Time Series Approach. Journal of Cultural Economics 30(2):109-125.

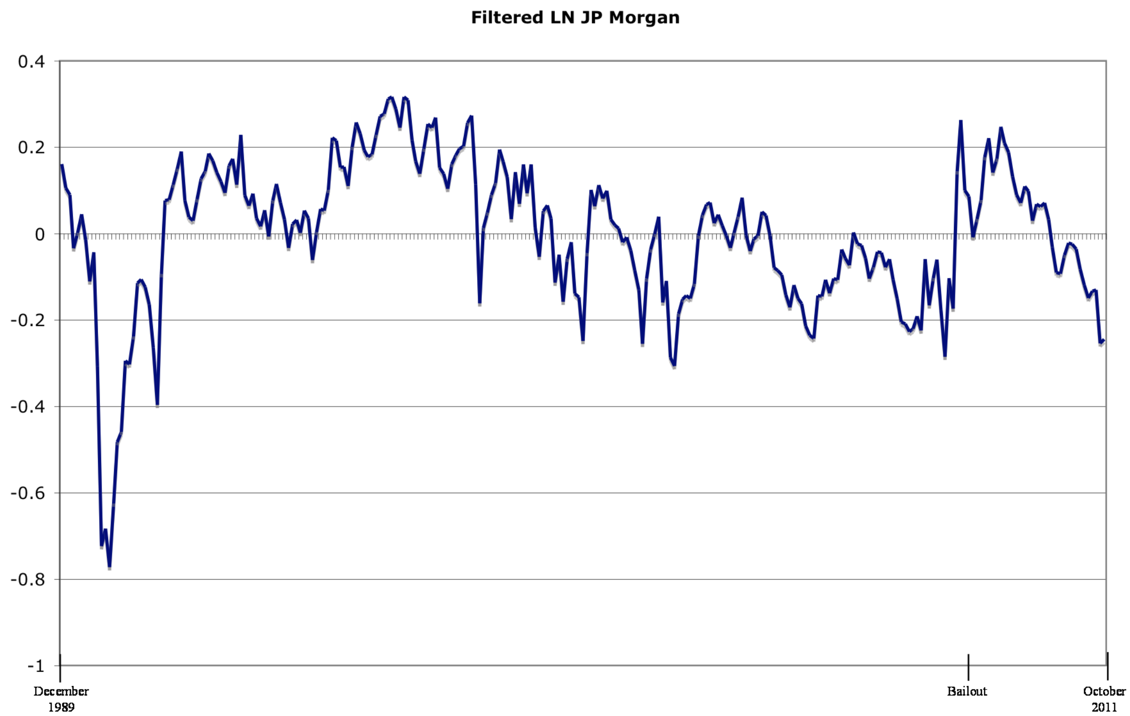
Yahoo Finance. (2011). Historical Prices. http://finance.yahoo.com. Accessed on 8/27/2011.

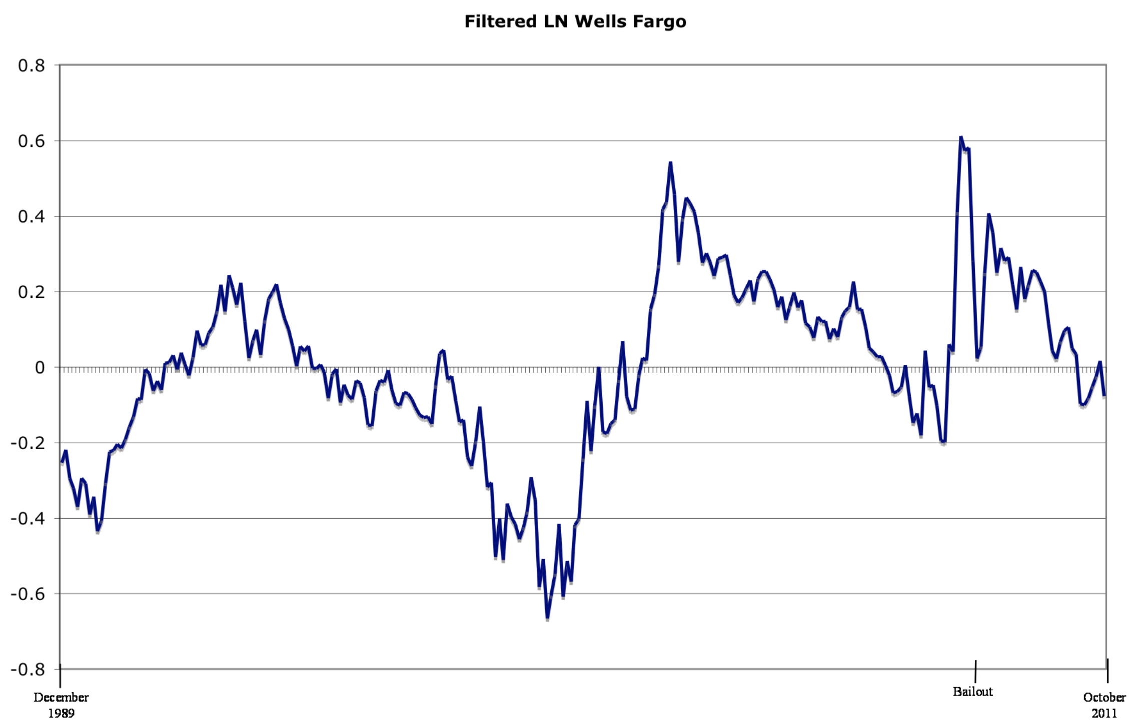
APPENDIX I
Individual Filtered LN Bank Share Price Illustrations

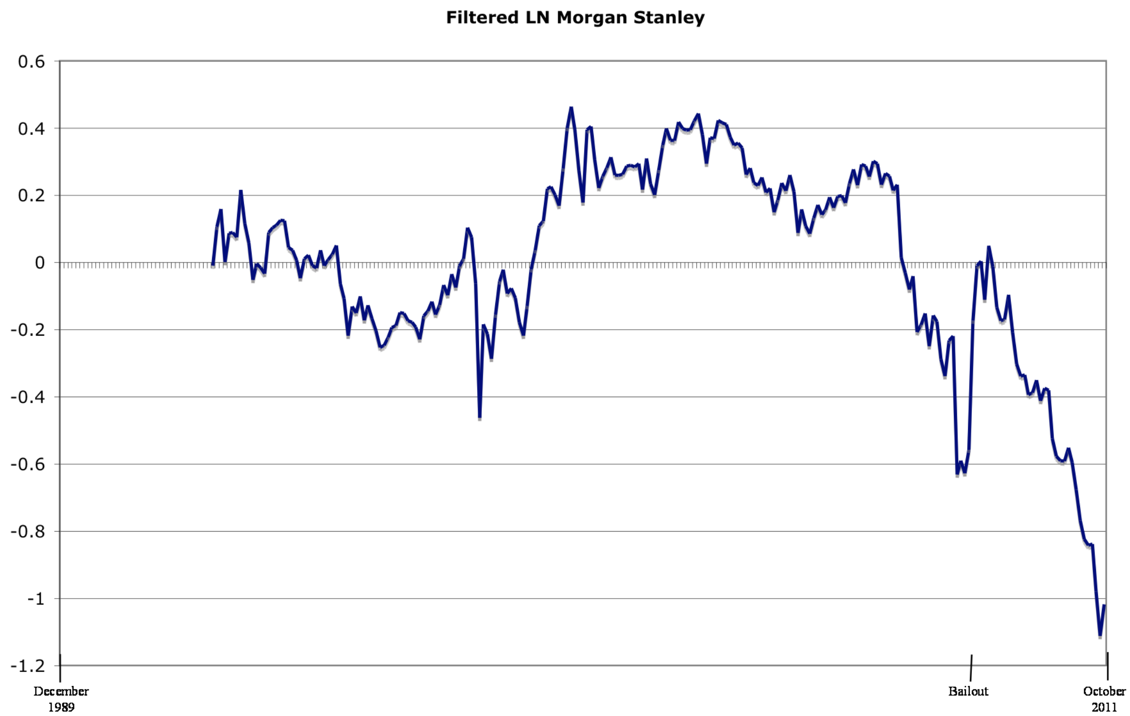
(A1.1)

