

# *Changes in Labor Market after Financial Crisis in United States*

Haochen Chen<sup>1,a,\*</sup>

<sup>1</sup>Stevenson School, Pebble Beach, CA 93953, United States  
a. [bchen24@stevensonschool.org](mailto:bchen24@stevensonschool.org)

\*corresponding author

**Abstract:** The unemployment rate in the United States surged to approximately ten percent in October 2009, achieving a historic high since July 1983, as a result of the mortgage crisis in the early twentieth-first century. Through time series analysis, this research paper examines the degree to which the three categories of the unemployment rate: overall, adult, and youth; had been affected by the housing bubble. This research paper discovers that the youth unemployment rate had been affected the most by the Great Recession. This research paper also concludes that the housing crisis in 2008 had lagging effects on the unemployment rate because undulations in the labor market necessitate additional time to be perceived, unlike the direct impact of the crisis on stock market price. Suggestions proposed by this research paper to the government and financial institutions include the implementation of rigorous manipulation in the credit system and the supervision of uncontrolled increases in prices.

**Keywords:** housing bubble, unemployment, time series analysis

## 1. Introduction

Already in the 1920s, credit issues had emerged in the economy of the United States, leading to a substantial economic downturn. Celebrating the end of the first world war, the United States entered into a period known as the “roaring twenties”, which led to a series of social and economic changes in the United States. People tended to spend money to purchase consumer goods such as luxury and automobiles. Numerous enterprises during this era thrived as the companies increased the amount of money borrowed for business expansion. Though the economy was boosted as a result of increasing economic output, the federal government and the central bank had not yet realized the detrimental effects brought by the uncontrolled borrowing of money. As production increased when more investors were positive regarding the future trend of the economy, the price of products decreased, which is known as deflation [1]. The stock prices dropped corresponding to the decreased price of goods, compelling investors to cease further investments in the market. The cases of stated incidents spiked in the nineteen twenties, which ultimately led to the commencement of the financial crisis: The Great Depression.

The root of the financial crisis lay in the uncirculated credit system. Since many equities such as stocks that people owned decreased in value, borrowers were unable to repay debts to the bank, resulting in numerous people being unable to retrieve their deposits from the bank [2]. Investors were intimidated by the abrupt downturn of the economy, and the majority of them retrieved the investments that they made in the stock market. The economy shrank drastically since 1930, recording

negative values of the annual rate of change of real gross domestic product. An approximately negative thirteen percent change in GDP was recorded in 1932, according to Federal Reserve Economic Data (FRED) [3]. The unemployment rate, conversely, increased significantly during the era of economic recession. According to the Bureau of Labor Statistics (BLS), the unemployment rate of the United States was three-point two percent in 1929, following an approximately twenty percent increase within four years [4].

Similar to the Great Depression, the economy during the 2009 economic crash experienced a significant decrease. The first-ever annual decrease in GDP was recorded from 2008 to 2009, estimating a decrease of two percent according to Federal Reserve Economic Data [5]. As reflected by the historical data of the Federal Reserve Board (FRB), a trend of increasing consumer credit persisted until June 2008, followed by an unprecedented decrease until September 2010 [6]. Increasing consumer credit indicates the rising intention to purchase goods and services using credit issued by financial institutions. The decrease in consumer credit since the collapse of the housing market reflects the stricter regulation of the credit system. Low barriers to lending funds from the central bank as the federal government adjusted the federal fund rate to around one percent in July 2003, enabling a greater number of people to borrow money to purchase an estate [7]. Investment banks applied thirty to forty times of leverage onto their investments. However, as interest rates rose, an increased number of investors defaulted because they could not repay their mortgages, and several hedge fund giants were unable to procure profit from the mortgage market consistently, which created housing bubbles [2]. An increasing number of houses was sold in the market, but supply far exceeded the demand of the housing market, resulting in the lowering of prices for homes. According to the Bureau of Labor Statistics (BLS), the nominal value of residential investment experienced steady growth since 1993. However, residential investment and residential construction rose substantially in scale from 2003, followed by an abrupt decrease from 2006 to 2008 [4]. The statistics of the residential investment emphasized the important role that the housing market played in the economy of the United States in the first decade of the twentieth-first century, and the unprecedented decrease in the nominal value of residential investment and residential construction marked the end of housing market dominance in the economy and the flaw of the credit system in the United States.

