INVESTIGATION OF THE INFLUENCE OF UNEMPLOYMENT ON ECONOMIC INDICATORS

Ilona Tregub, Olga Filina, Irina Kondakova

Financial University under the Government of the Russian Federation

1. Phillips curve

In economics, the Phillips curve (named by William Phillips) is a historical inverse relationship between the rate of unemployment and the rate of inflation in an economy. Stated simply, lower unemployment in an economy is correlated with a higher rate of inflation.

Econometrics model

$$\begin{cases} \pi_t = c + a\pi_{et} - bU_t + bU_n + \upsilon_t \\ t = 1,2,..; a, b, c, > 0 \end{cases}$$

Where:

- b is a positive constant,
- U is unemployment,
- U_n is the natural rate of unemployment or NAIRU,
- π and π_e are the inflation and expected inflation respectively.
- ε_t is a disturbed term,
- t is time period,
- *c*, *a* are the coefficients

1.1. Correlation analysis

First step of analyzing econometrics model is Correlation Analysis. We started with Philips curve and statistical data of China. For this macroeconomic law we need data about expected inflation and inflation rates, unemployment rate, inflation rate we took as CPI.

To make correlation analysis we use Excel file. First of all, we should understand which variable is dependent and which variables are independent. For our analysis we should construct matrix of correlation and diagrams with trend, at the end we should make a conclusion about dependence between variables. Next step is to put data into cells and columns. After that I find coefficient of correlation using the correlation function. In my example we make correlation analysis for Fisher equation, in this law we have one dependent variable-inflation rate and two independent variables- expected inflation rate and unemployment rate. We start with testing coefficient of correlation between expected inflation and inflation rates. We should chose the statistical function and allocate two necessary arrays.

After that we obtain our coefficient of correlation, in my case, the coefficient of correlation is 0,9-it means that there is strong positive dependence between inflation and expected inflation rates, as one indicators increases, another also increases. The same

procedure we made for other independent variable. And we obtain following results: it means that there is strong positive dependence between inflation and expected inflation rates