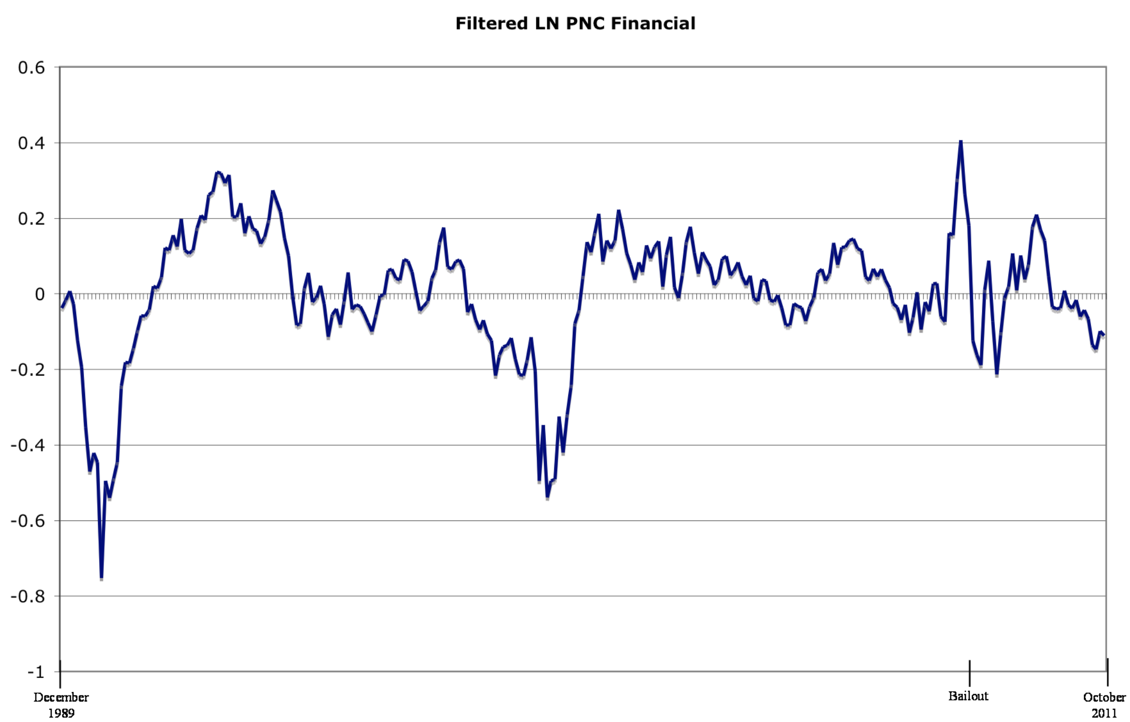




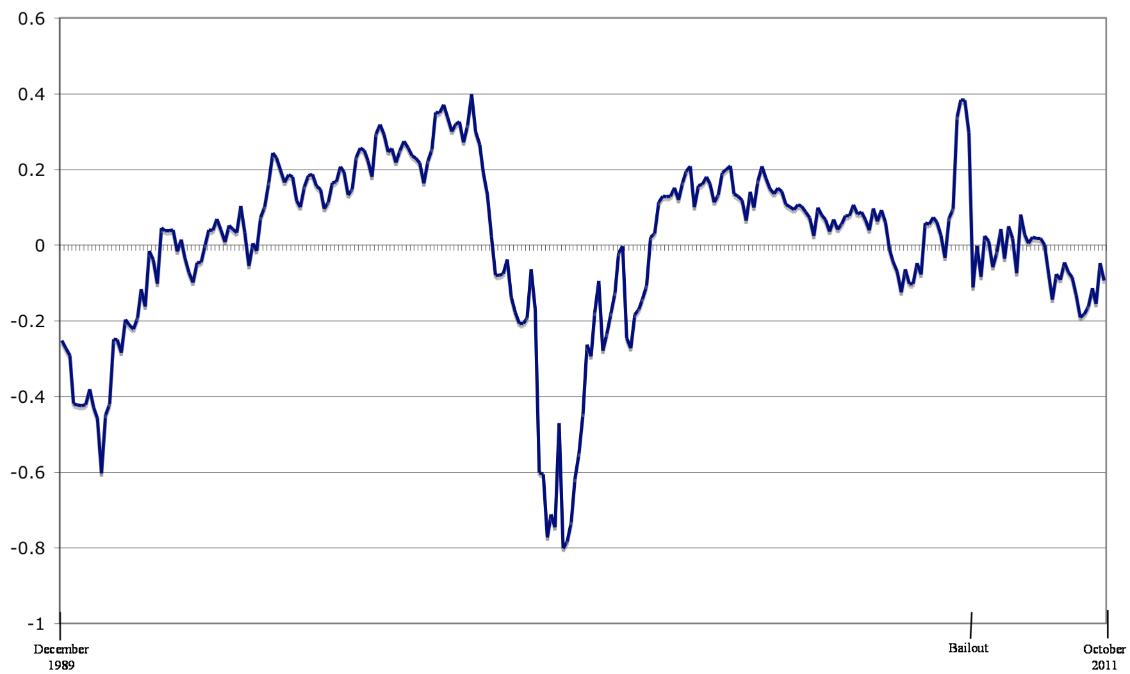

Filtered LN JP Morgan
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
December 1989
Bailout
October 2011


Filtered LN Wells Fargo
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
December 1989
Bailout
October 2011

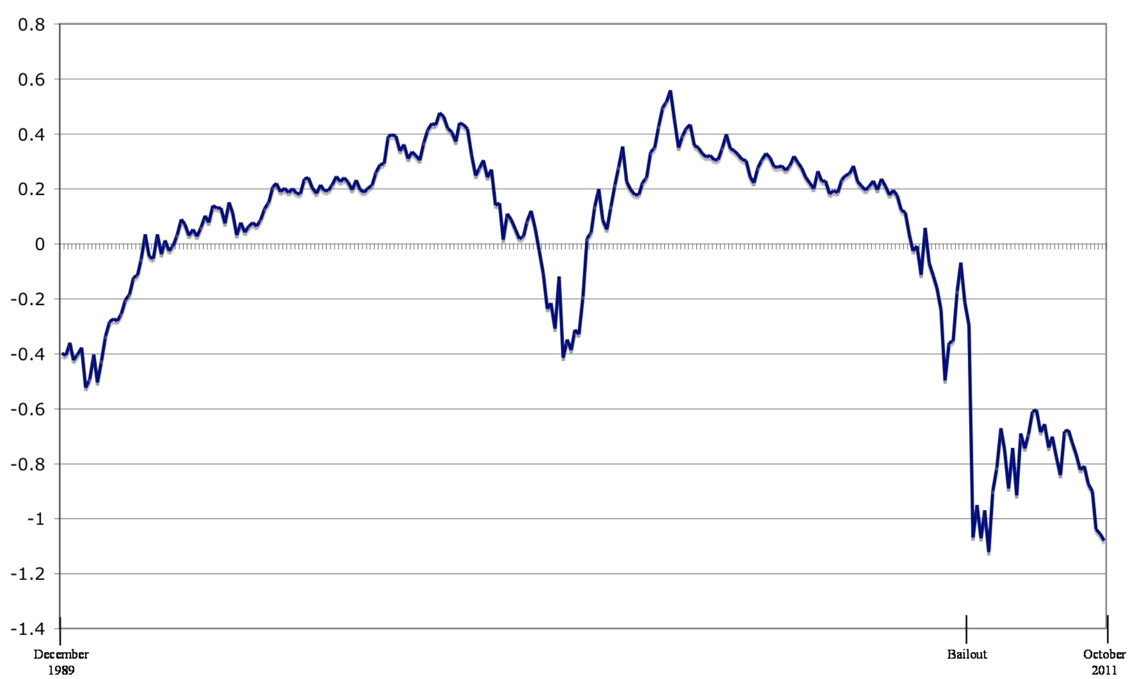

Filtered LN Morgan Stanley
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
December 1989
Bailout
October 2011