Unbalanced assets and liabilities drove several investment banks including the Lehman Brothers toward bankruptcy, leading to thousands of people in the financial industry losing their jobs. The unemployment rate in the United States climbed to ten percent in October 2009, more than double the unemployment rate of that at the beginning of 2007 [3]. Such a high unemployment rate took roughly half a decade for the economy to recover to pre-crisis level, decreasing from ten percent in the unemployment rate to four and a half percent in the unemployment rate. As reflected in the data recorded by the Bureau of Labor Statistics (BLS), residential construction-related employment experienced an abrupt increase since 2000, highlighting the increasing demand for real estate in the United States [4]. Mortgages were permitted to large populations in the United States, stimulating the purchase of houses using money borrowed from banks. More people were employed in the construction sector to meet the rising demand for housing in the market. However, the housing bubble burst in 2008 as numerous people were unable to repay the loans procured from the bank, which coincided with the decrease in residential-construction-related employment in the latter half of the first decade in the twentieth-first century.

The Great Recession had a significant impact on the wages of workers in the United States. Wages had been stagnant for many workers even before the crisis, but the crisis worsened the situation. According to Social Security Association (SSA), the average wage index (AWI) experienced its first-ever negative increase since 1985, estimating one and a half percent decrease from 2008 to 2019 [8]. The average amount of employers struggled to compete in a challenging economic environment, they often froze wages or reduced benefits, leading to a decline in real wages for many workers. Aggregate

wages dropped approximately four percent from 2008 to 2019, highlighting the financial difficulties experienced by companies during the recession. Cutting the wages of employees was an alternative for companies to minimize losses during the economic recession and poor performance of the company other than laying off workers [8]. Both mentioned methods that companies utilize in times of recession intensify the financial burden on workers, leading the stress and anxiety of workers to increase.

This research mainly focuses on evaluating the extent to which the 2009 economic crisis affected the unemployment rate in the United States. This study investigates the impact of the crisis on various groups in the workforce by classifying the unemployment rate into three categories, including the general unemployment rate, adult unemployment rate, and youth unemployment rate. By constructing time series models with computer language R, this paper could identify the seasonality of unemployment rate data from 2000 until 2018 and draw conclusions based on the gathered data and constructed models. This paper uses the ARIMA time series model to predict the future tendency of the unemployment rate based on historical data. From time series analysis, this paper hypothesized that the unemployment rate would fluctuate around two to three percent, or potentially be lower as the scale of the economy is continuously expanding. In addition, this paper aims to examine the accuracy of the time series model by comparing the predicted unemployment rate with the actual unemployment rate, and whether the fluctuation pattern of the unemployment rate repeats itself throughout the history of the United States.

The rest of this paper is organized as follows: Section two introduces the setting of the experiment and the method that this research utilizes to procure the result; Section three analyzes the results of the time series modeling in the experiment; Section four entails a discussion of the implication of the experiment, and insight that readers could acquire from interpreting this research; Section five includes a conclusion of this research paper.

## **2. Data and Model**

### **2.1. Data Sources**

This paper acquired unemployment rate data of the United States from Organization for Economic Co-operation and Development (OECD) [9]. To better understand the effects the 2008 housing crisis had on particular groups of people, this study uses three types of data: the general unemployment rate, adult unemployment rate, and youth unemployment rate. The overall unemployment rate refers to the percentage of the labor force who is actively looking for jobs though temporarily unemployed, and it is measured by the number of unemployed in the labor market divided by the total number of unemployed individuals in the labor force, which is composed of the unemployed and employed individuals. The adult unemployment rate indicates the percentage of individuals within the age range of twenty-five to seventy-four who are actively searching for employment, and the rate of adult unemployment rate can be calculated by dividing the number of unemployed adults by the total number of adults in the labor market. The youth unemployment rate refers to the percentage of individuals aged from fifteen to twenty-four who are currently unemployed as compared to the total number of this age group. The data used to conduct the time series analysis contains the unemployment rate of the United States from 2000 to 2008, and the data contains the recorded monthly unemployment rate from April 2000.

