THE EFFECTS OF REAL INTEREST RATES ON SOCIAL DIMENSION: A CASE STUDY OF UNEMPLOYMENT IN THE UNITED STATE

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ABSTRACT

This paper aims to analyze the long-run impact of real interest rate on the unemployment rate in the United State (US). The Residual Based Test (Philips-Perron) test and Error Correction Models (ECM) regression are applied. The cointegration tests show that there are long-term relationships among real interest rate, oil price and industrial production index. Both of real interest rate and oil price have positive significant long-term impacts on the unemployment rate. The affect of oil price is almost three times greater than real interest rate in terms of contribution to the unemployment rate in the U.S. Meanwhile, the industrial production index has a significantly negative impact.

Keywords: The U.S., Unemployment Rate, Real Interest Rate, Oil Price, Industrial Production Index, Cointegration

1. INTRODUCTION

Unemployment is an important macroeconomic and political problem all economies confronts (Dogrul and Soytas, 2010). Therefore, it is well recognized as a negative matter since affects the economy in indirectly way. The number of poor and criminality, for instance, will increase along with the increasing number of jobless people. The limitation of income source will encourage a one do instant way to earn money. Furthermore, the dynamics impacts of unemployment may differ amongst countries at the divergence stage of economic expansion. Since it creates social and economic impacts, hence it is important to identify the main factor affecting the rate of unemployment at most. Developed countries, however, still face the problem of unemployment as what happened in the United State (U.S.). Indeed, the source problem of unemployment from supply-demand side in one country to other country is different. Productivity of labour, wages, oil price and interest rate are some of examples factor affecting unemployment rate from supply side perspective. Meanwhile, the unemployment rate will nearly run with the dynamic of business cycle, technology development, and the number of population.

In general, an increase in unemployment due to more employed persons losing their jobs or more entrants from outside of the labor force being unsuccessful in their effort to be employed like what happened in the U.S. in the late of 2007. Bureau of Labor Statistics (BLS) of the U.S reports that the labor market weakened from May 2007 to May 2008. The number of unemployed persons rose from 6.9 million to 8.5 million, and the jobless rate increased from 4.5 to 5.5 percent. A rise in unemployment might be expected to coincide with a decline in employment. Throughout most of 2007, the official measures of unemployment rose due to declines in the outflows from unemployment, that is fewer unemployed persons were able to find employment and fewer left the labor force. As its result, the share of those who remained jobless from month to month increased

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from 47 to 51 percent, and the number of unemployed persons rose. In contrast, inflows into unemployment had little effect on the rise in unemployment during this period. The share of the employed that became unemployed remained relatively stable throughout both 2006 and most of 2007, at about 1.2 percent of total employment. Similarly, the flow of individuals from outside the labor force to unemployment also changed little in 2007, hovering around 2.3 percent of all persons not in the labor force.

The reason behind this increasing number is caused by the attack of financial crisis and economic meltdown entering a nightmare recession in the late 2007. It has caused several serious economic problems such as the significantly increasing number of jobless people which created skyrocketing unemployment. The wage was paid at the lower level causing many families fell down into poverty. As it was widely known, this crisis come up due to the ascending price of housing in the early 2006 combined with credit tightened since 2007 and high oil prices in 2008. Swagel (2009) explain further that the financial crisis in September 2008 clearly exacerbated the pre-existing economic slowdown, turning a mild downturn into a deep recession. Families stopped spending, while firms stopped hiring and paused investment projects. As a result, the economy plunged, with GDP falling by 5.4 percent and 6.4 percent (at annual rates) in the last quarter of 2008 and the first quarter of 2009—the worst six months for economic growth since 1958. In effect, the events of September and October 2008 were a severe negative shock to the people confidence in the economy, and in the ability of the U.S. government and political system to deal with the crisis.

