

## **A RESEARCH ON THE RELATIONSHIP BETWEEN THE UNEMPLOYMENT RATE AND THE INFLATION RATE IN BULGARIA**

This study examined the causal and quantitative relationships between the unemployment rate and the the inflation rate in Bulgaria. The statistical analysis studied the relationship between the two economic variables using monthly and annual data. A comparison has been made of the results obtained for Bulgaria and European Union (28 countries). An assessment of the equilibrium level of unemployment (NAIRU<sup>1</sup>) for the period 2000-2013 (annual data) and January 2000 – March 2014 (monthly data) has been performed.

JEL: E24; E31

Knowledge of the cause-and-effect relationships and quantity dependences between the rates of inflation and unemployment is of great importance for every macroeconomic policy. The currently dominating policy in most countries contains the use of unemployment as an instrument to control inflation, and vice versa – a decrease in inflation is usually associated with an increase in unemployment.

### **Theoretical framework**

The macroeconomic analysis proves that there is a definite relation between the rates of unemployment and inflation (Savov, Mirkovich, Kazakov, Yotova, Gechev, Statev, Rakarova, Atanasov, 1998). The negative relationship between them is graphically represented by the Short-Run Philips Curve whose theoretical grounding is based on the following lines of reasoning (Carlin, Soskice, 1990; Layard, Nickell, Jackman, 1991, 2005; Franz, 1996; Stock, Vogler-Ludwig, 2010): Workers and employees aspire to higher real wages, while employers' decisions about the prices of the goods and services offered depend on labour costs per unit of production. The achievement of equilibrium depends on the balance between the level of prices of the goods and services produced and the claims for the size of wages. Wages are determined by the anticipated prices, with the increase being higher if unemployment rate is lower, and vice versa. The rate of growth of real wages is determined by the formula

$$\Delta(w-p^e)=\alpha_0 - \alpha_1 U,$$

where:  $w$  and  $p^e$  are the logarithms of wages and anticipated prices, respectively;

$\Delta$  - is the change compared to a preceding period<sup>2</sup>;

$U$  – is the unemployment rate;

$\alpha_0$  and  $\alpha_1$  – are parameters (the point where the graph and the y-axis intersect and the slope of the linear-logarithmic function, respectively).

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<sup>1</sup> Non-Accelerating Inflation Rate of Unemployment.

<sup>2</sup> In fact,  $\Delta \ln x$  is the rate of growth of the quantity  $x$  because  $\Delta \ln x \sim \Delta x/x$ .

Similar reasoning can be applied to price-setting:

$$(1) \Delta(p-w^e) = \beta_0 - \beta_1 U,$$

where  $w^e$  is the logarithm of the wages anticipated by the employers.

If the distribution claims have been agreed, i.e. the current prices and wages are equal to the levels anticipated ( $\Delta p = \Delta p^e$  and  $\Delta w = \Delta w^e$ ), then from the above formulas we obtain

$$(2) U^* = \frac{\alpha_0 + \beta_0}{\alpha_1 + \beta_1},$$

where  $U^*$  is the equilibrium unemployment rate (NAIRU - non-accelerating inflation rate of unemployment).

The influence of the supply shocks (for example, raw material price increases or a productivity slowdown) can result in a rise in the NAIRU. This can be expressed by a modification of equation (1) (Franz, 1996):

$$\Delta(p-w^e) = \beta_0 - \beta_1 U + \gamma \cdot \Delta z,$$

where:  $z$  is the vector of the other factors influencing the level of prices;<sup>3</sup>

$\gamma$  – the vector of the parameters.

In this case the following formula for the equilibrium unemployment rate (NAIRU) is obtained:

$$U^* = \frac{\alpha_0 + \beta_0 + \gamma \cdot \Delta z}{\alpha_1 + \beta_1}.$$

If the current values of prices and wages do not coincide with the anticipated values, then what is obtained for the unemployment rate is:

$$(3) U = \frac{\alpha_0 + \beta_0 - \Delta(p-p^e) - \Delta(w-w^e)}{\alpha_1 + \beta_1} = U^* - \frac{\Delta(p-p^e) + \Delta(w-w^e)}{\alpha_1 + \beta_1}$$

If we assume that the differences between the anticipated and current prices and wages are equal (i.e.  $\Delta(p-p^e) = \Delta(w-w^e)$ ), then according to formula (3) we will have:

$$(4) U - U^* = -\frac{1}{\theta_1} \Delta(p - p^e),$$

where  $\theta_1 = (\alpha_1 + \beta_1)/2$ .

Formula (4) can also be written in the following way:

$$\pi - \pi^e = -\theta_1 (U - U^*),$$

where  $\pi$  is inflation, and  $\pi^e$  – expected inflation. The formula thus obtained expresses the negative relationship between unanticipated inflation and cyclical unemployment. The advantage of this way of deriving Philips curve is that unemployment and inflation are regarded as the twin economic 'evils' (Franz, 1996). The quantity

<sup>3</sup> The logarithms of the variables participate in the vector.

NAIRU shows to what extent at  $U > U^*$  unemployment can be restrained through the macroeconomic policies carried out, without this resulting in an increase in the inflation rate. If the current unemployment rate reaches NAIRU, i. e.  $U = U^*$ , other economic measures, aimed at the factors determining NAIRU -  $U^*$ , should be undertaken. It follows from formula (2) that  $U^*$  grows if the parameters  $\alpha_0$  and/or  $\beta_0$  assume higher values, i.e. when employers and/or workers want to have increased participation in the social product distribution. The case of  $U < U^*$  leads to growing rates of inflation. Since this situation is undesirable, restrictive measures should be taken for the equation  $U = U^*$  to be achieved or for  $U^*$  to be decreased through the influence of factors determining  $U^*$ .

### An investigation of the relationship between the rates of unemployment and inflation in Bulgaria and in the EU-28

*Annual data*

The annual data for the Bulgarian economy for the period between 2000 and 2013 have been used in the investigation (see Fig. 1). From the point of view of the interdependence between unemployment and inflation the period considered can be divided into four sub-periods (see Tsanov, Shopov, Beleva, Hristoskov, Lukanova, 2012, p. 10-11).

Figure 1

A comparison of the rates of unemployment\*, inflation\*\* and chain growth rate of the physical volume of the GDP (compared to the previous year)\*\*\* in Bulgaria for the period between 2000 and 2013.