### **2.2. Unit Root Test (ADF)**

This paper uses a unit root test in analyzing the data. Unit root test provides insight into whether a time series is stationary or non-stationary, meaning that the variance of the data set does or does not change over time. For this research, this paper examines if the unemployment rate data acquired from

OECD is stationary by applying Augmented Dicky-Fuller (ADF). The ADF tests the unit root, which implies the non-stationary nature of a time series [10]. The null hypothesis argues that the time series is non-stationary. The p-value of the ADP test indicates the possibility that the null hypothesis can be confirmed. If the p-value exceeds ten percent, then the null hypothesis cannot be rejected, meaning that the time series is non-stationary. Non-stationary time series necessitates differencing to achieve stationary. Non-stationary time series are typically less valuable in analysis because statistical properties such as mean and variance are less predictable, leading to unreliable statistical inferences from the data. Additional sophisticated uses of time series modeling are necessary to discover the underlying dynamics of time series.

According to Table 1, after differencing the raw data, the p-value decreases to a value close to zero, which indicates that the null hypothesis can be rejected. The time series for both December 2007 and Jun 2008 become stationary after differencing, which enables further time series modeling to be conducted.

Table 1: ADF test.

Variables	t-statistic	p-value
<b>Panel A</b>		
		Dec 2007
Raw		
Overall	-1.863	0.6735
Adult	-1.594	0.7949
Youth	-1.938	0.6345
	Difference	
Overall	-5.287	0.0001
Adult	-7.680	0.0000
Youth	-5.506	0.0000
<b>Panel B</b>		
		Jun 2008
Raw		
Overall	-1.698	0.7519
Adult	-1.420	0.8551
Youth	-1.890	0.6596
	Difference	
Overall	-5.142	0.0001
Adult	-7.596	0.0000
Youth	-5.288	0.0001

### 2.3. PACF and ACF

By adjusting the value of p, d, and f values, which represent the orders of the autoregressive (AR), integrated(I), and moving average(MA), on the ARIMA model, this paper could acknowledge what values of the stated indices best minimize the p-value in the ADF test, allowing researchers to acquire predictions of the overall, adult, and youth unemployment rate with greater accuracy [11]. The autoregressive order(p) indicates several prior time series values used to forecast the current value. The integrated order(d) represents the number of differences needed to attain stationarity for the time series. The moving average order(q) suggests the total amount of previous error terms used to forecast the present value. Depending on whether the time series is stationary or not, indices of the ARIMA model could be adjusted to achieve better prediction of future values.

Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) are also generated as data visualizations in the time series analysis. Both graphical tools are essential in aiding the

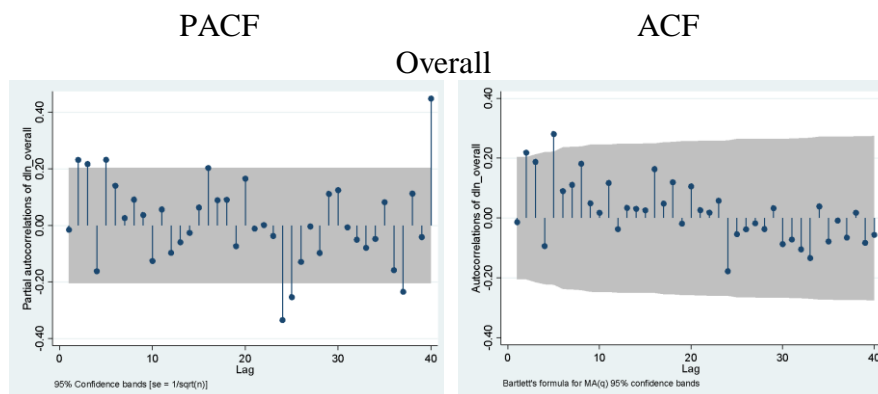
analysis of time series data and identifying recurring patterns between the data points [11]. The ACF measures how a specific time in the series relates to the previous point, which allowed this paper to determine the order of the moving average(q), but the PACF evaluates the direct relationship between a point in the time series and its lagged value without taking into account the intervening lags, which enabled this paper to determine the order of autoregressive(p). However, both functions are particularly useful to determine the order of autoregressive and moving average terms in the ARIMA model.