Many previous research literally proven that crisis come up in to the picture due to the existence of interest rate. As of Meera and Larbani (2004) explains that interest is the main source of economic downturn. Empirically, Basu et.al. (2001) proof that in the U.S. there is a positively relationship between unemployment rate and interest rate risk. In the case of Turkey, Dogrul and Soytas (2010) forecast that in the long run the rise of interest rate will cause the number of unemployment. Contrastingly, Philips (1958) reports that in the case of United Kingdom (UK) the relationship between interest rate and unemployment is negative. Referring to this opposite findings, this research investigates factors affecting unemployment in the U.S by applying Error Correction Model (ECM) procedures. There are 3 involved variables in the econometric model, such as Real Interest Rate (RIR), Oil price (Oil) and Index Production (IP).

The rest of this paper is organized into five parts. Part 2 exhibits literature review comprising of the hypotheses development. Part 3 elucidates research method along with the econometric model and data. Part 4 shows the empirical results and analysis. Some conclusions are presented in Part 5.

1.2. Research Scope and Contributions
This research will be only focused on the impact of real interest rate, oil price and industrial production index on the unemployment rate in the U.S, i.e., from supply sides. In addition, many previous research focus of research in Islamic economics is concentrated on the function of zakah, infaq, sadaqah, and case study of sharia banking. In the other words, only few of conducted researches in Islamic economics are explored in labour matters. Therefore, this study will especially contribute to fulfill the gap of literatures in Islamic labour economics.

1.3. Data Sources
This research takes sample period from the first quarter of 1980 to the first quarter of 2012. All of calculated data were taken from International Monetary Fund (IMF), International Financial Statistics (IFS) of the IMF and Bureau of Labour Statistics (BLS) of the U.S.
2. LITERATURE REVIEW

2.1. The Factors Affecting Unemployment

2.1.1. Interest Rate
Riba or the concept of interest rate in the existing monetary economic system becomes a fundamental variable. Many groups of economist believe that the interest rate will never be eliminated from the world economic system. Kayadibi (2011) delineated that the pro-riba groups believed that riba is the fundamental of global economic system due to it compensates a person’s consumption today for some potential benefit in the future. Rationally, interest indeed has to be existed in the economy. Therefore, those who against this thinking will be judged as an irrational and undeveloped class. Many recent conducted researches, on the opposite, proved that what is happening crisis today is triggered by the existence of interest rate in the economic system. Furthermore, Rehman and Ghaffari (2012) conclude that the interest rate is a useless policy tool which has no power to reduce inflation; on contrary, it can cause increment in inflation via the cost channel. Therefore the study concludes that central banks should never use high interest rate to fight with inflation and the justification of existence of interest i.e. as a monetary policy tool is wrong and must be ruled out.

Related to the objective of this research, there are several channels how interest rate influence the rate of unemployment. First, the increasing of interest rate will push the cost of production into higher level causing number of investments go down. In some cases this declining encourages some closure of the business unit affecting the number of retrenchment of employed workers rise. Second, to cover the increasing in production cost, the producer will increase the price of produced goods and services causing the rate of inflation go up (Aliero, 1992). Empirically, Basu et.al. (2001) show that in the U.S. there is a positively relationship between unemployment rate and interest rate risk by using GARCH model. Similarly, Dogrul and Soytas (2010) forecast by applying Toda-Yamamoto procedure, they find that in the long run the rise of interest rate will cause the number of unemployment rise in Turkey.

Even so, in some countries there is a possibility of negative relationship between interest rate and unemployment. When the interest rate falls down, hence the number of unemployed people will rise up, vice versa. The rationale reason behind this phenomenon can be explained by Philips curve theory proposed by A.W. Phillips in 1958. He reported evidence of an inverse relationship between the rate of increase in wages and the rate of unemployment. By comparing rates of rise in wages with the rate of unemployment rates in Britain spans from 1861 to 1957, he found that as the labor market tightened, and the unemployment rate fell, money wages tended to rise more rapidly. Because wage increases are closely correlated with price increases, thus this relationship was widely interpreted as a trade-off between inflation and unemployment (Cashel, 2004).