\* Eurostat. Unemployment rate, by gender (age 15-74); \*\* HICP (2005 = 100)- annual data (average index and rate of change), Eurostat, <http://epp.eurostat.ec.europa.eu/>; \*\*\* Eurostat. Real GDP growth rate - volume - Percentage change on previous year.

During the first period (2000-2001) there was a negative relationship between unemployment and inflation. Unemployment grew by 3.1 percentage points (from 16.4% in 2000 to 19.5% in 2001), and inflation fell by 2.9 percentage points (from 10.3% in 2000 to 7.4% in 2001). This period is characterized by a certain drop in the growth rate of the real GDP by 1.5 percentage points (from 5.7 to 4.2, respectively). The following factors had a favourable influence on the economic development of the country: the effects of discipline and stability exercised by the currency board, the acceleration of the structural reforms, the support of the international financial institutions – IMF and the World Bank (Tsanov, Shopov, Beleva, Hristoskov, Lukanova, 2012, p. 42-43). Simultaneously, the privatization and liquidation of a series of businesses and the restructuring of the energy sector led to a considerable increase in unemployment. The Kosovo War and the shutdown of the transport corridors in Europe had an unfavorable influence on the economy and on the labour market accordingly (see *ibid.*).

During the second period (2002-2003) a trend toward a simultaneous decrease in both unemployment and inflation was observed. The unemployment rate dropped by 4.5 percentage points (from 18.2% in 2002 to 13.7% in 2003), and inflation fell by 3.5 percentage points (from 5.8 to 2.3 respectively). During the period between 2002 and 2004 economy went through a phase of enlivenment and accelerated growth – the growth rate of the real GDP grew in 2003 versus 2002 and in 2004 versus 2003 by 0.8 and 1.2 percentage points, respectively. Among the main factors favouring the upward economic development were the restructuring of the energy sector, privatization of commercial banks, measures implemented to encourage small and medium-sized business, active policies designed and carried out on the labour market, etc. (Tsanov, Shopov, Beleva, Hristoskov, Lukanova, 2012, p. 51-52).

Steady economic growth was observed during the third period (2004-2008). The growth rate of the real GDP was between 6.2 and 6.7%. A negative relationship between unemployment and inflation was present. Unemployment decreased by 6.5 percentage points (from 12.1% in 2004 to 5.6% in 2008), and inflation rose (with certain fluctuations) by 5.9 percentage points (from 6.1 to 12%). The coefficient of correlation representing the relationship between the two variables for the period was – 0.837, which shows a very strong negative relationship between them. The main factors exerting a favourable influence on the economic development of the country at the time were: the accession of Bulgaria to the European Union as a full member; a series of institutional and normative changes related to the synchronization of the Bulgarian legislation with that of the EU; a considerable increase in direct foreign investment; the financial discipline and supportive actions of the international financial institutions. The investments put mainly into the construction sector and real estate and much less into the industrial sector may be recognized as an unfavourable moment (Tsanov, Shopov, Beleva, Hristoskov, Lukanova, 2012, p. 52-58). At the end of this period the economy began to 'overheat' and showed the first signs of crisis – shrinkage of production and product exports, tension in the banking system, the 'bursting' of the real estate bubble.

The world financial and economic crises affected the Bulgarian economy at the end of 2008. (Tsanov, Shopov, Beleva, Hristoskov, Lukanova, 2012, p. 89). In 2009 the growth rate of the real GDP had the lowest negative value – 5.5%, and during the years that followed the values varied from 0.4 до 1.8%. A considerable drop in the growth rate of the real GDP in 2009 led to a substantial decrease in inflation the very same year and to a great increase in unemployment, but in 2010. This shows the existence of a one-year lag (delay) with which the effects of the aggravated macroeconomic environment affected unemployment.

During the fourth period (2009-2013) there was again a negative relationship between unemployment and inflation, but the trends were of opposite sign, compared with the previous period. Unemployment grew by 6.2 percentage points (from 6.8% in 2009 up to 13% in 2013), and inflation decreased (with certain fluctuations) by 2.1 percentage points (from 2.5 to 0.4%, respectively). The dependence between the two variables in 2009-2013 was less pronounced. The correlation coefficient representing the relationship between them for the period considered was  $-0.411$ , which shows a moderate negative relationship. The main factors exerting an unfavourable influence on the economic development of the country during that period were: the shrunken domestic consumption and export; repeated cuts in investment; negative expectations of job losses and closure of production facilities; increased grey economy; unconvincing management decisions on finding ways out of the crisis; social tension. Inflation rose due to an increase in the prices of key commodities like oil and grain on the international markets (Tsanov, Shopov, Beleva, Hristoskov, Lukanova, 2012, p. 58-59).

During the period after 2008 the active policy on the labour market was implemented in the circumstances of an economic crisis, financial restrictions, social tension and political instability. The initiatives of the active policy on the labour market were financed by the state budget and the European Social Fund through the implementation of OP for Human Resources Development 2007-2013. For the period 2007-2013 the funds provided amounted to 1213 thousand EUR, with national co-financing measuring 684 thousand EUR. The active policy on the labour market was aimed at both the unemployed and employed persons, with the former getting engaged in training and employment programmes, and the latter – in training in new vocational skills and/or key competencies.<sup>4</sup> Regarding the policies implemented on the labour market under the circumstances of an economic and financial crisis, the lack of clearly defined and consistent anti-crisis measures should be noted. The passive policies were targeted at providing income support to the unemployed but their effect was relatively modest and temporary due to the small amount and the short period of payment of unemployment compensations. With active policies the priority is given to the training, upskilling and retraining of the labour force but the effects of their implementation become evident in the long run. (Tsanov, Shopov, Beleva, Hristoskov, Lukanova, 2012, p. 68-69).