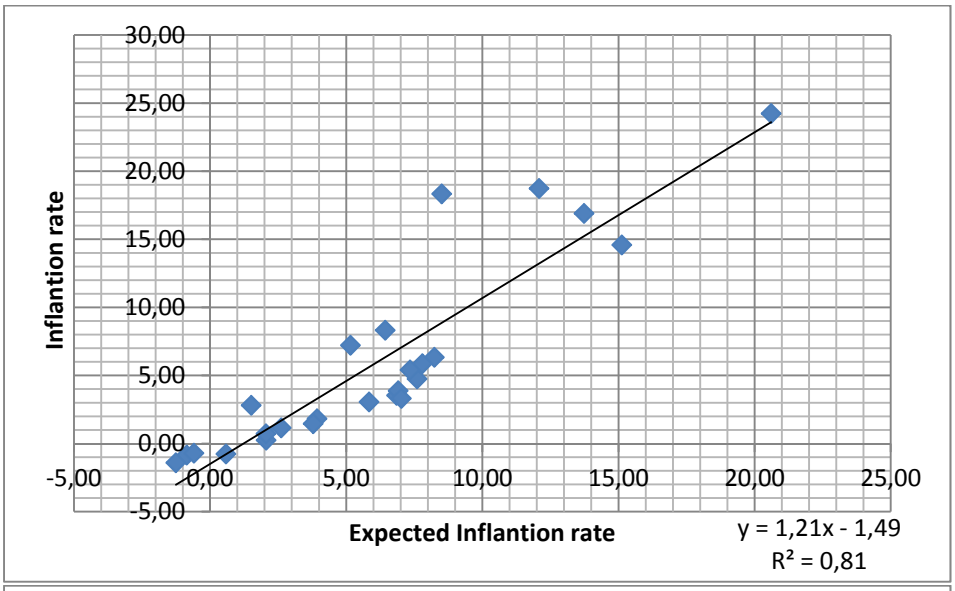
r_1=0,90

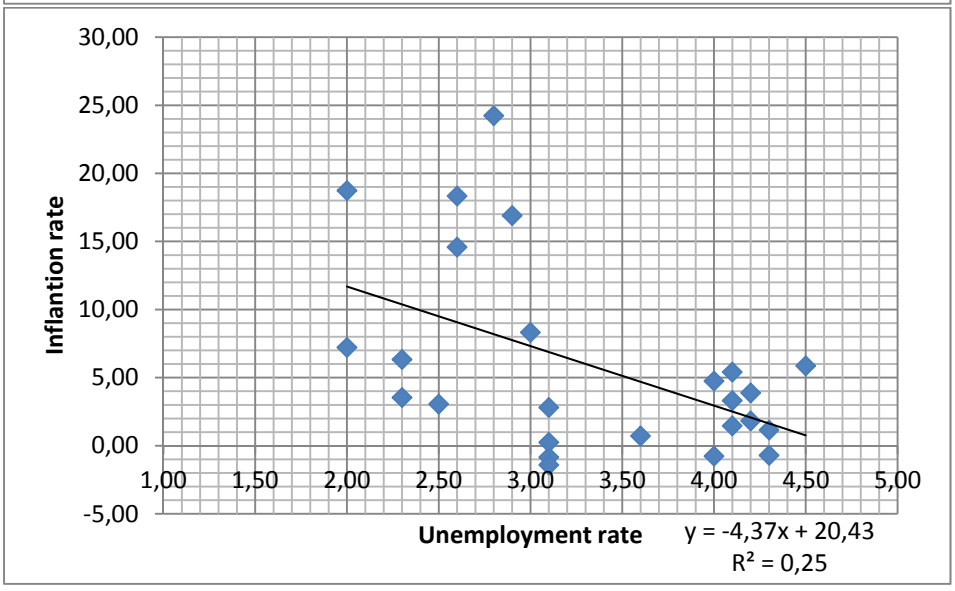
r_2=-0,50

It means that there is medium negative dependence between inflation and unemployment rates

For full correlation analysis we need to construct scatter plot to determinate the function of dependence between two variables.

On the scatter plot we name dependent and independent variables, in my case it is nominal and real interest rates. Also, it is better to reduce the numbers in the formulas to two decimal place value. To sum up, in our scatter plot it is necessary to show diagram between two variables, line of trend, equation of the function, square of R and the name of variables.





Making Correlation Analysis we can come up to conclusion that inflation rate depends positively on expected inflation rate and medium negatively on unemployment

rate. As inflation rate and unemployment rate have negative relation (as one increase, another decreases), consequently, statistical data of China proves Phillips curve.

1.2. Regression analysis.

After testing dependence between variables and proved that in our equation we have positive dependence between variables, we should make regression analysis to find estimation of coefficients, standard deviation of coefficients and disturbed terms, R^2 and F. All these we need to construct estimated equation for our model. First of all, we have the second variant of basic model; we have one dependent variable and two independent variables.

	b	*a*	*c*				
	-1,73	1,12	4,83	*Estimation of Coeffitients*			
	0,81	0,12	3,08	*Standard Deviation of Coeffitients*			
R^2	0,85	2,92	#Н/Д	δ_ε			
F	60,00	21,00	#Н/Д				
	1020,66	178,61	#Н/Д				

After that it is neccesary to make regression analysis. To do this we should find in Excel file “Data Analysis”, select “Statistical” and then “Regression”. We will get the window which we shoul fulfill with our data. Here we should put our statistical data of variables and chose free cell where we want to see our result. Moreover, it is important to note that when we select our arrays of data, we should select all cells except of the last array of each variable. Also, we put sticks near the representation of graphs of remains. At the end press “Enter” and see the result as graphs and tables. This information is necessary for further tests and makes estimated equation. Below is our result of Fisher equation with estimation of coefficients, standard deviation of coefficients and disturbed terms, R square and value of F. Estimated equation

$$\begin{cases} y_t = 4{,}83 + 1{,}12x_{1t} - 1{,}73x_{2t} + \varepsilon_t \\ \quad (3{,}08)\ (0{,}12) \quad (0{,}81) \quad (2{,}92) \\ \quad R^2 = 0{,}85 \quad F = 60{,}00 \end{cases}$$

Third step is F-test. This we need to estimate random or not random our square R. Using this function is necessary to get value of F critical. F_{crit}=3,47. As our F critical is less that F statistical we can come up to conclusion that R^2 is not random and quality of specification is high.