2.1.2. Oil Price
As one of the important determinant world economic performance, oil price has big effect on the dynamic of macroeconomic environment. Refering to International Energy Agency (IEA), the impact of oil price depends on the share of the cost of oil in national income, the degree of dependence on imported oil and the ability of end-users to reduce their consumption and switch away from oil. It also depends on the extent to which gas prices rise in response to an oil-price increase, the gas-intensity of the economy and the impact of higher prices on other forms of energy that compete with or, in the case of electricity, are generated from oil and gas. Therefore, the bigger the oil-price rise and the longer higher prices are sustained, the bigger the macroeconomic impact. In this case, for net oil-exporting countries, the rise of oil price will
directly push up real national income through higher export earnings, vice versa. In the same time its gain, however, would be later offset by losses from lower demand for exports generally due to the economic recession suffered by trading partners.

These domino impacts will affect also on the rate of unemployment. The transmissions of these impacts through channel of production cost in industries that depend on the world price oil. As Loungani (1986) elucidates that when the price of oil reach a peak for some period of time, it will change the production structure. In detail, the rising oil price will stimulate the firm to increase the marginal cost of production from oil intensive to less-oil intensive. Therefore, in the long run this change in turn generates capital and labor reallocation across sectors that can affect unemployment in the long run.

Empirically, Kooros et.al (2006) investigates the impact of oil price on the unemployment rate in Louisiana. They found that an increase in the price of crude oil for million BTUs by one dollar will result in a decrease in unemployment in Louisiana by 1.08 per cent, but oil prices alone do not sufficiently explain unemployment in Louisiana. Yau (2010) finds also that oil price shock will increase price level and decrease money supply leading to worse-off unemployment in the U.S. Meanwhile, Löschel and Oberndorfer (2009) observe that in the case of Germany the rise of oil price will induce unemployment rate in the labour market go up using data spans from 1973 to 2008.

2.1.3. Industrial Production
This research use industrial production index (IPI) instead of gross domestic product (GDP) due to IPI more represents economic activities in particular industry. Formally, IPI conveys amount of output from the manufacturing, mining, electric and gas industries. The reference year for the index is 2002 and a level of 100. Each individual index is calculated using the Fischer index formula. This index is released by the Federal Reserve Board, meanwhile the production data is received directly from the Bureau of Labor Statistics (BLS) and trade associations, both on physical output and inputs used in the production process. Investors usually benefit this index of various industries to examine the growth in the respective industry. If the index is growing month-over-month for a certain industry, it implies that the firm in the industry is performing well.

In addition, IPI can be used for measuring income in such country (Baak, 2006). Thus, IPI might be used also for measuring the economic activities; however, it is not as comprehensive as GDP. In this case, if the index of industrial production increases, thus it will yield a decreasing in unemployment rate, vice versa. In other words, the relationship between them is negative.

3. RESEARCH METHOD AND HYPOTHESES DEVELOPMENT

3.1. Cointegration Test
Gujarati (2003: 822) noted that the existence of cointegrating relationships is indicated when two or more non stationary series could have at least a linear combination which is stationary, I(0). In short, the stationary linear combination cancels out the stochastic trends in the two series, proven by checking the residuals from the regressions are stationary, I(0). Thomas (1997: 438-443) noticed that the presence of cointegration for multivariate equation case (as this research case) is detected by applying Johansen cointegration test. Afterwards, the empirical result of Johansen test will be confirmed by Error Correction Model (ECM), as follows:
\[
\Delta UN_t = \alpha + ECT_{it-1} + \sum_{h=0}^{nx} \beta_h \Delta RIR_{it-h-1} + \sum_{h=0}^{np} \gamma_h \Delta OIL_{it-h} + \sum_{h=0}^{np} \delta_h \Delta IP_{t-h} + \sum_{h=0}^{np} \eta_h \Delta IM_{it-h} + \sum_{h=0}^{np} \varphi_h \Delta M_{1t-h} + u_{it}
\]

Here, the length of involved for each variable is denoted as \(nx\), \(np\), \(ns\), and \(nc\). As of Baak (2007, 2006, and 2005) explains that negative and significant of the estimated error correction term (ECT) coefficient \((ECT_{it-1})\) represents the presence of long-run relationships amongst variables included in the model. Since, there is at least one cointegration amongst included variables, the causal relationship among these variables will be detected by the ECM procedures.