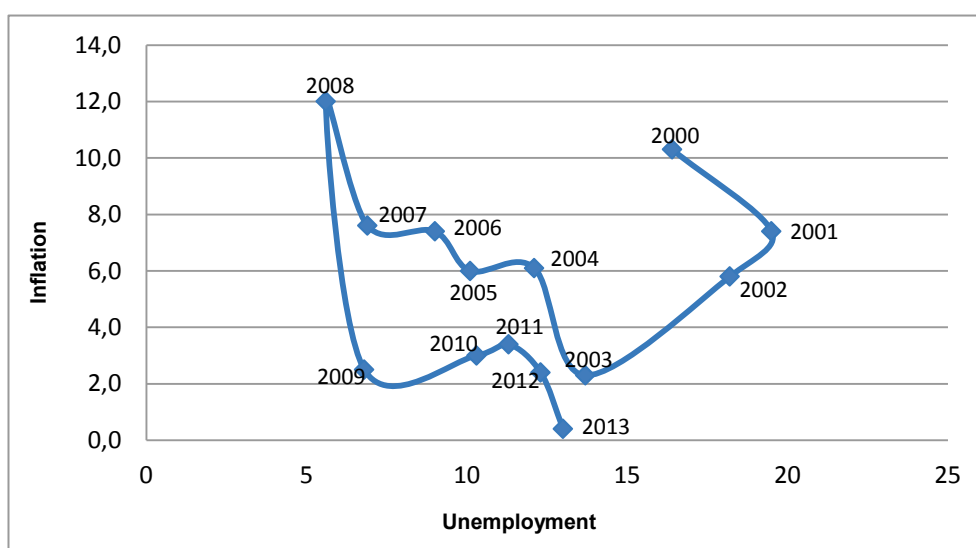
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<sup>4</sup> National Employment Agency. Statistics and analyses. Annual surveys, <http://www.az.government.bg/>.

As can be seen in Figures 1 and 2 in 2008 unemployment in Bulgaria reached its lowest value for the period considered (5.6%), and inflation – the highest (12%). Unemployment was the highest in 2001 (19.5%), and inflation was the lowest in 2013 (0.4%).

Figure 2

Dynamics of the unemployment and inflation rates in Bulgaria for the period between 2000 and 2013



According to the results obtained for the Bulgarian economy it was only during the period of enlivenment and accelerated growth (2002 - 2004) that a positive relationship between unemployment and inflation was observed. During the other periods the relationship was negative.

To select the most appropriate model that can be used to describe the relationship between unemployment and inflation in Bulgaria an assessment of the different models has been made by means of SPSS – a statistical software package. The probability of a type I error size of  $\alpha=0.05$  has been accepted in the analyses. The different models were compared according to the value of the coefficient of determination (the explanatory part). According to the results obtained the highest values are of this coefficient for the quadratic (0.358) and the cubic (0.398) models. The value of the coefficient of determination for the linear model is 0.004. The three models considered are not adequate because  $Sig.>\alpha=0.05$ . Since the difference between the values of the coefficient of determination for the linear and the other two models is greater than 0.1, the cubic model has been selected as the most adequate one. (Mishev, Goev, 2010) (see Fig. 3).

Figure 3

A cubic model of the relationship between unemployment and inflation in Bulgaria (annual data)

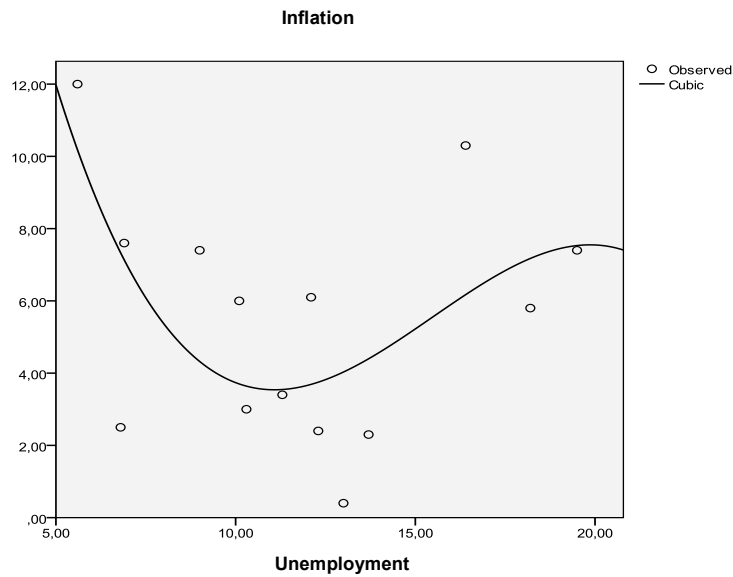


Table 1

Results obtained from the regression analysis performed with the help of SPSS for the variables *unemployment* and *inflation* (Bulgaria, annual data)

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
,631	,398	,217	2,936

The independent variable is Unemployment.

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	56,921	3	18,974	2,201	,151
Residual	86,208	10	8,621		
Total	143,129	13			

The independent variable is Unemployment.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Unemployment	-7,825	6,300	-.9,865	-1,242	,243
Unemployment ** 2	,550	,543	17,581	1,014	,335
Unemployment ** 3	-,012	,015	-7,903	-,816	,433
(Constant)	38,834	22,593		1,719	,116

As can be seen from the data in Table 1 the model is not adequate, the regression coefficients are not statistically significant ( $Sig.>\alpha=0.05$ ). According to the results obtained the relationship between inflation ( $\pi$ ) and unemployment ( $U$ ) in Bulgaria for the period 2000 – 2013 is described by means of the following regression equation:

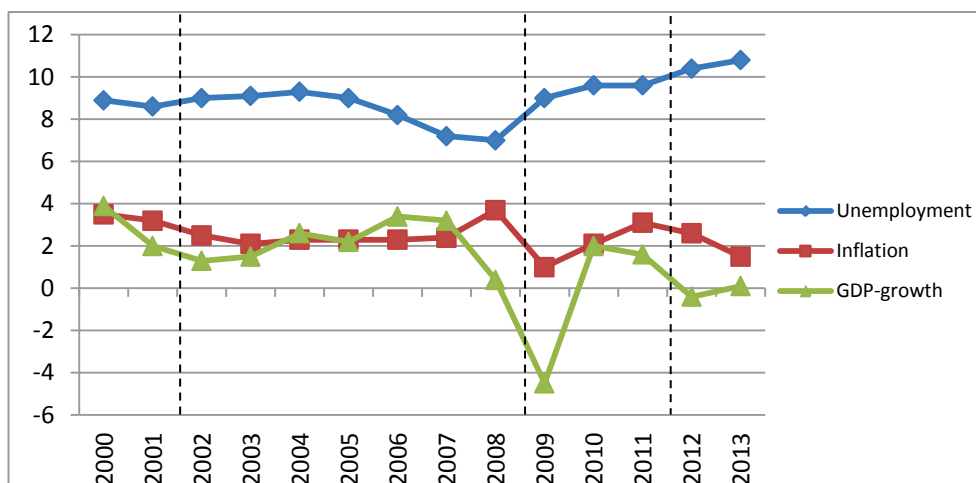
$$\pi = 38,834 - 7,825 \cdot U + 0,550 \cdot U^2 - 0,012 \cdot U^3 + \varepsilon_t,$$

where  $t=1,2,3,\dots,14$  (number of years),  $\varepsilon$ -error.