Integrated order(d) is often used to determine the times that a time series needs to be differenced to achieve stationary. If the ACF shows a slow decay, then further differencing is required to remove the non-stationary property of the time series. In addition, if the PACF demonstrates a sharp drop after a specific point in the time series, then the time series needs to be differenced by the order of that specific point.

### 3. Experiment Result and Analysis

The raw data of overall, adult, and youth unemployment rates from April 2000 to February 2018 are used to conduct the ARIMA time series model. This paper set December 2007 and June 2008 as two starting points of the analysis to examine the hysteresis impact of the housing crisis on the labor market in the United States. This paper discovers that the unemployment data for all three categories in both starting points are non-stationary from the ADF test, which would require this paper to modify the order of the ARIMA model to further conduct time series analysis.

The p-value before the ARIMA modeling is point seven five, which means that the null hypothesis arguing the time series is non-stationary is accepted because the value exceeds the critical value of point zero five. However, after the modeling by using the ARIMA model, this paper procures much less p-value compared to pre-modeling values with a p-value that is less than point zero five. With a p-value less than the critical value (typically less than point zero five or point zero one), the time series can be proven as non-stationary, and further modeling and differencing would entail for time series analysis to proceed. Differencing the time series data becomes indispensable in eliminating non-seasonal patterns and constructing time series analysis with a stationary time series model, which benefits this paper to gain a more accurate forecast of the future tendency of the unemployment rate in the United States.



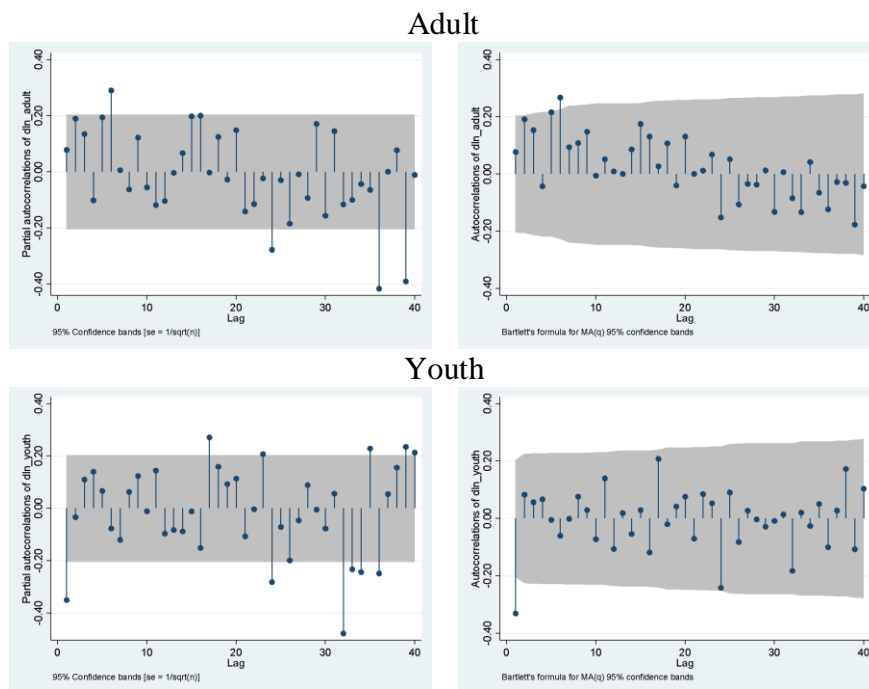


Figure 1: PACF and ACF, Dec 2007.  
 Photo credit: Original

This paper sets the order of the ARIMA model for overall unemployment rate data with December 2007 to (5,1,5), as shown in figure 1. Five are both significant on the PACF and ACF graphs as the autocorrelation on lag five exceeds the critical value. The time series is differenced once because of the non-stationary nature of the raw data. Since the autoregressive(p) yields a value of five, five fitted values after December 2007 would have the best accuracy of prediction. The fitted value is significant in time series analysis because the value represents the unemployment rate in the parallel world. The difference between the fitted value and the actual value reflects the impact of the housing crisis on the labor market. The average value of difference yields points zero three differences between the actual overall unemployment rate and the fitted value from January 2008 to May 2008, which informs this paper of the lagging impact of the Great Recession on the labor market.