### 3.2. Hypotheses Development

The source of dynamic of employment and unemployment, as stated at the outset, might come from several factors. Different country has different main affecting factors of unemployment. As of Basu, et.al. (2001), Dogrul and Soytas (2010), Loungani (1986), Cashel (2004), Kooros et.al (2006), Yau (2010) and Löschel and Oberndorfer (2009) the econometric model of how real interest rate affects unemployment in the U.S can be framed as follows. All of variables are measured in natural logarithm, except RIR.

\[
UN_t = \beta_0 + \beta_1 RIR_t + \beta_2 OIL_t + \beta_3 IP_t + \epsilon_t \quad (2)
\]

Subscript \(t\) represents time of quarterly data spans from 1980 Q1 to 2012 Q1. \(UN_t\) denotes the rate of unemployment in the US provided widely by the IFS IMF.

Real interest rate, \(RIR_t\), measures the expected interest rate which will be received by investor after allowing inflation rate. The formula of real interest rate is generally known, i.e, it equals to the nominal interest rate minus inflation rate. It is expected that between \(UN_t\) and \(RIR_t\) might has positive and negative relationship. If the estimated coefficient sign is positive, it means that the rising of interest rate will push the cost of production increase, then level of investment fall. It will cause firms dismiss their worker, hence the rate of unemployment rise. Meanwhile, if the estimated coefficient sign is negative, it suggests that the Philips curve phenomenon occurs in the U.S.

\(OIL_t\) measures the strength relationship between oil price and unemployment. It will affect production cost of the firms which has dependence of world price oil. It is suggested that the relationship between them is negative. As the price of oil rise, it will increase cost of production, hence the firms will both reduce their product quantity and dimish their worker in order to reduce the cost. Here, the portion of wage, as widely known, is the biggest percentage in producing such products.

\(IP_t\) denotes industrial production index. As stated at the literatures review part, it can be utilized for measuring amount of output from the manufacturing, mining, electric and gas industries. By using \(IP_t\), it is expected that this proxy could represent economic activities in particular industry. In this case, if the index of industrial production increases, thus it will yield a decreasing in unemployment rate, vice versa. In other words, the relationship between them is negative.

\(^2\) For further explanation (see chapter 2 Literature Review).
4. EMPIRICAL RESULT AND ANALYSIS

4.1. Unit Roots Test
In order to detect the equilibrium relationship, this research will firstly test the order of integration involved in the model, i.e. unemployment rate, real interest rate, oil price, and Industrial production. To do so, Philip-Perron (PP) procedures is applied to test for both the level and the first difference. The optimal length of lag applied in the test is determined by using Aikake Information Criterion (AIC). As described in Table (1), all variables of PP statistics are lower than MacKinnon critical value. It means all variables are not stationary at the level, however, all the variables are integrated of order one I (1) or stationary at the first difference.