In the course of the investigation the relationship between unemployment and inflation has been considered, using the annual data for the EU-28 for the given period.

Figure 4

A comparison of the rates of unemployment, inflation\* and chain growth rate of the physical volume of the GDP (compared to the previous year) in the EU-28 for the period between 2000 and 2013.



\* For the period 2000-2010 the definition is different, see HICP (2005 = 100) - annual data (average index and rate of change), Eurostat, <http://epp.eurostat.ec.europa.eu/>.

The analyzed period is divided into four sub-periods:

*During the first sub-period (2000-2001)* a trend toward a simultaneous decrease in both unemployment and inflation was observed. Unemployment fell by 0.3 percentage points (from 8.9% in 2000 to 8.6% in 2001), and inflation - by 0.3 percentage points (from 3.5 to 3.2%, respectively). This period was characterized by a drop in the growth rate of the real GDP by 1.9 percentage points (from 3.9 in 2000 to 2 in 2001).

*During the second sub-period (2002-2008)* there was a negative relationship between unemployment and inflation. In 2002-2004 the unemployment rate increased



by 0.3 percentage points and inflation decreased by 0.2 percentage points. For 2005-2008 unemployment decreased by 2 percentage points and inflation rose by 1.4 percentage points. In 2004-2007 there was a considerable drop in unemployment by 2.1 percentage points (from 9.3% in 2004 to 7.2% in 2007) and a slight rise in inflation by 0.1 percentage points (from 2.3 to 2.4%, respectively). The coefficient of correlation representing the relationship between unemployment and inflation for 2002-2008, was  $-0.648$ , which shows a strong negative relationship between these variables. The period between 2002 and 2007 was characterized by accelerated economic growth of the economies of the member-states of the EU. The rate of growth of the real GDP grew from 1.3% at the beginning to 3.2% at the end of this period. However, the negative impact of the world economic crisis became visible in 2008. It was related to a huge drop in production - there was a near-zero rate of growth of the real GDP (0.4%). The impact of the drop in production in 2008 on unemployment and inflation resulted in a one-year lag. In 2009 a considerable rise in unemployment (by 2 percentage points) and a fall in inflation (by 2.7 percentage points) versus the previous year were reported.

*During the third sub-period (2009-2011)* the negative impacts, caused by the world economic crisis, became most obvious. In 2009 the growth rate of the real GDP for the EU-28 had the lowest negative value  $-4.5\%$ , and during the years that followed the values fluctuated from 1.6 to 2%.<sup>5</sup> During the third period a trend toward a simultaneous rise in unemployment and inflation was observed. Unemployment rose by 0.6 percentage points (from 9% in 2009 to 9.6% in 2011), and inflation - by 2.1 percentage points (from 1 to 3.1%, respectively). The coefficient of correlation representing the relationship between unemployment and inflation for the period 2009-2011 was 0.879, which shows a very strong positive relationship between these variables.

*During the fourth sub-period (2012-2013)* there was a negative relationship between unemployment and inflation. Unemployment increased by 0.4 percentage points (from 10.4% in 2012 to 10.8% in 2013), and inflation decreased by 1.1 percentage points (from 2.6 to 1.5%, respectively). During this period the growth rate of the GDP fluctuated around 0%.

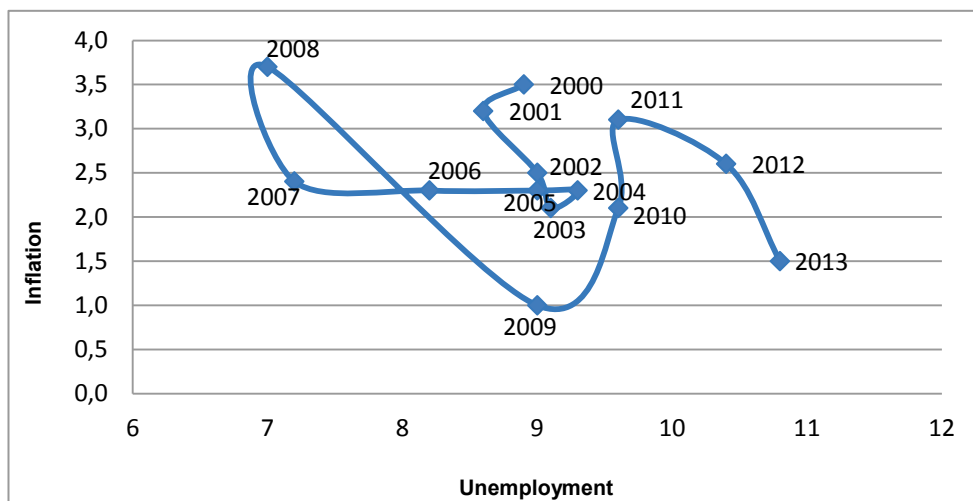
Figures 4 and 5 show that the lowest rate of unemployment corresponded to the highest rate of inflation for the period and, vice versa - the highest rate of unemployment corresponded to one of the lowest rates of inflation. And in reality in 2008 unemployment in the EU-28 reached the lowest level (7%), and inflation - the highest (3.7%). In 2013 unemployment was the highest (10.8%), and the inflation rate was among the lowest for the period (1.5%) (the only lower rate was in 2009 - 1%).

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<sup>5</sup> For the Bulgarian economy those results were  $-5$ , 5 and 0,4 - 1,8%, respectively. Therefore, the impact of the world economic crisis on Bulgaria's economy was stronger in comparison with that on the EU-28.

Figure 5

Dynamics of the unemployment and inflation rates in the EU-28 for the period between 2000 and 2013



According to the results obtained for the EU-28 during the period of enlivenment and accelerated growth (2002-2008) and during the period of zero growth (2012 – 2014) a negative relationship between unemployment and inflation was observed. During the other periods (of economic decline 2000–2001 and of the world economic crisis 2009–2011) the relationship between the two variables was positive.