2. Okun's Law

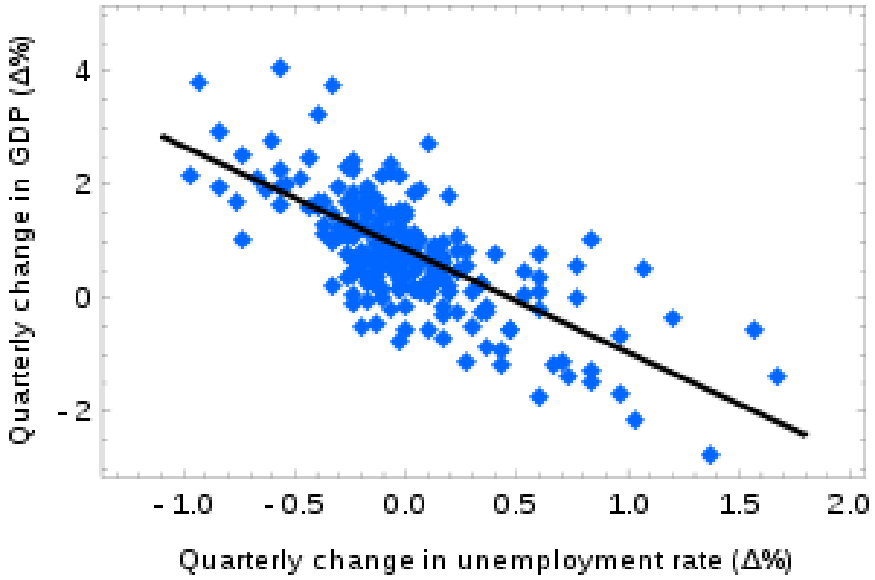
Okun's law is an empirically observed relationship relating unemployment to losses in a country's production. Okun's law states that a one point increase in the unemployment rate is associated with two percentage points of negative growth in real GDP.

This law is named after Arthur Okun, the economist who, in 1962, was the first to make detailed observations about this relationship. So-called "natural unemployment"

refers to the fact that there will always be at least a certain amount of unemployment in a free market economy, because of voluntary changes in employment and other reasons not related to economic hardship.

In its most basic form, Okun's law investigates the statistical relationship between a country's unemployment rate and the growth rate of its economy. The economics research arm of the Federal Reserve Bank of St. Louis explains that Okun's law "is intended to tell us how much of a country's gross domestic product (GDP) may be lost when the unemployment rate is above its natural rate." It goes on to explain that "the logic behind Okun's law is simple. Output depends on the amount of labor used in the production process, so there is a positive relationship between output and employment. Total employment equals the labor force minus the unemployed, so there is a negative relationship between output and unemployment (conditional on the labor force)."

It is most important to note that Okun's law is a statistical relationship that relies on a regression of unemployment and economic growth. As such, running the regression can result in differing coefficients that are used to solve for the change in unemployment, based on how the economy grew. It all depends on the time periods used and inputs, which are historical GDP and employment data. The law has indeed "evolved," or changed over time to fit the current economic climate and employment trends at the time. One version of Okun's law has stated very simply that when unemployment falls by 1%, GNP rises by 3%. Another version of Okun's Law focuses on a relationship between unemployment and GDP, whereby a percentage increase in unemployment causes a 2% fall in GDP.



All the necessary information for the country we have chosen (the USA) concerning the Okun's law I downloaded from the website of The World Bank (http://data.worldbank.org/country/united-states).

For this model we needed data on Current unemployment rate, Unemployment rate at previous moment of time and Growth rate of output. Thus, I just found needed indicators in a given Excel file.

The unemployment rate at current moment of time (U_t) depends positively on the unemployment rate at previous moment of time (U_{t-1}) and negatively on the growth rate of output from previous to current moment of time (G_{yt}).