Table 1: PP Unit Roots Test for the Level and the First Differences

<table>
<thead>
<tr>
<th>Indonesia to the US</th>
<th>Level</th>
<th>First Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lag</td>
<td>PP Test</td>
</tr>
<tr>
<td>Unemployment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1</td>
<td>-2.149</td>
</tr>
<tr>
<td>Trend and Intercept</td>
<td>1</td>
<td>-3.482</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>-2.884</td>
</tr>
<tr>
<td>Real Interest Rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1</td>
<td>-2.069</td>
</tr>
<tr>
<td>Trend and Intercept</td>
<td>1</td>
<td>-3.482</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>-2.884</td>
</tr>
<tr>
<td>Oil Price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1</td>
<td>-0.571</td>
</tr>
<tr>
<td>Trend and Intercept</td>
<td>1</td>
<td>-3.482</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>-2.884</td>
</tr>
<tr>
<td>Industria production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1</td>
<td>-0.731</td>
</tr>
<tr>
<td>Trend and Intercept</td>
<td>1</td>
<td>-3.482</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>-2.884</td>
</tr>
</tbody>
</table>

Source: IFS and BLS. Author’s calculation.
The figures in the brackets are the order of integration
*) Denotes rejection of a unit root hypothesis based on Mackinnon’s critical values at the level of significance α=1%, 5%, 10%.

4.2. The Cointegration Test
The urgency of the cointegration test is to examine “spurious regression” problem. Gujarati (2003: 822) noted that the existence of cointegrating relationships is indicated when two or more non stationary series could have at least a linear combination which is stationary, I (0). In short, the
stationary linear combination cancels out the stochastic trends in the two series, which can be proven by checking the residuals from the regressions are stationer, I(0).

**Table 2. Residual Based Test: PP Test**

<table>
<thead>
<tr>
<th>PP Statistics</th>
<th>-6.193* (I)</th>
</tr>
</thead>
</table>

Source: IFS and BLS. Author’s calculation.
*) Denotes rejection of a unit root hypothesis based on Mackinnon’s critical value at at the α=1%, 5%, 10%.

Residual-based test of PP procedures are be applied in order to test the stationary of residual regression model (Equation 1). Table (2) describes its results. It is clearly showed that the residuals from all regressions are stationer, I (0) which means there are long-run relationships among variables examined in econometric model. Henceforth, this finding is supported by the error correction model (ECM) estimation. Table (3) shows the estimated coefficient of error correction term (ECT) in all of regression results are negative and significant at the level of significances, α=5% and 10%. In other words, this result shows long-run relationships among variables involved.

**Table 3. ECM Estimation**

<table>
<thead>
<tr>
<th>C</th>
<th>RIR</th>
<th>OIL</th>
<th>IP</th>
<th>ECT</th>
<th>R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.0005</td>
<td>0.016</td>
<td>-0.041</td>
<td>-1.285*</td>
<td>-0.322*</td>
<td>0.237</td>
<td>2.682</td>
</tr>
<tr>
<td>0.0101</td>
<td>0.010</td>
<td>0.0521</td>
<td>0.481</td>
<td>0.065</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: IFS and BLS. Authors' calculation.
Notes: Standard error in parantheses
The asterisk (*)indicate the rejection of the null hypothesis of a zero coefficient at the 5% significance level.

**4.3. The Estimated Coefficient Interpretation**

To this end, this study only focuses on the impact of factors affecting unemployment rate in the U.S, thus the short run impacts will be ignored. Equation (2) explores that unemployment rate in the U.S. are both positively influenced by real interest rate and oil price. Here, if there is an increasing of 1 percent real interest, it is expected that the unemployment rate will also rise around 0.026 percent. This result is supported by the findings of Meera and Larbani (2004), Hardi et.al (2012) and Putriani, et.al. (2012) that conclude interest rate has a negative impact on the economics performance. Meanwhile, the oil price affects greater, i.e. an increasing of 1 percent in oil price will contribute 0.071 percent rise in jobless people. In other words, the effect of oil price is almost 3 times greater than real interest rate. As expected before, industrial production has a negative significant impact on the level of unemployment. It implicitly means that if there is a decreasing of 1 percent in industrial production then it will turns out an increasing 2.388 percent of jobless people in the U.S.
Table 4: OLS Estimation

<table>
<thead>
<tr>
<th>C</th>
<th>RIR</th>
<th>OIL</th>
<th>IP</th>
<th>R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.286*</td>
<td>0.026*</td>
<td>0.071*</td>
<td>-2.388*</td>
<td>0.501</td>
<td>2.682</td>
</tr>
<tr>
<td>0.322</td>
<td>0.0028</td>
<td>0.037</td>
<td>0.240</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: IFS and BLS. Authors’ calculation.
Notes: Standard error in parantheses
The asterisk (*) indicate the rejection of the null hypothesis of a zero coefficient at the 1%, 5% and 10% significance level.