Filtered LN PNC Financial
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
December 1989
Bailout
October 2011

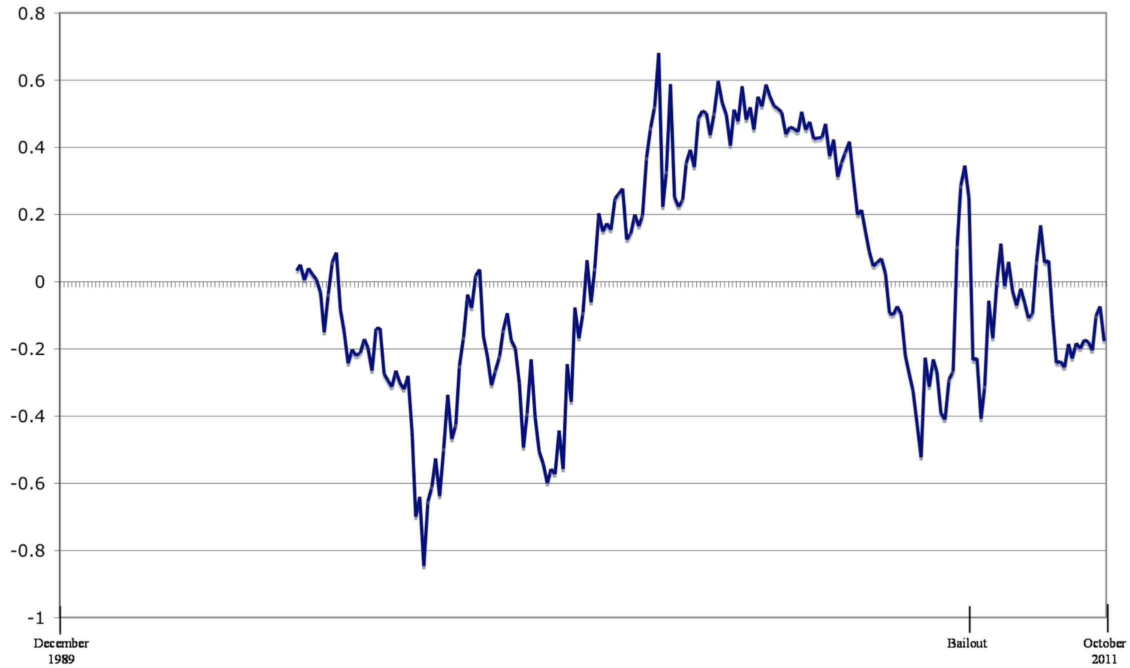
Filtered LN US Bancorp



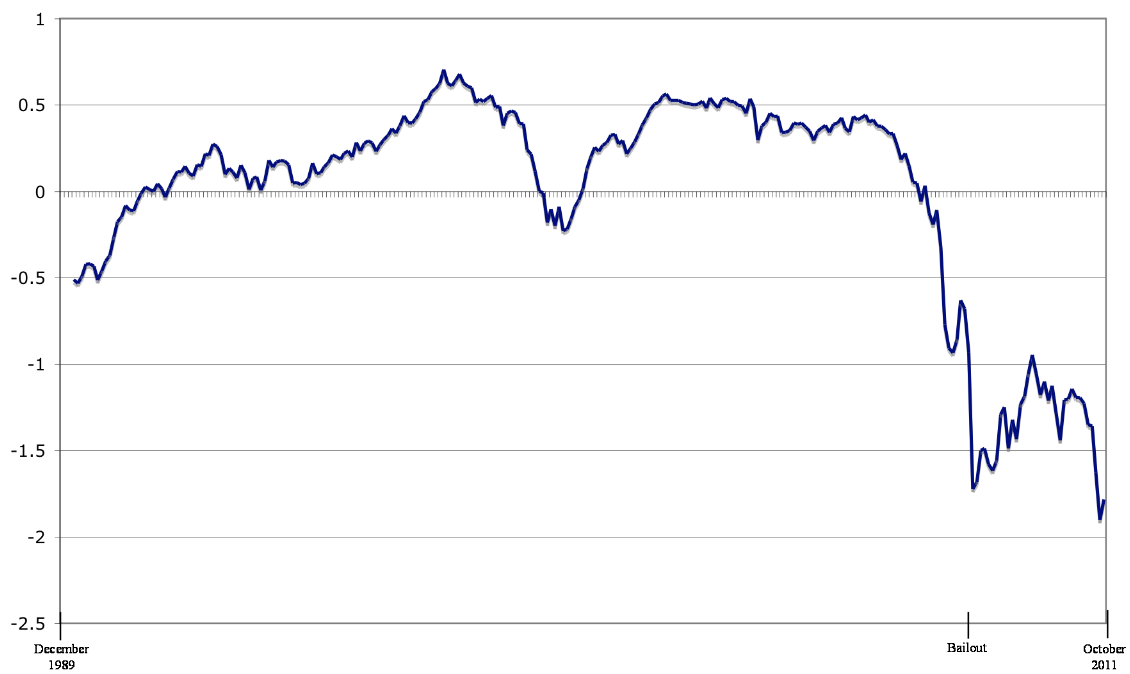
Filtered LN Suntrust

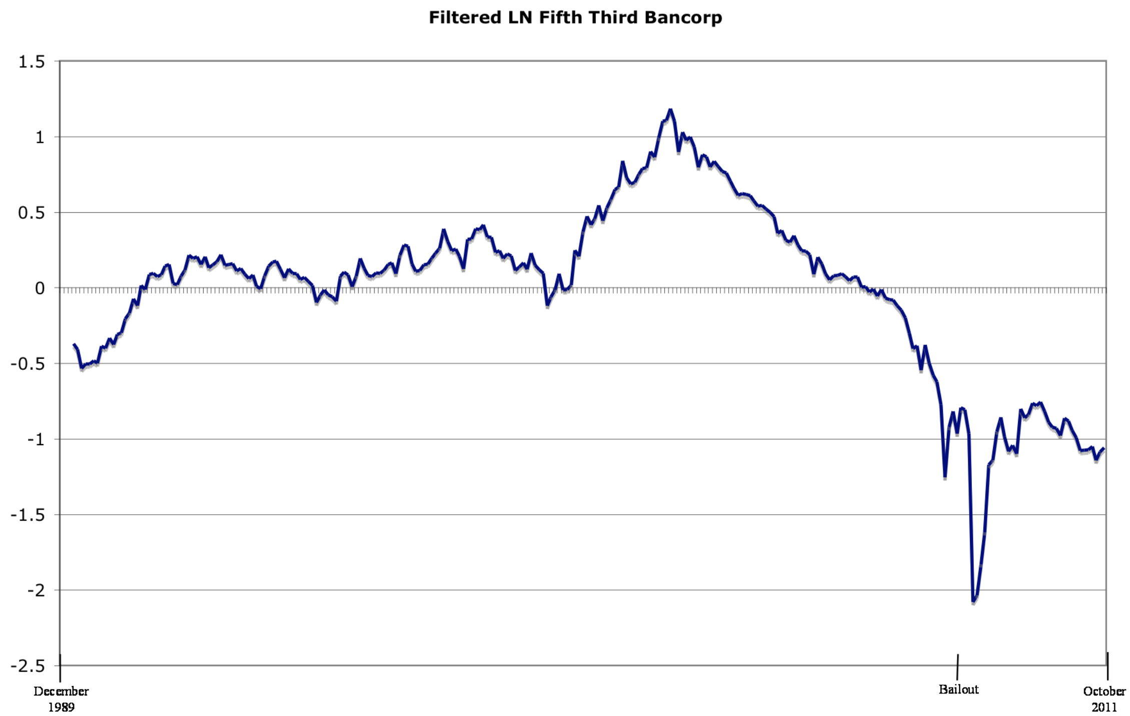