The initial form of the econometric model is:

$$\begin{cases} U_t = a_0 - a_1 G_{yt} + a_1 G_y + a_2 U_{t-1} + \varepsilon_t \\ a_0, a_1 > 0, 0 < a_2 <= 1 \\ E(\varepsilon_t) = 0 \\ \sigma(\varepsilon_t) = const \end{cases}$$

Where

Ut is the unemployment rate at current moment of time;

U_{t-1} is the unemployment rate at previous moment of time;

G_y is the normal growth rate;

G_{yt} is the growth rate of output from previous to current moment of time;

a_0, a_1, a_2, are coefficients;

ε_t is disturbance term.

2.1. Correlation analysis

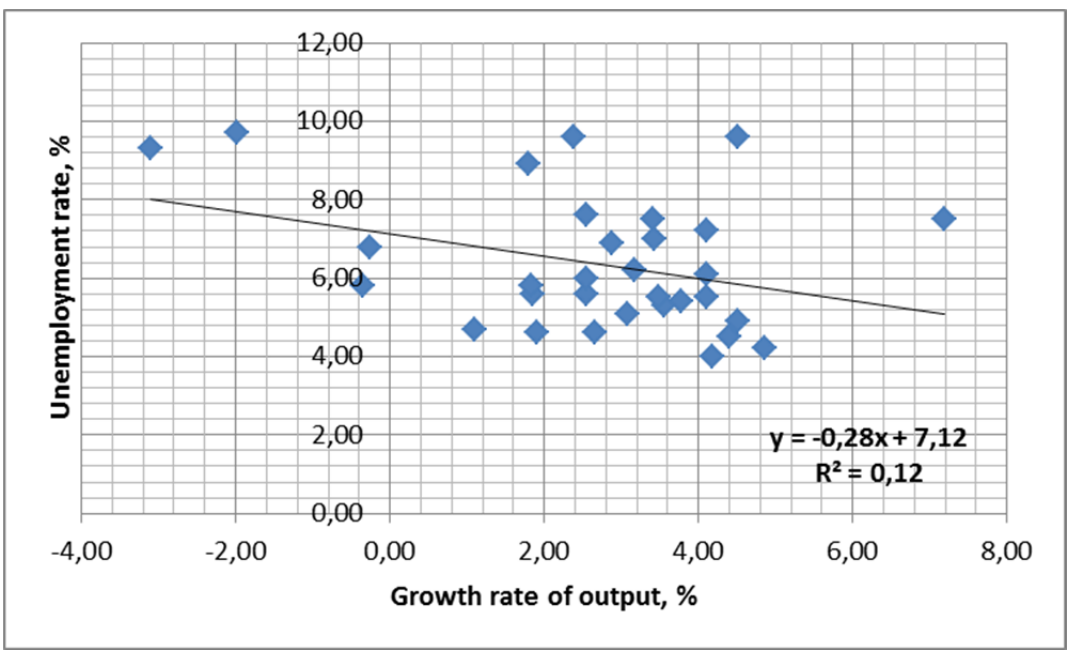
To analyze the correlation between variables and to build the scatter diagram, we constructed a table in Excel with initial data:

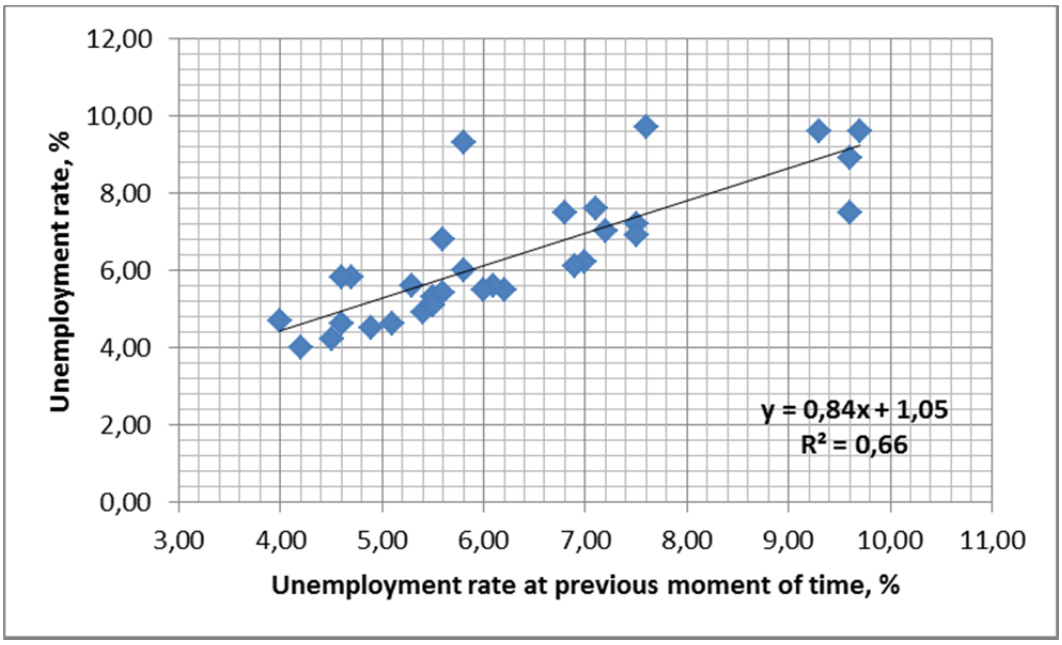
As the model has more than two variables, it is needed to create the matrix of pair correlation.

Matrix of pair correlation			
	Ut	*Ut-1*	*Gyt*
Ut	1		
Ut-1	0,81	1	
Gyt	-0,34	0,20	1

The Scatter Diagram showing the relationship between Current unemployment rate (U_t) and the Unemployment rate at previous moment of time (U_{t-1})

The Scatter Diagram showing the relationship between Current unemployment rate (U_t) and the Growth rate of output (G_{yt})





Conclusion

- Correlation coefficient between current unemployment rate (U_t) and unemployment rate at previous moment of time (U_{t-1}) is equal to 0,81. It indicates that there is a strong positive linear relationship between current unemployment rate (U_t) and unemployment rate at previous moment of time (U_{t-1}).
- Correlation coefficient between current unemployment rate (U_t) and growth rate of output (G_{yt}) is equal to -0,34. It indicates that there is a very weak negative linear relationship between current unemployment rate (U_t) and growth rate of output (G_{yt}).
- The Scatter Diagram showing the relationship between Current unemployment rate (U_t) and the unemployment rate at previous moment of time (U_{t-1}) indicates that the relation between two variables is linear and positive.
- The Scatter Diagram showing the relationship between current unemployment rate (U_t) and growth rate of output (G_{yt}) indicates that the relation between two variables is linear and negative.
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2.2. Regression analysis

	a_1	a_2	a_0	
	-0,45	**1,00**	**1,28**	
S_{ai}	**0,04**	**0,06**	**0,35**	
R^2	→ 0,93	0,45	#Н/Д	← σ_ε
F	182,43	27	#Н/Д	
	72,80	5,39	#Н/Д	
F crit	3,33	F crit < F		

coefficient a_0 is 1,28
coefficient a_1 is -0,45
coefficient a_2 is 1,00
standard deviation of a_0 is 0,35

standard deviation of a_1 is 0,04
standard deviation of a_2 is 0,06
standard deviation of disturbance term ε_t is 0,45
R^2 is equal to 0,93 and F is equal to 182,43
Thus, the estimated form of the econometric model is

$$\begin{cases} U_t = 1{,}28 - 0{,}45G_{yt} + a_1 G_y + 1U_{t-1} + \varepsilon_t \\ \quad (0{,}35)\ \ (0{,}04) \qquad\qquad (0{,}06) \qquad (0{,}45) \\ R^2 = 0{,}93 \qquad F = 182{,}43 \end{cases}$$

Conclusion

- R^2 is 0,93, it is close to 1, thus, regression line including G_{yt} and U_{t-1} in the model explains values of U_t.

F is equal to 182,43 and F critical is equal to 3,33. Value of F critical is much lower than value of F, thus, we can conclude that R^2 is not random and the quality of specification is high.

Hence, it can be concluded that this model is applicable to the USA under the period from 1981 to 2011.