Graph 1: The U.S. Oil Imports

In addition, the estimated coefficient in table (4) can be inferred that oil might be benefited as a potential bargaining power to oil importer countries in terms of political power. It is widely known

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3 Table 4 shows the result after Cochrane Orcutt procedures applied. To see the difference before and after iteration (see: Appendix).
that the U.S imports almost their oil from muslim countries. Up till now, the development of muslim countries are very left behind from developed countries, particularly to the U.S. In many cases of negotiation, muslim countries may not be able to bargain the offered options, however, it will harm them. The attack of Israel to Palestine, for instance, may not be shortly stopped. If all of oil importer muslim countries do agree to stop their oil import transaction to the U.S and allied states, hence it is expected that the war between Israel and Palestine can be stopped and the power of world economy will be governed by the muslim countries. Graph (1) shows oil volume imported by the U.S.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

According to the outset empirical findings, there are some analysis and international trade policy recommendations for muslim countries in particular. First, since interest rate has been proven as one of the main root causes of unemployment (read: economic fluctuation), thus it needs to eliminate it from the economic system, especially in muslim countries. In this case, debt -along with interest imposed on it- is the real terrorist creating poverty in many countries, particularly in muslim countries. It might be referred that what is happening in muslim countries today caused by they do not consider the warning of Islam related to the peril of the existence interest (riba/usury) in the economy activities. In order to eliminate interest rate in the economic system, a muslim country could implement “little policy” as a starting point. For instance, by empowering the use of zakah, improving the role of islamic microfinance to eradicate unemployment and poverty, and encouraging society to develop cooperative system. By these three policies, it is expected that the role of interest rate in the economic system can be reduced in short run and totally eliminated in the long run.

Second, it is clearly showed that the estimated coefficient of oil price is 3 times greater compared to real interest rate. Therefore, it is expected to use oil as a political weapon in order to equalize the bargaining power amongst muslim countries to the US in particular. As of graph (1) shows that there is a dependency of the U.S to the almost muslim countries around the world.

Third, it urges to improve the quality of next muslim generation both soft and hard skill. Since the level of education of muslim countries are lower than developed countries, then their (muslim individual) position in terms of jobs will also be lower than others. Therefore, a muslim government must do concern about this matters.

REFERENCES


APPENDIX

OLS before Iteration Cochrane Orcutt

Dependent Variable: UR  
Method: Least Squares  
Date: 11/19/12  Time: 08:51  
Sample: 1980Q1 2012Q2  
Included observations: 130

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>16.83856</td>
<td>0.478419</td>
<td>35.19625</td>
<td>0.0000</td>
</tr>
<tr>
<td>RIR</td>
<td>0.023799</td>
<td>0.001452</td>
<td>16.39161</td>
<td>0.0000</td>
</tr>
<tr>
<td>OIL</td>
<td>0.150172</td>
<td>0.021542</td>
<td>6.971167</td>
<td>0.0000</td>
</tr>
<tr>
<td>IP</td>
<td>-2.341639</td>
<td>0.129518</td>
<td>-18.07958</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.796614  Mean dependent var 9.016366  
Adjusted R-squared 0.791771  S.D. dependent var 0.245234  
S.E. of regression 0.111906  Akaike info criterion -1.512037  
Sum squared resid 1.577879  Schwarz criterion -1.423805  
Log likelihood 102.2824  Hannan-Quinn criter. -1.476186  
F-statistic 164.5036  Durbin-Watson stat 0.703739  
Prob(F-statistic) 0.000000

Note:
Autocorellation can be informally seen from low value of Durbin-Watson (DW) test i.e. less than 1.2. Based on the regression result above, the value of DW test is 0.703. In order to prove formally, then some tests of classical assumptions are applied as follows.