Filtered LN Capital One Financial

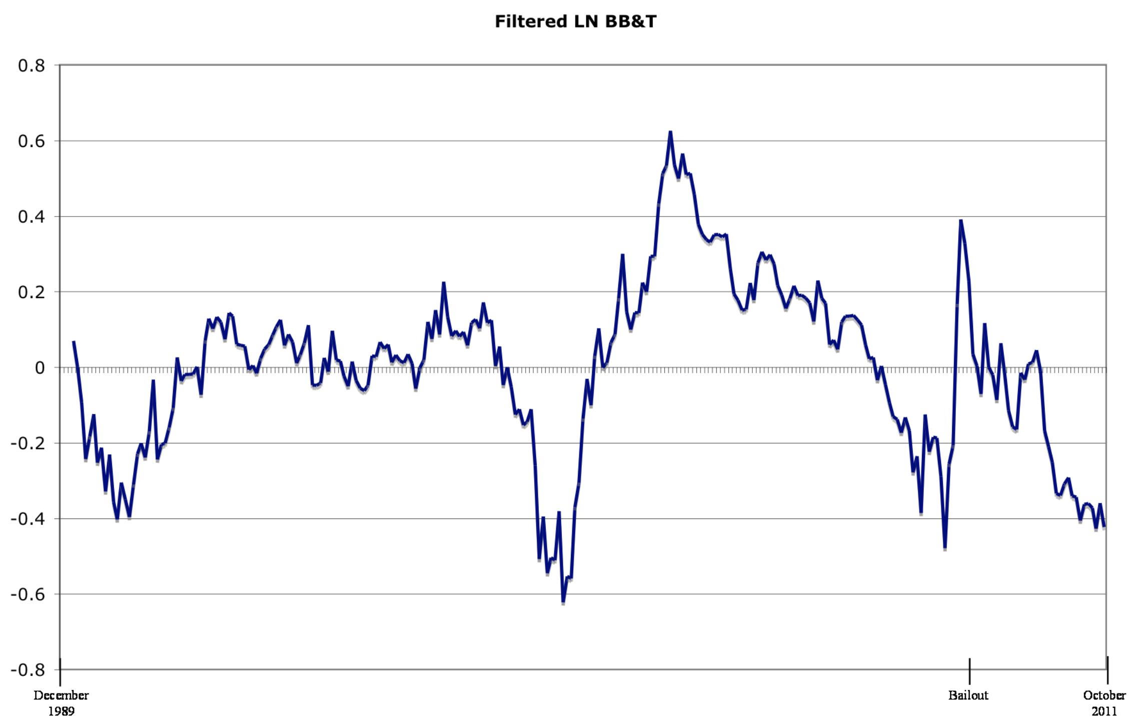


Filtered LN Regions Financial

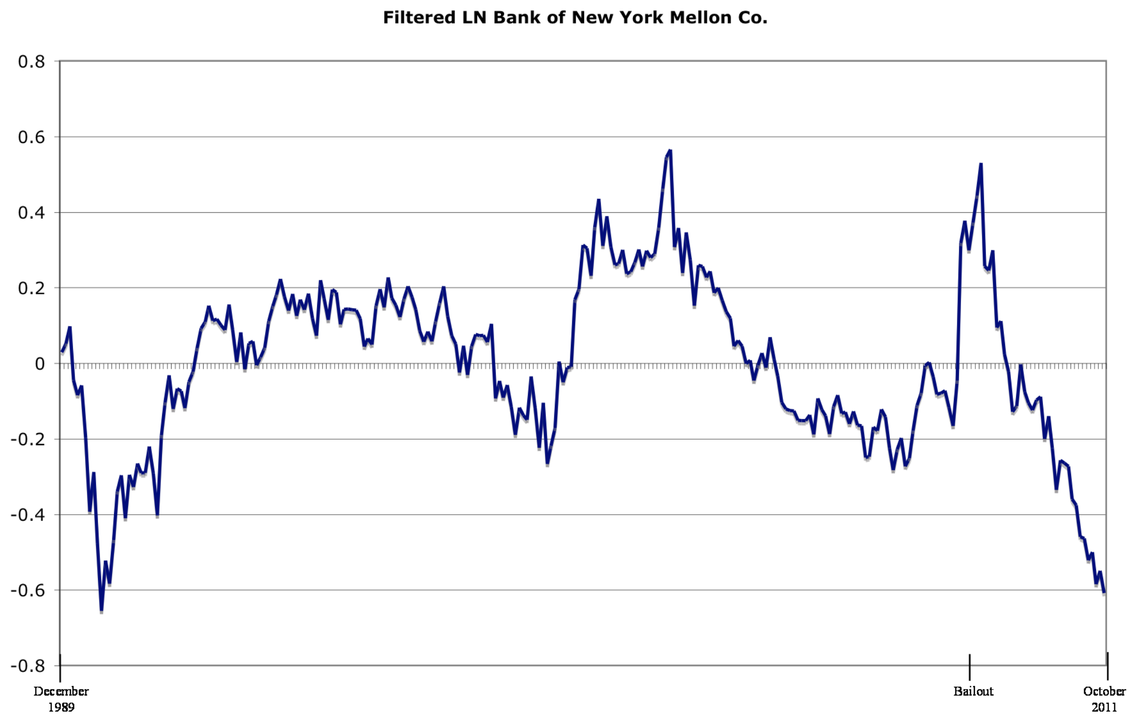


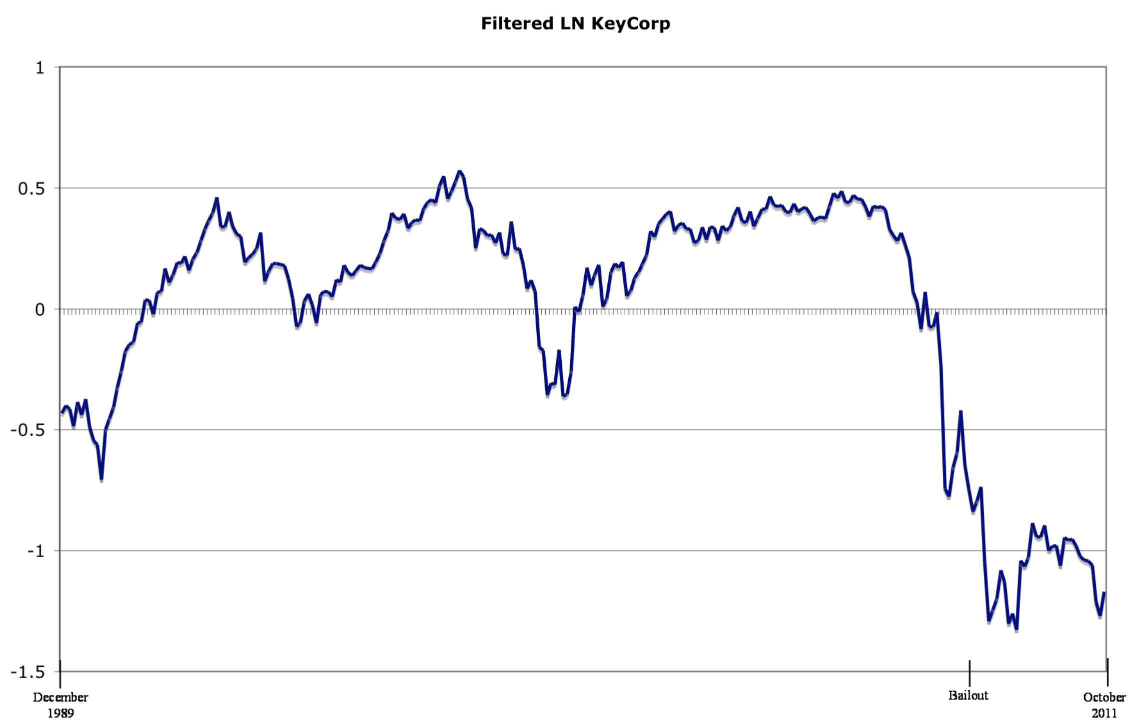


Filtered LN Fifth Third Bancorp
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
December 1989
Bailout
October 2011