To select the most appropriate model, that can be used to describe the relationship between unemployment and inflation in the EU-28, an assessment of the different models has been made by means of SPSS – a statistical software package. The results obtained show that the highest are the values of the coefficient of determination with the inverse (0.173) and logarithmic models (0.172), and with the linear model it is 0.170. The three models considered are not adequate because  $Sig.>\alpha=0.05$ . Since the difference between the values of the coefficient of determination for the linear and the other two models is smaller than 0.1, the linear model has been selected as the most adequate one.

As can be seen from the data in Table 2 the model is not adequate, and the regression coefficient before the variable *inflation* is not statistically significant ( $Sig.>\alpha=0.05$ ). According to the results obtained the relationship between inflation ( $\pi$ ) and unemployment ( $U$ ) in the EU-28 for the period 2000 – 2013 is described by means of the following regression equation:

$$\pi = 5,082 - 0,291 \cdot U + \varepsilon_t.$$

Figure 6

A linear model of the relationship between unemployment and inflation in the EU-28 (annual data)

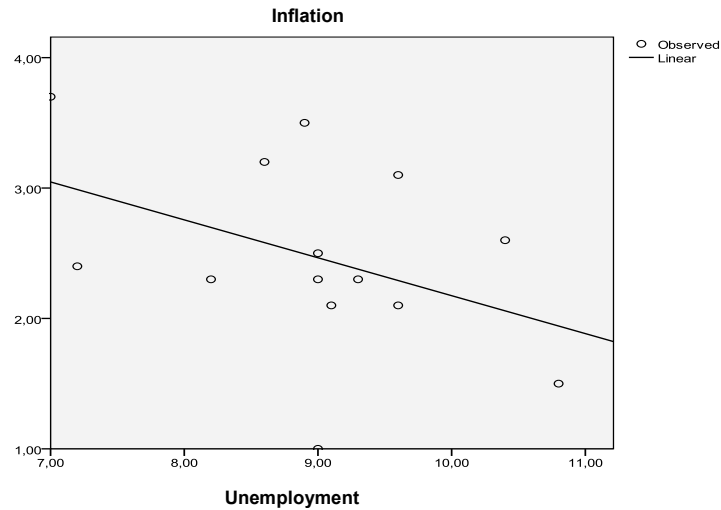


Table 2

Results obtained from the regression analysis performed with the help of SPSS for the variables unemployment and inflation (EU-28, annual data).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,412 <sup>a</sup>	,170	,101	,69522

a. Predictors: (Constant), Unemployment

ANOVA<sup>b</sup>

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,189	1	1,189	2,459	,143 <sup>a</sup>
	Residual	5,800	12	,483		
	Total	6,989	13			

a. Predictors: (Constant), Unemployment

b. Dependent Variable: Inflation

Coefficients<sup>a</sup>

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5,082	1,675		3,034	,010
	Unemployment	-,291	,185	-,412	-1,568	,143

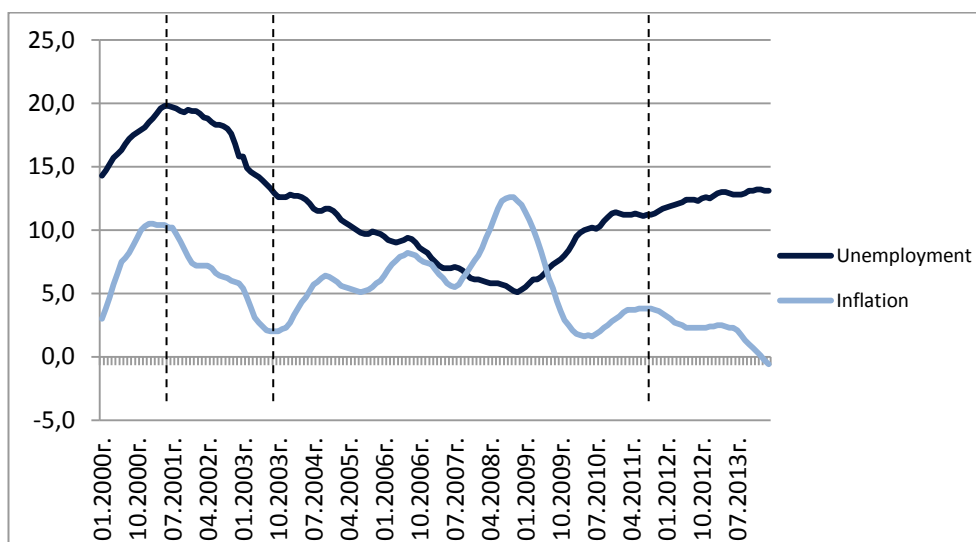
a. Dependent Variable: Inflation

*Monthly data*

In the course of the investigation the relationship between unemployment and inflation has been considered (12-month average rate of change), with monthly data for Bulgaria for the period 2000M01- 2014M03 being used.

Figure 7

A comparison of the rates of unemployment\* and inflation (12-month average rate of change)\*\* in Bulgaria for the period between 2000M01- 2014M03



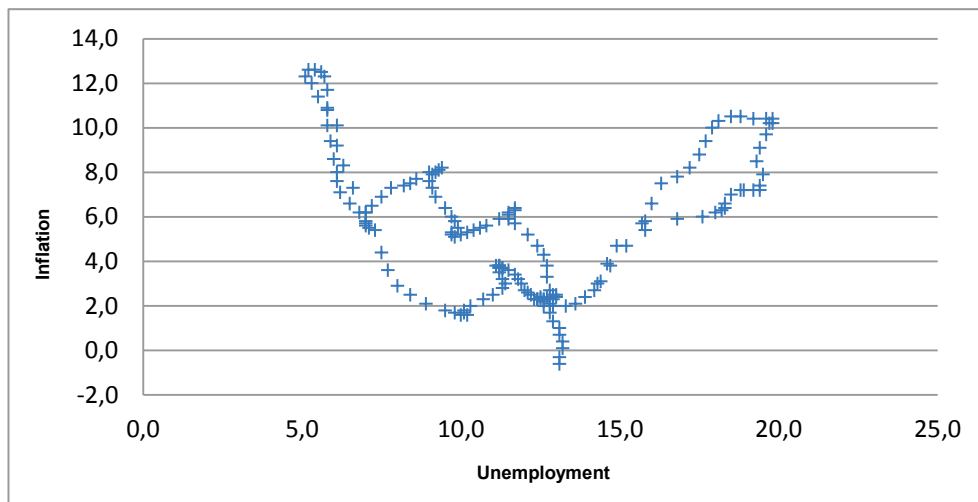
\* Eurostat. Unemployment rate by gender and age groups - monthly average, %, Seasonally adjusted data, <http://epp.eurostat.ec.europa.eu/>; \*\* HICP (2005 = 100) - monthly data (12-month average rate of change), Eurostat, <http://epp.eurostat.ec.europa.eu/>