Classical Assumptions Test

Autocorrelation
Breusch-Godfrey Serial Correlation LM Test:

| F-statistic | Prob. F(2,124) |  
|-------------|----------------|--------|
| 76.85663    | 0.0000         |
| Obs*R-squared | 71.95452     | Prob. Chi-Square(2) 0.0000 |

Since the value of tested probability of X > statistic probability (α= 5%), hence residual of regression estimator has suffered by autocorrelation.

Heteroscedasticity
Heteroskedasticity Test: Breusch-Pagan-Godfrey

| F-statistic | Prob. F(3,126) |  
|-------------|----------------|--------|
| 6.821465    | 0.0003         |
| Obs*R-squared | 18.16395      | Prob. Chi-Square(3) 0.0004 |
| Scaled explained SS | 12.78388 | Prob. Chi-Square(3) 0.0051 |
Since the value of tested probability of $X >$ statistic probability ($\alpha = 5\%$), hence the regression equation has suffered by heteroscedasticity.

### Multicoleniarity

<table>
<thead>
<tr>
<th></th>
<th>UR</th>
<th>RIR</th>
<th>OIL</th>
<th>IP</th>
</tr>
</thead>
<tbody>
<tr>
<td>UR</td>
<td>1</td>
<td>0.2496846</td>
<td>0.5157024</td>
<td>-0.0241626</td>
</tr>
<tr>
<td>RIR</td>
<td>0.2496846</td>
<td>1</td>
<td>0.5718307</td>
<td>0.9467975</td>
</tr>
<tr>
<td>OIL</td>
<td>0.5157024</td>
<td>0.5718307</td>
<td>1</td>
<td>0.4823032</td>
</tr>
<tr>
<td>IP</td>
<td>-0.0241626</td>
<td>0.9467975</td>
<td>0.4823032</td>
<td>1</td>
</tr>
</tbody>
</table>

Generally, the value of estimated coefficient correlation all of observations shows is bigger than 0.80, except RIR variable with IP, viceversa. In other words, there is no multicoleniarity indication on the regression model. Nevertheless, according to Gujarati (2003), the multicoleniarity indication can be ignored since the model may yield BLUE estimation.

### OLS After Iteration Cochrane Orcutt

Dependent Variable: UR2  
Method: Least Squares  
Date: 11/19/12  Time: 18:01  
Sample (adjusted): 1980Q2 2012Q2  
Included observations: 129 after adjustments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>6.285999</td>
<td>0.321849</td>
<td>19.53091</td>
<td>0.0000</td>
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<tr>
<td>RIR2</td>
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<td>0.002762</td>
<td>9.397137</td>
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<tr>
<td>OIL2</td>
<td>0.070725</td>
<td>0.037219</td>
<td>1.900240</td>
<td>0.0597</td>
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<tr>
<td>IP2</td>
<td>-2.387777</td>
<td>0.240257</td>
<td>-9.938426</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared | 0.501211 | Mean dependent var | 3.309818 |
Adjusted R-squared | 0.489240 | S.D. dependent var | 0.116498 |
S.E. of regression | 0.083258 | Akaike info criterion | -2.103222 |
Sum squared resid | 0.866492 | Schwarz criterion | -2.014546 |
Log likelihood | 139.6578 | Hannan-Quinn criter. | -2.067191 |
F-statistic | 41.86898 | Durbin-Watson stat | 2.682429 |
Prob(F-statistic) | 0.000000 |               |        |

Note:  
Based on the regression result above, the value of DW test has changed, i.e. 2.68. In other words, the result has no longer suffered by autocorrelation.