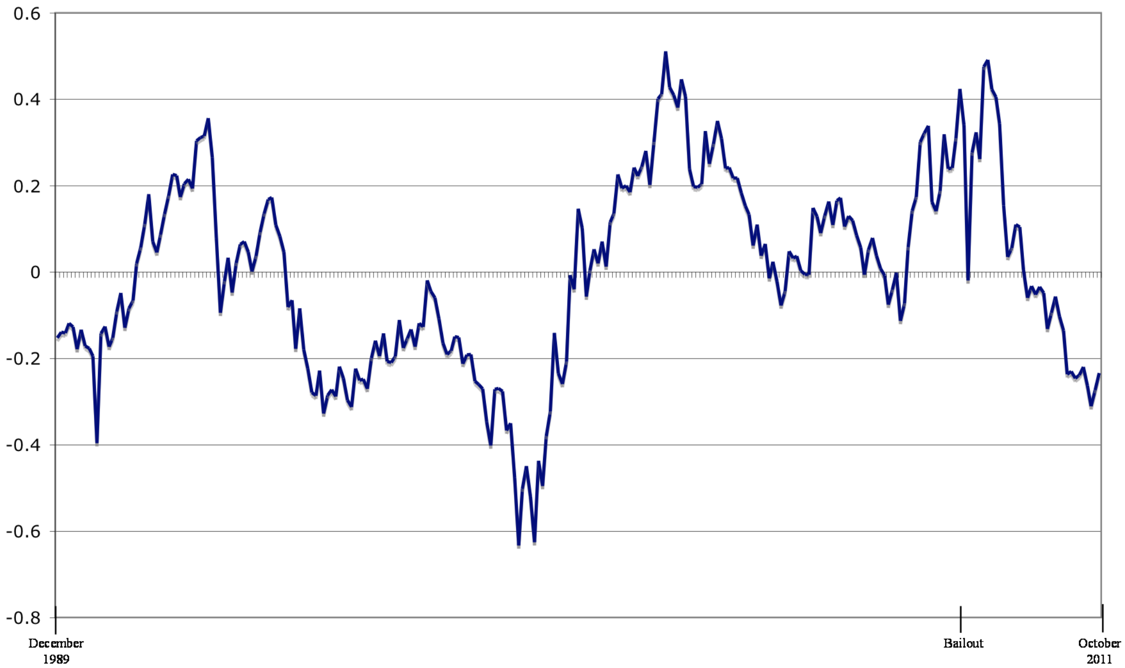


Filtered LN BB&T
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
December 1989
Bailout
October 2011

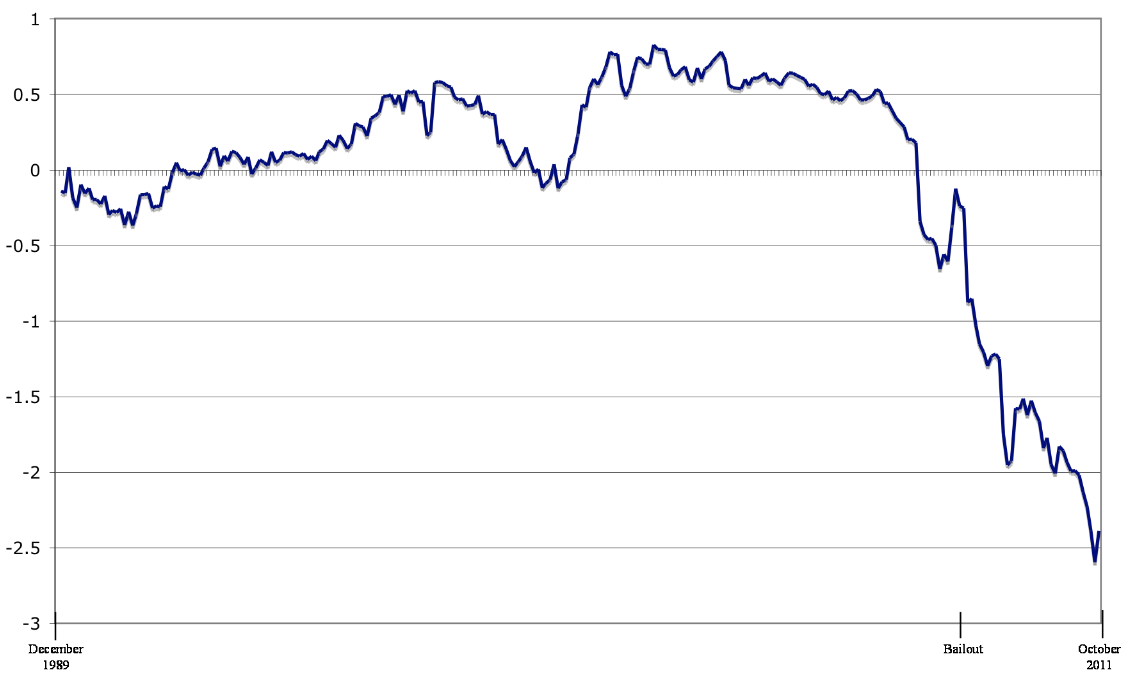

Filtered LN Bank of New York Mellon Co.
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
December 1989
Bailout
October 2011