The considered period 01/2000 – 03/2014 is again divided into four sub-periods. For each of them the coefficient of correlation representing the relationship between unemployment and inflation has been calculated. During the first period (01/2000-05/2001) it was 0.959, which shows a very strong positive relationship between the two variables. There was a simultaneous increase in both unemployment and inflation. During the second period (06/2001-08/2003) the coefficient of correlation was 0.942, which again shows a very strong positive relationship between the two variables. A trend toward a simultaneous decrease in unemployment and inflation was observed. During the third period (09/2003-11/2008) the coefficient of correlation was  $-0.797$ , which shows a very strong negative relationship between the two variables. At the beginning of the period unemployment decreased and inflation increased which was followed by a trend in the opposite direction (unemployment increased and inflation decreased). During the fourth period (12/2008-03/2014) the coefficient of correlation

was  $-0.818$ , which again shows a very strong negative relationship between the two indicators. During this period there was an increase in unemployment and a decrease in inflation (with certain fluctuations).

Figure 8

Dynamics of the unemployment and inflation rates in Bulgaria for the period 2000M01 - 2014M03



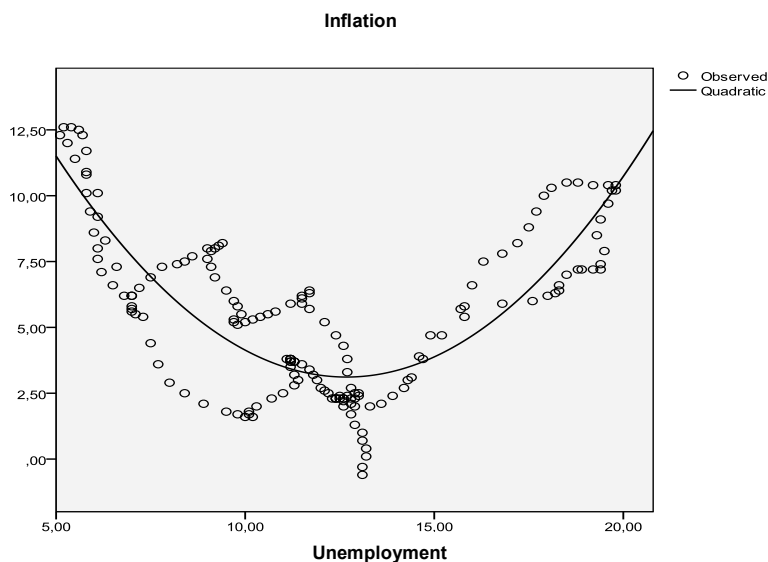
In the period considered unemployment in Bulgaria reached the highest rate during 05/2001 and 06/2001 (19.9%), and the lowest – during 11/ 2008 (5.2%). Inflation in Bulgaria reached the highest rate during 09/2008 and 10/ 2008 (12.6%), and the lowest – during 03/2014 ( $-0.6\%$ ). Figure 7 shows that for the period 06/2001 – 11/2008 there was a trend toward a decrease in unemployment. From 08/2007 on inflation began to rise rapidly and in 09/2008 and 10/2008 it reached its maximum value for the period – 12.6%. One of the main factors for the rapid increase in inflation for the period 08/2007 – 10/2008 was the considerable fall in unemployment in this period. During 08/2007 the unemployment rate was 6.9% and in 10/2008 it reached 5.3%. It can be assumed that one of the reasons for the increase in inflation for the period 08/2007 – 10/2008 was the drop in unemployment below its equilibrium rate (NAIRU). This means that NAIRU in Bulgaria for the period investigated varied around and above 6%. Since the dynamics of the equilibrium (natural) rate of unemployment depend largely on the changes in structural unemployment, it could be presumed that the economic and financial crisis of 2008 brought about an increase in the values of these indicators.<sup>6</sup>

<sup>6</sup> In his investigation of the economies of 20 developed countries Ball (2009) came to the conclusion that recessions have an overall negative impact on the potential of the labour market in

An assessment of the different models that can be used to describe the relationship between unemployment and inflation in our country has been made in this investigation. According to the results obtained the biggest are the values of the coefficient of determination with the quadratic (0.691) and the cubic models (0.692). (the two models are adequate because  $Sig.<\alpha=0.05$ .) The value of the coefficient of with the linear model is 0.004. (This model is not adequate because  $Sig.>\alpha=0.05$ .) Since the difference between the quadratic and the cubic models is minimal (0.001) as regards the explanatory part, the quadratic model has been selected as the most adequate one.

Figure 9

A quadratic model of the relationship between unemployment and inflation (Bulgaria, monthly data)



As can be seen from the data in Table 3 the model is adequate and the regression coefficients are statistically significant ( $Sig. <\alpha=0.05$ ). The coefficient of determination shows that 69.1% of the total variation of the response variable is explained by the movement of the predictor. Therefore, the relationship between inflation ( $\pi$ ) and unemployment ( $U$ ) in Bulgaria for the period 2000M01-2014M03 is described by the following regression equation:

$$\pi = 25,983 - 3,607 \cdot U + 0,142 \cdot U^2 + \varepsilon_t.$$

the long run and result in an increase in the natural rate of unemployment (contrary to the assumptions of some theoreticians that the natural rate of unemployment is not affected by the phases of the economic cycle).

Table 3

Results obtained from the regression analysis performed with the help of SPSS for the variables unemployment and inflation for Bulgaria (monthly data)

*Model Summary*

R	R Square	Adjusted R Square	Std. Error of the Estimate
,831	,691	,687	1,725

The independent variable is Unemployment.

**ANOVA**

	Sum of Squares	df	Mean Square	F	Sig.
Regression	1115,446	2	557,723	187,497	,000
Residual	499,726	168	2,975		
Total	1615,172	170			

The independent variable is Unemployment.