The ARIMA model generates orders of (6,1,6) and (17,1,1) for the adult unemployment rate and youth unemployment rate, respectively. Both unemployment data necessitate an order of difference to adjust to stationary nature, which allows this paper to spot additional time-invariant patterns. This paper chooses seventeen as the order of autoregressive but no other values because the time series contains monthly data, so overmuch value for autoregressive order would undermine the accuracy of the prediction. Although the average value of difference yields around point zero five changes in the adult unemployment rate, the average value of difference yields a greater value of change in the youth unemployment rate with approximate point three percent change, highlighting the relatively instant effect on the youth population in the labor market by the housing crisis of 2008.

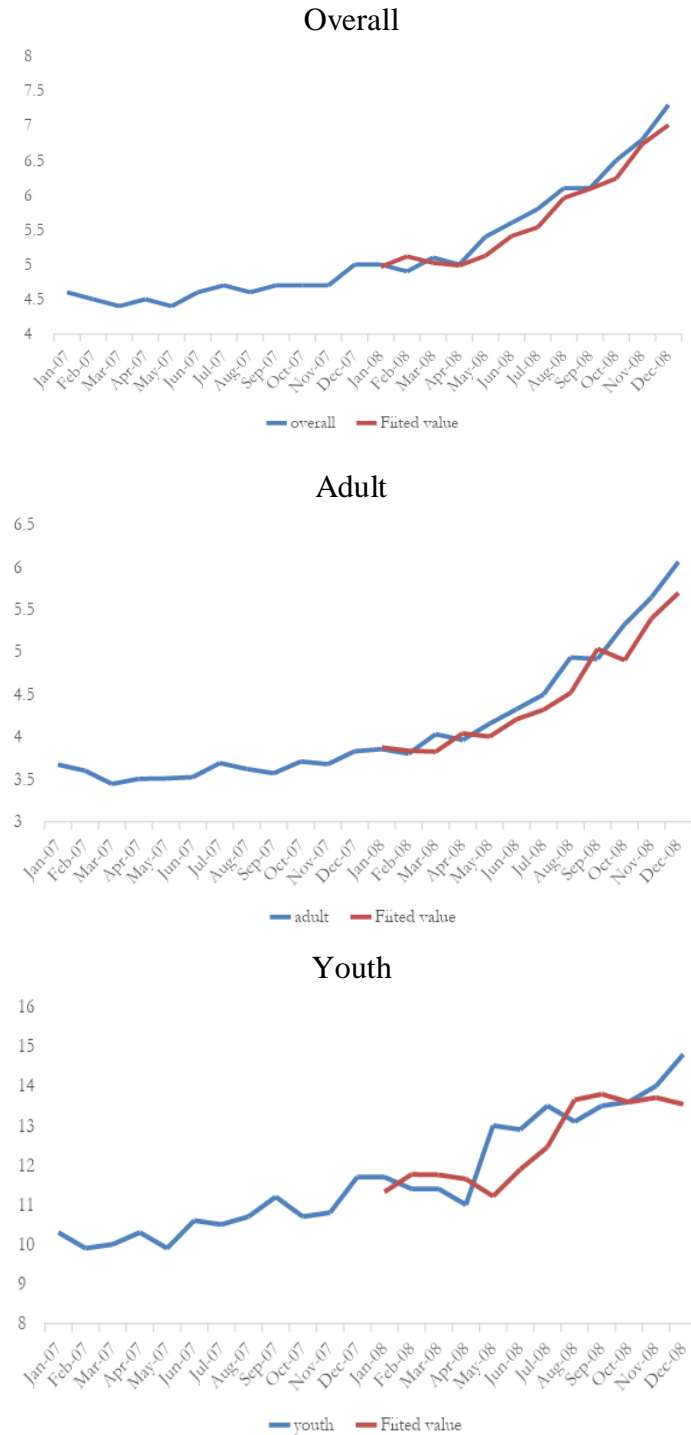


Figure 2: Actual and fitted value, before Dec 07.  
 Photo credit: Original

When the adult unemployment rate and youth unemployment rate from December 2007 are examined, this paper finds that the impact on the unemployment rate is less significant compared to the time series with starting point of June 2008, as shown by figure 2 and 3. The average difference between overall and fitted values that were generated for the time series with starting point in June