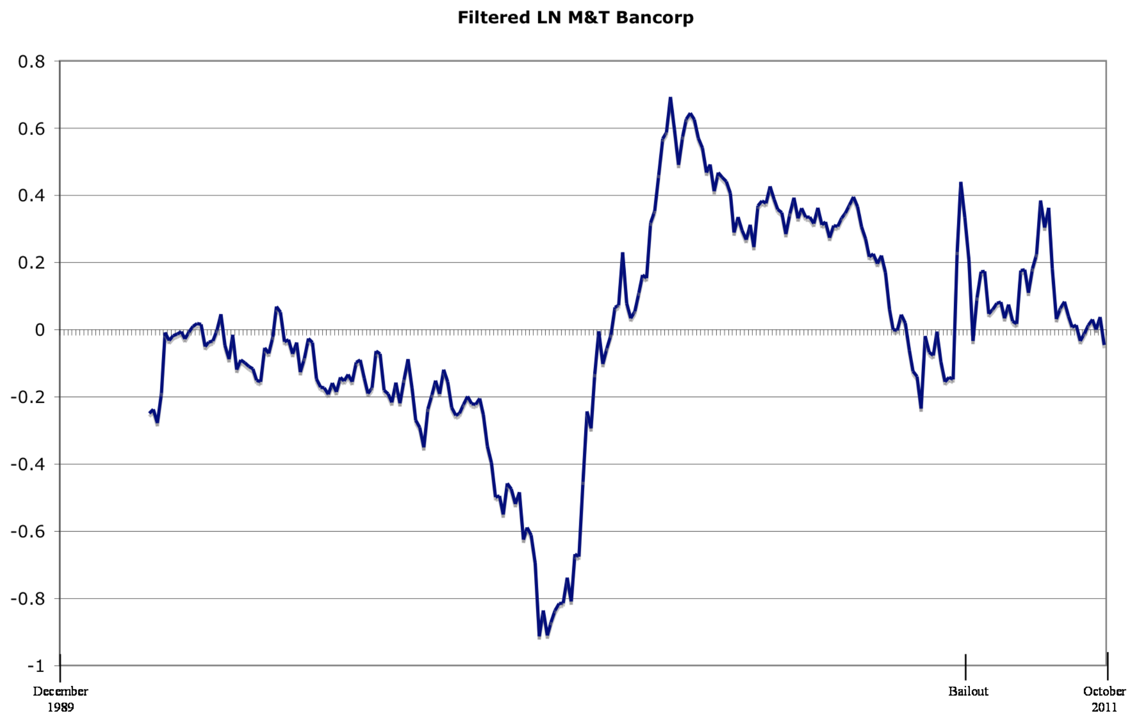

Filtered LN KeyCorp
1
0.5
0
-0.5
-1
-1.5
December 1989
Bailout
October 2011

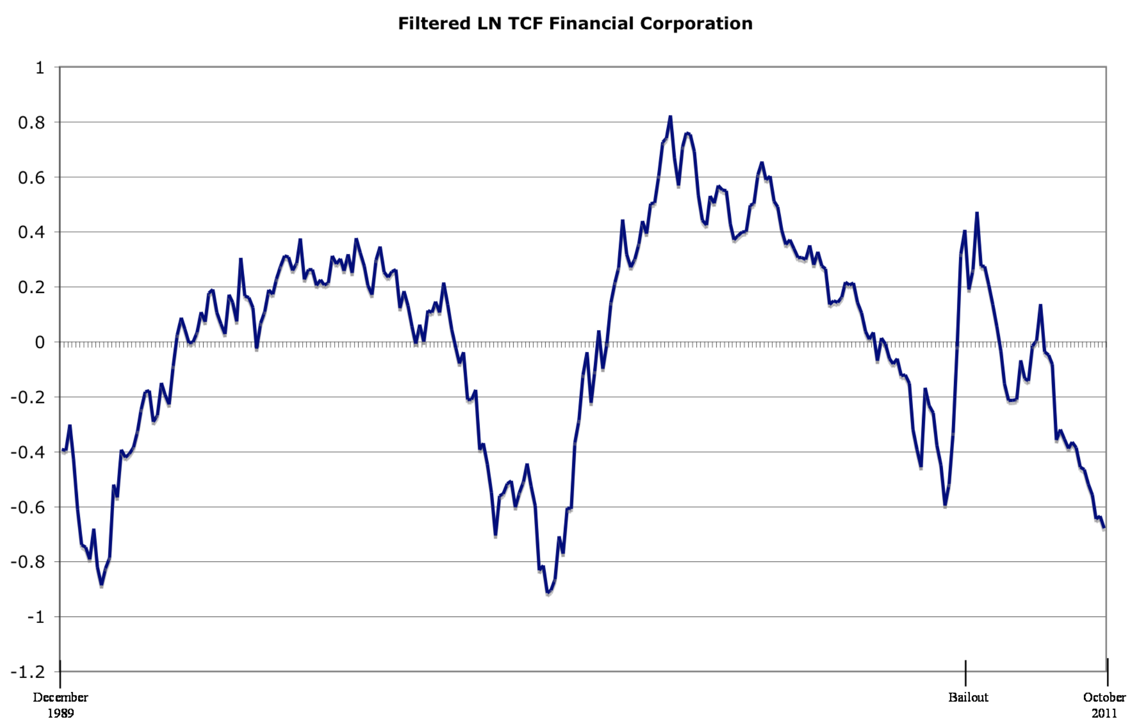
Filtered LN State Street



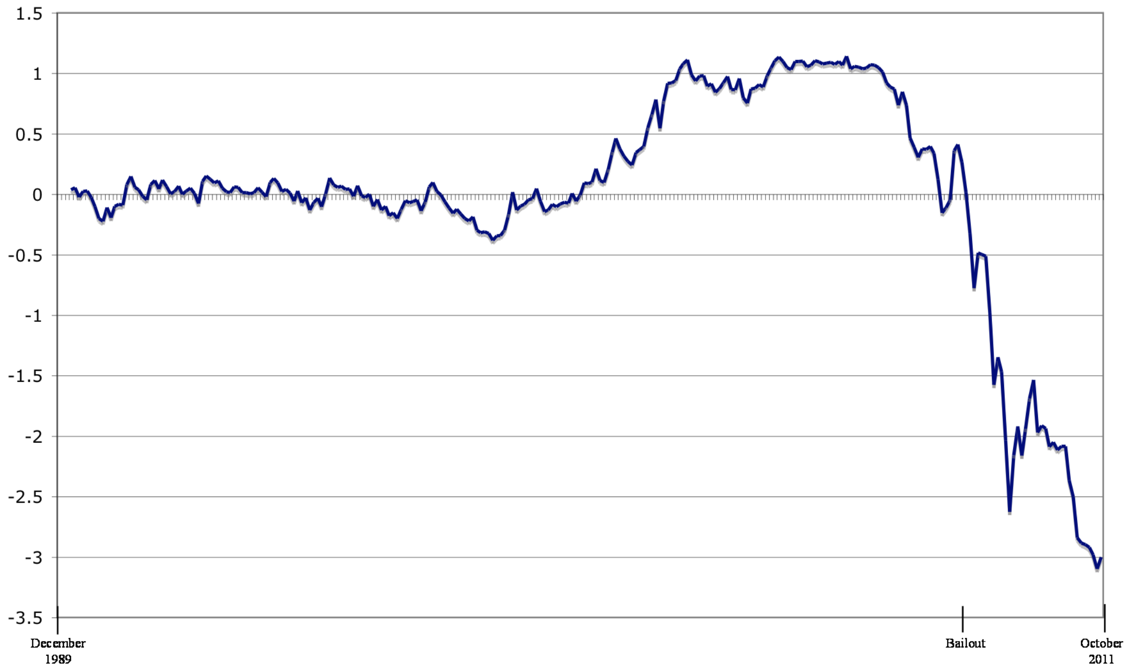
Filtered LN Synovus Financial



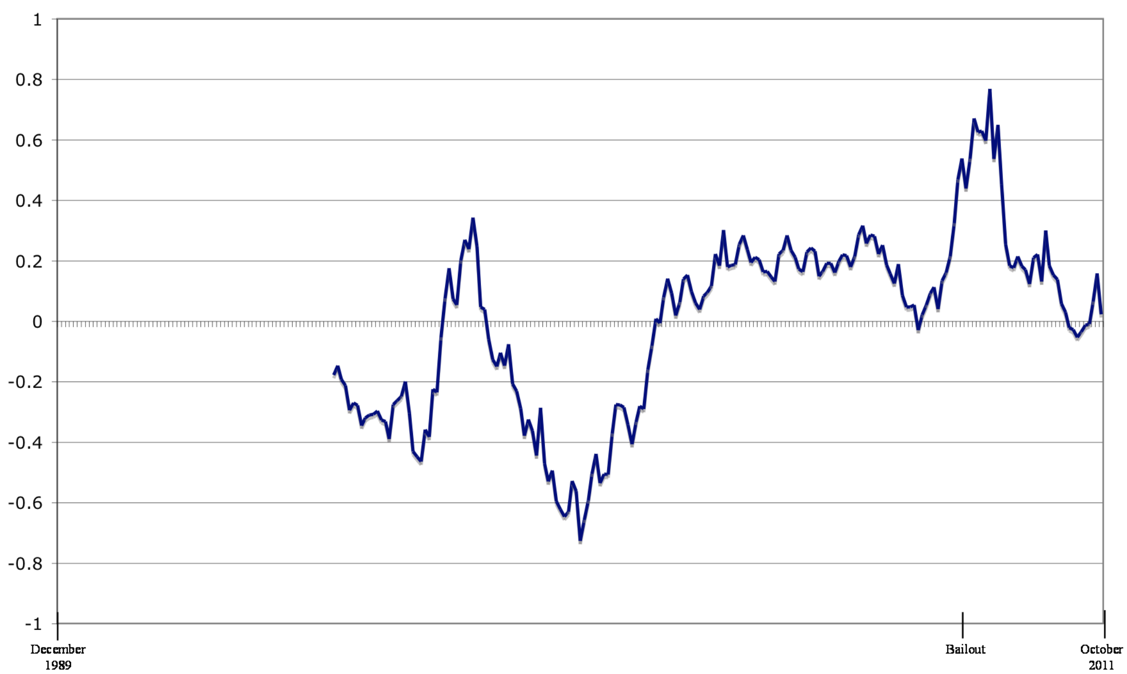

Filtered LN M&T Bancorp
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
December 1989
Bailout
October 2011


Filtered LN TCF Financial Corporation
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
December 1989
Bailout
October 2011