**Coefficients**

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Unemployment	-3,607	,187	-4,720	-19,274	,000
Unemployment ** 2	,142	,007	4,728	19,304	,000
(Constant)	25,983	1,108		23,456	,000

The rate of unemployment in the country in 03/2014 was 13.1%. The interpretation of the coefficients of the regression equation shows that when the unemployment rate  $U$  decreased by 1 percentage point from 13.1 to 12.1%, the inflation rate  $\pi$  increased slightly - by 0.029 percentage points (from 3.100 to 3.129%). When the decrease in unemployment was from 12.1 to 11.1%, the increase in inflation was bigger - by 0.313 percentage points (from 3.129 to 3.441%), and the drop in unemployment from 13.1 to 9.1% corresponded to an increase in inflation by 1.818 percentage points (from 3.100 to 4.918%). According to the formula obtained when the unemployment rate is around or below 6%, inflation rises considerably (it reaches values above 9.5%), which confirms the conclusion that the equilibrium rate of unemployment (NAIRU) in Bulgaria for the period was about 6% (see Fig. 9).

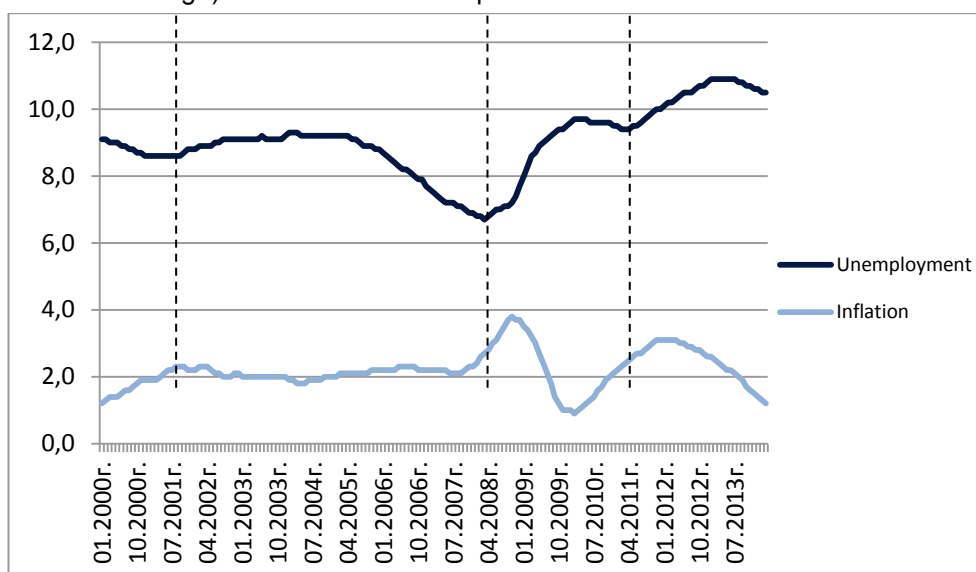
The relationship between unemployment and inflation has further been investigated, with the monthly data for the EU-28 for the period being used.

The considered period 01/2000 – 03/2014 is again divided into four sub-periods. For each of them the coefficient of correlation representing the relationship between unemployment and inflation has been calculated. During the first period (01/2000-09/2001) it was -0.932, which shows a very strong negative relationship between the two variables. There was a decrease in unemployment and an increase in inflation. During the second period (10/2001 – 03/2008) the coefficient of correlation was -0.666, which again points to a very strong negative relationship between unemployment and inflation. A trend toward a decrease in unemployment and an increase in inflation was observed. During the third period (04/2008 – 04/2011) this coefficient was -0.832, i.e.

there was a very strong negative relationship between the two variables. The trend was toward a rise in unemployment and a fall in inflation (with certain fluctuations). During the fourth period (05/2011 – 03/2014) the coefficient of correlation was  $-0.44$ , which shows a moderate negative relationship between the two variables. There was an increase in unemployment and a decrease in inflation (with certain fluctuations)

Figure 10

A comparison of the rates of unemployment and inflation (12-month average rate of change)\* in the EU-28 for the period between 2000M01- 2014M03



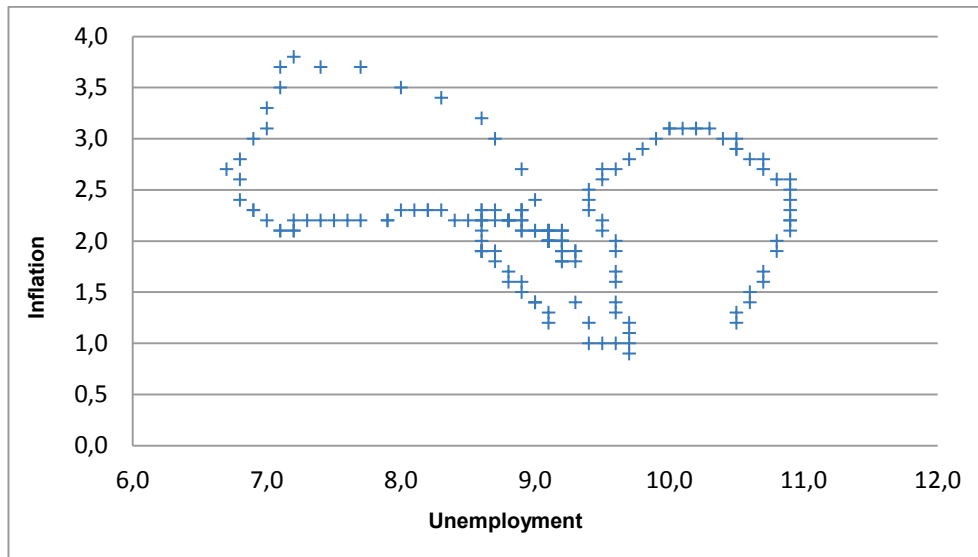
\* For the period 2000M01-2000M11 the data are evaluative; for the period 2000M01-2011M11 the definition is different (see HICP (2005 = 100) - monthly data (12-month average rate of change), Eurostat, <http://epp.eurostat.ec.europa.eu/>).

During the period considered unemployment in the EU-28 reached the highest rate during 01/2013 – 07/2013 (10.9%), and the lowest – during 03/2008 (6.7%). Inflation was the highest in 10/2008 (3.8%), and the lowest – during 02/2010 (0.9%). Figure 11 shows that over the period 04/2004 – 03/2008 there was a trend toward a decrease in unemployment. During 03/2008 it reached its lowest rate (6.7%). From 10/2007 on inflation in the EU-28 began to rise rapidly and in 10/2008 it reached its maximum value for the period (3.8%). One of the main factors for the rapid rise in inflation in the period 10/2007 – 10/2008 was the considerable fall in unemployment. The reason for the increase in inflation was the fall in unemployment below the equilibrium rate (NAIRU), and this effect became clear with about a seven-month lag. This means that the equilibrium rate of unemployment in the EU-28 fluctuated around 7%.