2008 far exceeds those generated for the time series with starting point in December 2007, informing this paper that the effect of the housing bubble was more prominent in June 2008 than in December 2007 due to the lagging property of the crisis on the unemployment rate. The average difference between overall and fitted values of June 2008 data is point one five, which is more than four times the average difference in December 2007. Similar to June 2008 overall unemployment rate data, June 2008 adult unemployment also experienced a similar increase in average difference, estimating more than three hundred percent of the increase. However, the impact of the housing crisis on the youth unemployment rate is more prominent than the other categories because the average difference achieved a value of point three, the highest value of the average difference recorded in the time series analysis of this research.

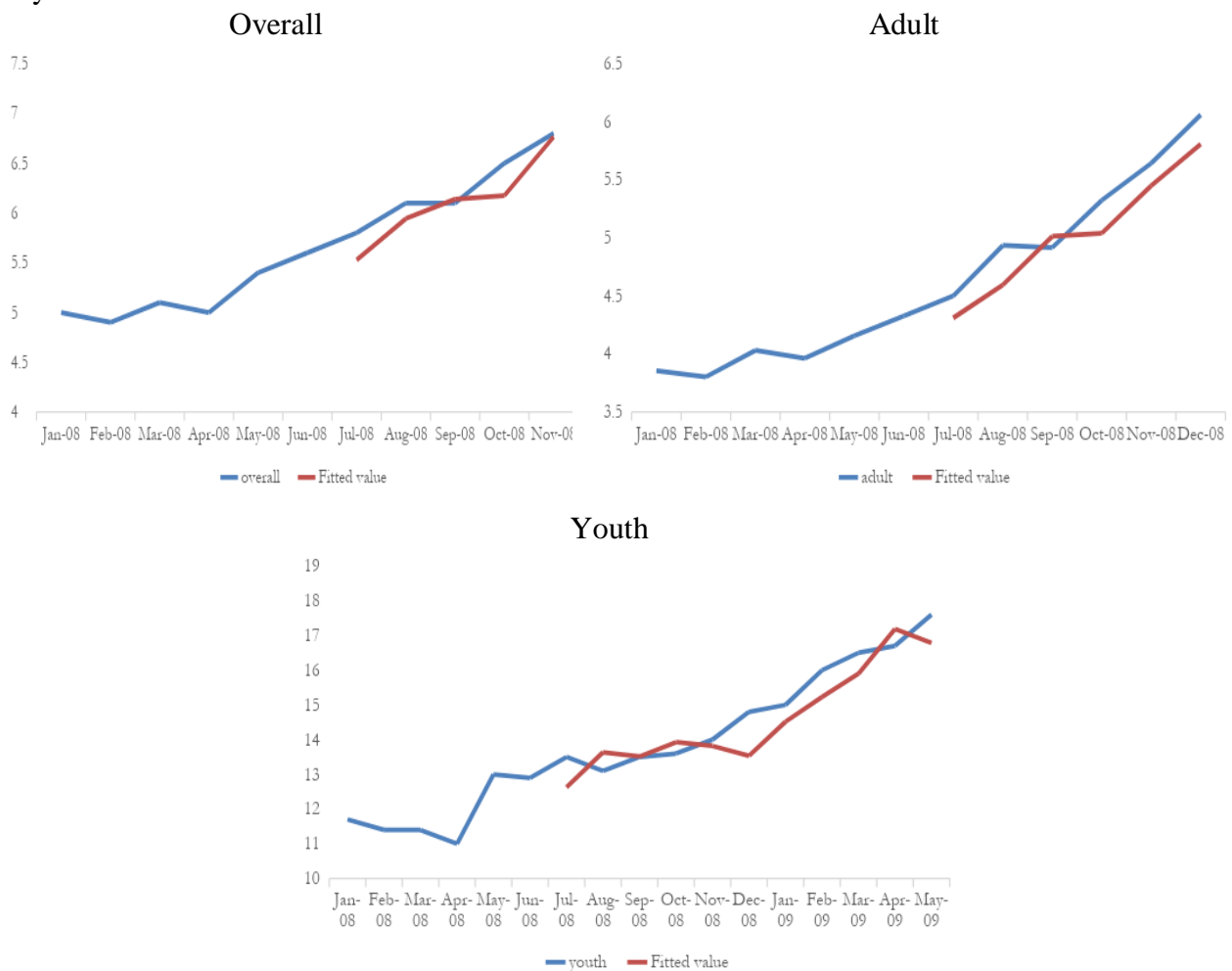


Figure 3: Actual and fitted value, before Jun 08.  
 Photo credit: Original

Overall unemployment rate and adult unemployment rate data with the initial point of June 2008 are modeled with the ARIMA model (5,1,5) and (6,1,6), respectively. The technique used to determine the order for the stated time series was similar to the data with starting point of December 2007, which indicates that the non-stationary aspects of the new data are similar to the old data. All three categories of unemployment rate data are at least differenced once to remove variant patterns in the time series.



The fitted value in Figure 4 demonstrates the tendency of unemployment rate if the housing bubble burst did not take place. Take the graph that depicts youth unemployment with Jun 2008 as an analytical point, the fitted value illustrates the possible rate of unemployment in each consecutive month after Jun 2008. Eleven data points are shown because of the selected p-value, the autoregressive, in the ARIMA model. The difference between actual youth employment and fitted value yields the scale that the unemployment rate was impacted by the Great Recession.

#### 4. Discussion

This research paper argues that though the labor market had been tremendously affected by the burst of the housing bubble in 2007-2008, the effect was rather lagging instead of directly affecting the unemployment rate. The Bureau of Labor Statistics (BLS) projected graphs and tables that illustrate the drop in Residential-construction-related employment since 2005 and the negative percentage change in the employment rate of the majority of industries [4]. However, data from BLS does not directly support the conclusion of this research paper because the data does not accurately reflect the lagging change in the labor market supply after the collapse of the housing market. Graphs on the Bureau of Labor Statistics depict the sudden downfall of Residential-construction-related employment starting from 2005, different than the lagging change in the overall unemployment rate starting from 2008 [4].