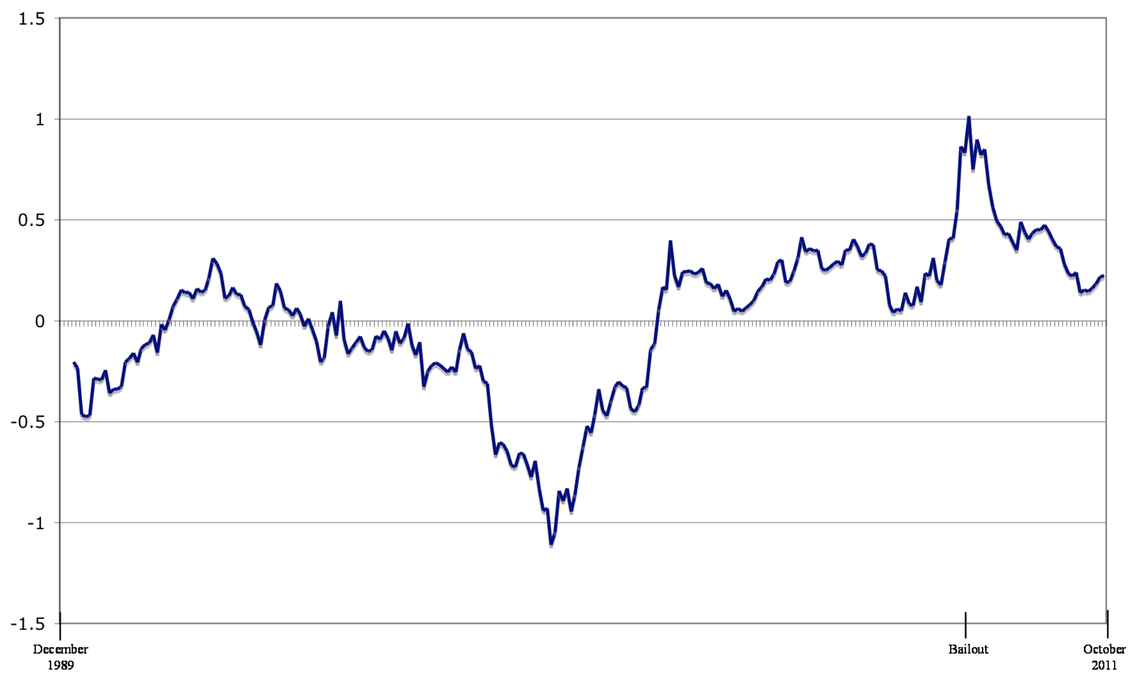
Filtered LN TCF Central Pacific Financial