Figure 11

Dynamics of the unemployment and inflation rates in the EU-28 for the period 2000M01- 2014M03



An assessment of the different models that can be used to describe the relationship between unemployment and inflation in the EU-28 has been made further in the investigation. According to the results obtained the biggest are the values of the coefficient of determination with the quadratic (0.163) and the cubic (0.165) models, and its value the linear model is 0.050. (The three models are adequate because  $Sig. < \alpha = 0.05$ .) Since the difference between the quadratic and the cubic models regarding the explanatory part is minimal (0.002), the quadratic model has again been selected as the most adequate one (see Fig.12).

As can be seen from the data in Table 4 the regression coefficients are statistically significant ( $Sig. < \alpha = 0.05$ ). Although the relative share of the explanatory part of the total variation of the response variable is only 16.1% (the coefficient of determination is equal to 0.163) and is smaller than the unexplained part, the model is statistically significant. A relatively higher value is obtained for the dispersion ratio – 16.306 (on the right of it is 0.000 of Fisher distribution with the respective degrees of freedom) and it proves the statistical significance of the model (Cholakov, 2007). Therefore, the relationship between inflation ( $\pi$ ) and unemployment ( $U$ ) in Bulgaria for the period 2000M01-2014M03 is described by the following regression equation:

$$\pi = 13,653 - 2,493 \cdot U + 0,134 \cdot U^2 + \varepsilon_t.$$

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Figure 12

A quadratic model of relationship between unemployment and inflation in the EU-28 (monthly data)

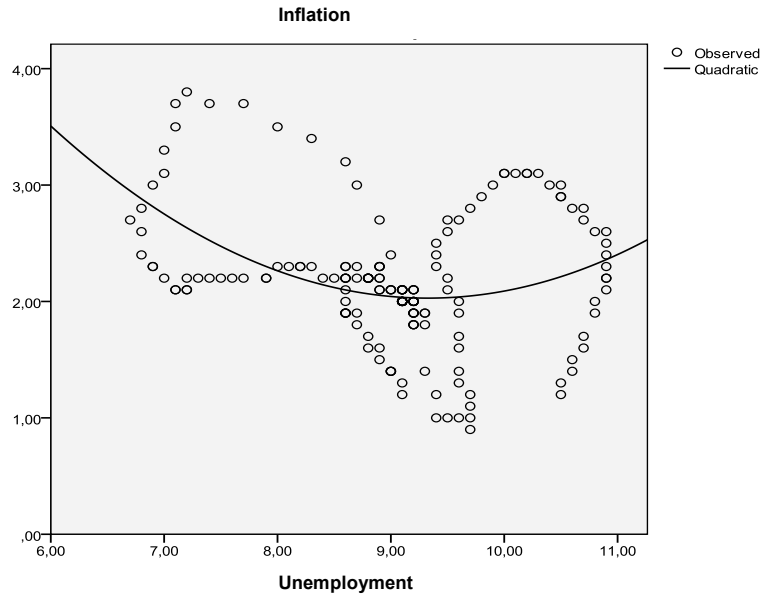


Table 4

Results obtained from the regression analysis performed with the help of SPSS for the variables unemployment and inflation for (EU-28, monthly data)

*Model Summary*

R	R Square	Adjusted R Square	Std. Error of the Estimate
,403	,163	,153	,527

The independent variable is Unemployment.

**ANOVA**

	Sum of Squares	df	Mean Square	F	Sig.
Regression	9,041	2	4,520	16,306	,000
Residual	46,573	168	,277		
Total	55,613	170			

The independent variable is Unemployment.

**Coefficients**

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Unemployment	-2,493	,501	-4,536	-4,979	,000
Unemployment ** 2	,134	,028	4,325	4,748	,000
(Constant)	13,653	2,210		6,178	,000

The rate of unemployment in the EU-28 in 03/2014 was 10.5%. The interpretation of the coefficients of the regression equation shows that as the rate of unemployment  $U$  decreased from 10.5 to 9.5% the rate of inflation  $\pi$  also fell by 0.187 percentage points (from 2.250 to 2.063%). When unemployment fell from 9.5 to 8.5%, inflation rose slightly - by 0.081 percentage points (from 2.063 to 2.144%). A decrease in unemployment from 10.5 to 7.5% was matched by a rise in inflation  $\pi$  by 0.243 percentage points (from 2.250 to 2.493%). According to the formula obtained when the rate of unemployment is around or below 7%, inflation rises rapidly (it reaches values above 2.8%), which confirms the conclusion that the equilibrium rate of unemployment (NAIRU) in the EU-28 for the period was around 7% (see fig. 12).

\*

In conclusion it can be noted that according to the results obtained from the investigation there is not any strict and uniform relationship between the rates of unemployment and inflation in Bulgaria. It has different manifestations during each particular phase of the economic cycle. A positive relationship between unemployment and inflation in the Bulgarian economy was observed during the period of enlivenment and accelerated growth (2002 - 2004), whereas in the economy of the EU-28 - at the time of economic decline (2000-2001) and of considerable decline caused by the world economic crisis (2009-2011). A negative relationship between the two variables in the Bulgarian economy was reported during the periods of economic decline (2000-2001), of steady growth (2004-2008) and of considerable decline (2009-2013), whereas in the economy of the EU-28 – during the period of enlivenment and accelerated economic growth (2002-2008) and of zero growth (2012-2014).

During the investigated period the equilibrium rate of unemployment in Bulgaria (around 6%) was slightly lower than that in the EU-28 (around 7%). The relationship between unemployment and inflation has a statistical character and as such it is unsteady and varies considerably in the course of time and during the different phases of the economic cycle. The relationship between the two indicators can be useful for forecasting, but on condition that the existing instability is taken into consideration. When macroeconomic policies (active and passive policies on the labour market, anti-inflation policies) are designed and applied, the complex and varying relations and dependences which exist between the major economic twin 'evils' - unemployment and inflation must be taken into consideration.

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16.VI.2014