Since the impact of the economic crisis does not usually directly affect the labor market, this paper proposes that the government should take serious and practical actions in combating the rising unemployment rate. For example, when the government perceives the credit issues emerging in the economy and unrelenting growth of housing demand, the government should implement policies such as mortgage restriction by raising the interest rate to reduce borrowing of money. Government should also fund the construction of houses to increase the supply in the housing market, which would bring down the price of housing and unnecessary mortgage to purchase.

Investors should also be aware of fluctuations in the housing prices in the market. An abrupt increase in the price of houses indicates the rising demand for housing and the shortage of housing supply, which would typically lead to irrational purchasing of housing through uncontrolled borrowing of money. To make rational decisions in the growing market, an investor should be more cautious with making a risky investment such as acquiring a mortgage to purchase a house that is currently overpriced significantly.

#### 5. Conclusion

Underlying credit issues in the early twentieth-first century created an unprecedented housing bubble in the economy of the United States, which plummeted the overall economic productivity and economic growth of the country. Unemployment skyrocketed as a result of the crisis, which led millions of people to lose their employment in the economic downturn.

Using Autoregressive Integrated Moving Average (ARIMA) model to conduct a time series analysis, this paper asserts that the housing market crisis in 2008 had indirect and lagging impacts on the labor market of the United States because of the staggering number of the fitted value generated by the model with different starting points. After the housing market bubble broke, three groups of unemployment rates—overall, adult, and youth—saw varying degrees of shifts in unemployment, with youth unemployment seeing the biggest increases. This paper concludes that the youth population in the labor market was most significantly affected by the housing market crisis due to the forced layoff of comparatively less sophisticated employees during economic downturns. To prevent similar economic disasters from happening in the future, this paper suggests the government to take action to reduce excessive loaning for consumer spending and implement better regulations in

emerging markets. This paper advises investors to take careful consideration in investing in the newly appeared market and make a rational decision when inquiring about loans from financial institutions.

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