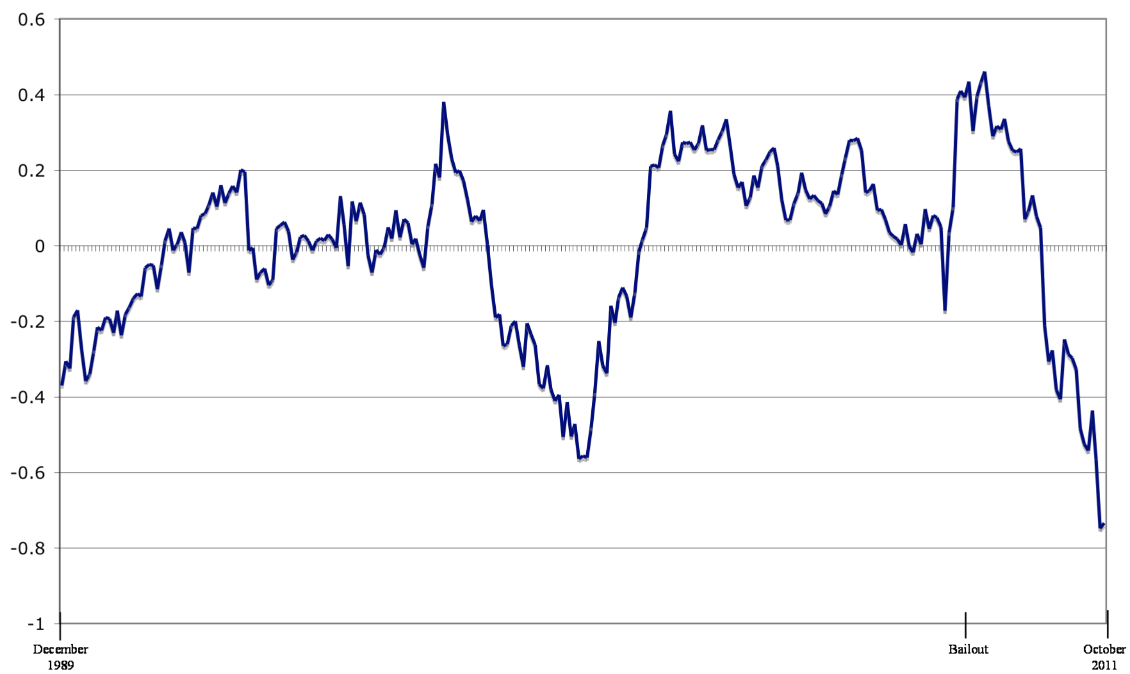
Filtered LN Community Auburn Bank



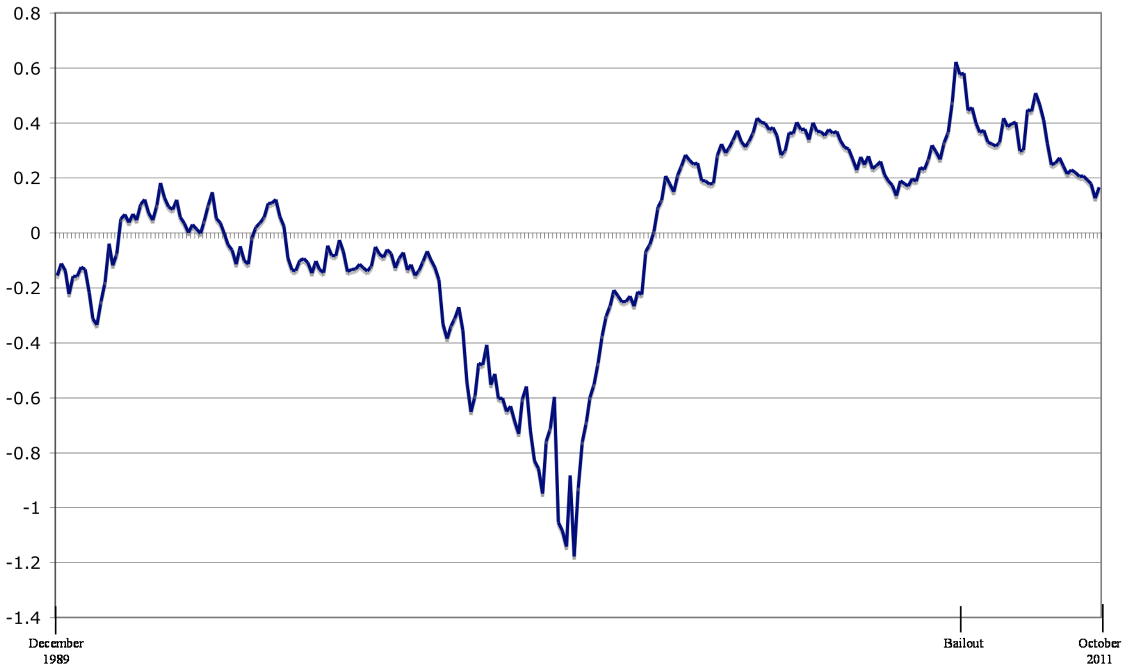
Filtered LN BancFirst Corporation



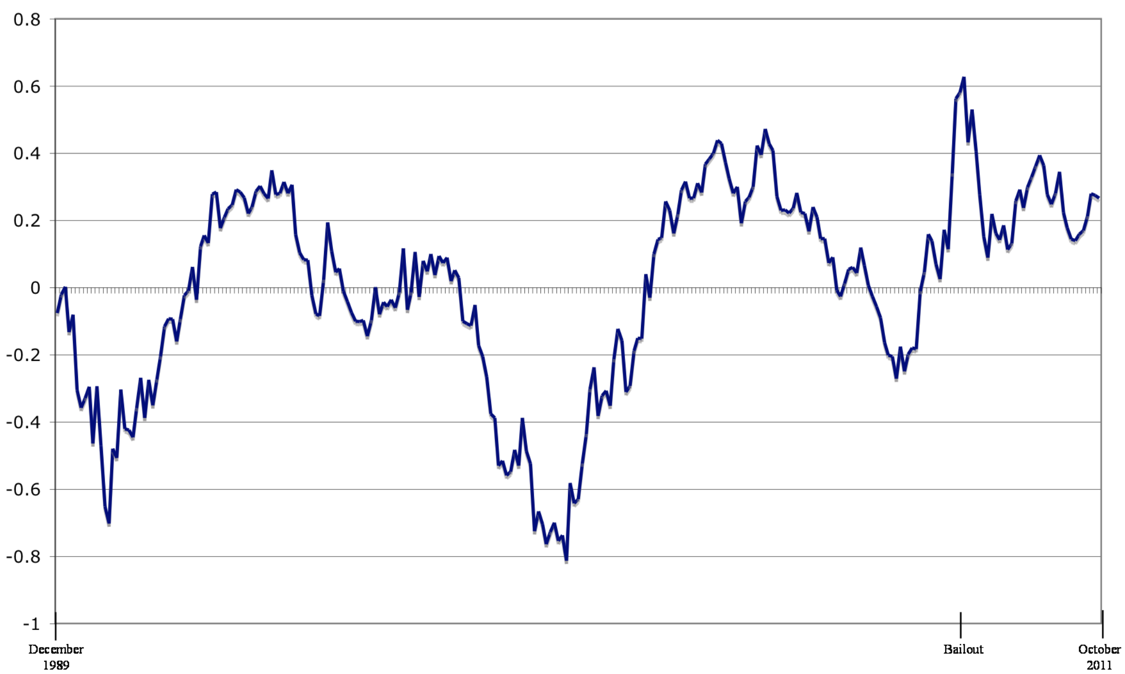
Filtered LN BancorpSouth Incorporated



Filtered LN Bank of Hawaii



Filtered LN Community Bank System Incorporated



Appendix II
Differencing of the Needed Filtered Bank Share Price Variables

After running the regression from equation 3.9, most of the ***PROCESS RESIDUALS*** from the individual banks analyzed reveals a white noise process (i.e. Box-Pierce and Box-Ljung Q-Statistics significance levels greater than .05). This is because we correctly modeled the time series process as an AR(1) process. However, the ***FILTERED BANK SHARE PRICE*** variable for Wells Fargo, Regions Financial, Synovus Financial Corporation, Central Pacific Financial, and Bank of Hawaii must be differenced in order to find white noise on the ***PROCESS RESIDUALS*** of these banks. The first step in this process is creating a differenced variable by lagging the necessary filtered variables for each of the needed banks by one period. This variable is formulated in the following manner:

(A2.1)

$$\textit{DIFFERENCED BANK SHARE PRICE} = \textit{FILTERED BANK SHARE PRICE}_t - \textit{FILTERED BANK SHARE PRICE}_{t-1}$$

As you can see, this new variable is the ***FILTERED BANK SHARE PRICE*** lagged by one period. Using this new variable, the ***DIFFERENCED BANK SHARE PRICE***, we can run the same intervention model regression from equation 3.9 only this time we will difference the ***DIFFERENCED BANK SHARE PRICE*** variable by the appropriate number of periods instead of just one period:

(A2.2)

$$\textbf{\textit{DIFFERENCED BANK SHARE PRICE}}_t = \beta_1\textbf{\textit{(ONE)}} + \beta_2\textbf{\textit{(DIFFERENCED BANK SHARE PRICE)}}_{t-n} + \beta_3\textbf{\textit{(BAILOUT DUMMY)}}_t + \varepsilon_t$$

where n denotes the desired number of lags

As we can see, the time series will take on the shape on an ARI(1,N) process instead of the previously assumed AR(1) process where N represents the number of periods that the time series is differenced. As mentioned in section 4.2, Wells Fargo, Regions Financial, Synovus Financial Corporation, Central Pacific Financial, and Bank of Hawaii can be 4th, 5th, 3rd, 2nd, and 3rd differenced, respectively, to produce a white noise process with regards to identifying the ***PROCESS RESIDUAL***. Table A2.1 shows the results from executing this differenced regression on these banks.

TABLE A2.1:
DIFFERENCED INTERVENTION MODEL REGRESSION RESULTS

BANKING INSTITUTION	ESTIMATED TIME SERIES PROCESS	DECAY RATE (β_2)	STOCK PRICE RESULT (β_3)	BOX-PIERCE / BOX-LJUNG Q-STAT SIGNIFICANCE
Wells Fargo	ARI(1,4)	-.22345474* *(-3.691)*	-.02253673 *(-1.645)*	.2774 / .2162
Regions Financial Corp.	ARI(1,5)	.154414* *(2.391)*	-.02699863* *(-1.598)*	..0607 / .0363
Synovus Financial Corporation	ARI(1,3)	-.16394939* *(-2.673)*	-.07044727* *(-4.019)*	.1512/ .0879
Central Pacific Financial	ARI(1,2)	-.24218875* *(-4.015)*	-.116418* *(-5.295)*	.1804 / .1249
Bank of Hawaii	ARI(1,3)	-.18589595* *(-3.052)*	-.01763083 *(-1.434)*	.3799/ .2902

* Statistically significant

We can see that the results illustrated in Table A2.1 are not that different from the results of the earlier non-differenced model.

Appendix III
The Bank Specific Bailout Dummy Intervention Analysis Model

As evidenced in Table 4.1, some of the ***BAILOUT DUMMY COEFFICIENTS*** on some of the bank analyzed are not significant. We can also see from the capital injection schedule on Table 3.1 that some U.S. banking institutions received funds at different times. We need to make sure that the reason why some of the ***BAILOUT DUMMY COEFFICIENTS*** resulting from our model are not significant is not because the individual bailouts of these banks occurred at a different time. Throughout this thesis, we have analyzed what the general effect that the initiation of the bailout had on U.S. banking share prices as a whole. Therefore, the ***BAILOUT DUMMY*** variable we earlier created was designed to represent this intervention in the general case for all banking institutions included in the model. Now, we will test to see if any banks whose ***BAILOUT DUMMY COEFFICIENT*** was not significant in the original model become significant when we tailor the ***BAILOUT DUMMY*** variable to the specific bailout timeframe of these corresponding banks. To do this, we must first create new ***BAILOUT DUMMY*** variables for each banking institution included in this extension. We will call these new dummy variables the ***BANK SPECIFIC BAILOUT DUMMY***. The ***BANK SPECIFIC BAILOUT DUMMY*** will contain 0's before the bailout and 1's after the bailout of the individual bank currently being analyzed in the model. Equation A2.3 shows this new intervention analysis regression equation.

(A2.3)

$$\textbf{\textit{FILTERED BANK SHARE PRICE}}_{i,t} = \beta_1\textbf{\textit{(ONE)}} + \beta_2\textbf{\textit{(FILTERED BANK SHARE PRICE)}}_{t-1} + \beta_3\textbf{\textit{(BANK SPECIFIC BAILOUT DUMMY)}}_{i,t} + \varepsilon_t$$

where i denotes the banking institution;
where t denotes the time period

The results from this regression are detailed in table A2.2.

TABLE A2.2:
BANK SPECIFIC DUMMY
INTERVENTION MODEL REGRESSION RESULTS

BANKING INSTITUTION	DECAY RATE (β_2)	STOCK PRICE RESULT (β_3)	BOX-PIERCE / BOX-LJUNG Q-STAT SIGNIFICANCE
U.S. Bancorp	.94172101* *(45.378)*	-.01610425 *(-1.165)*	.2049 / .1507
Capital One	.94145065* *(39.927)*	-.01994538 *(-.958)*	.1263 / .0695
TCF Financial	.97073546* *(62.549)*	-.03304947 *(-1.882)*	.9781/ .9674
M&T Bancorp	-.97118443* *(62.67)*	-.00631959 *(-.446)*	.4372 / .3437
PNC Financial	.90850306* *(34.995)*	-.01019394 *(-.781)*	.656/ .5695
Fifth Third Bancorp	.97183422* *(54.975)*	-.03005401 *(-1.162)*	.1447/ .1083

* Statistically significant

We can see that adding this ***BANK SPECIFIC BAILOUT DUMMY*** did not significantly change our results from the original model.