NBKR Working Paper

Analysis of the relationship between the dynamics of inflation and economic growth in Kyrgyzstan

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Analysis of the relationship between the dynamics of inflation and economic growth in Kyrgyzstan

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Abstract

The paper presents the main results of the theoretical and empirical analysis of the relationship between the dynamics of inflation and economic growth in Kyrgyzstan. The paper contains quantitative assessment based on regression and dynamic models.

Жыйынтык

Илимий иште Кыргызстандагы инфляциянын динамикасынын жана экономикалык өсүштүн ортосундагы өз ара байланыштын теоретикалык жана эмпирикалык анализдин негизги жыйынтыктары келтирилген. Илимий иште регрессиондук, динамикалык модельдин негизиндеги сандык баалар камтылган.

Резюме

В работе приведены основные результаты теоретического и эмпирического анализа взаимосвязи между динамикой инфляции и темпами экономического роста в Кыргызстане. Работа содержит количественные оценки на основе регрессионной, динамической модели.

Keywords: Phillips' model, the theory of adaptive expectations, Granger causality test, regression analysis, the method of least squares (OLS).

JEL Classification: E 31, E 50, E 52, E 58, E 61, D 80, D 84

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Content

Analysis of the relationship between the dynamics of inflation and economic growth in Kyrgyzstan[1]

We dedicate to all of our ancestors including Ismailov Zhumadilov, who faithfully served to their people

Introduction

There is no definite stable rigid connection between inflation and economic growth. Depending on the causes of inflation and general economic conditions in the country, inflation can have a different impact on economic growth. Therefore, to identify and understand the nature of a relationship between inflation and economic growth it is necessary to determine the causes of inflation and conditions of economic growth in the country, which will help to develop and implement an effective economic policy on the basis of empirical research. In this case, it should be noted that studies of the relationship between inflation and economic growth are necessary, but not sufficient for the development of effective economic policy. As the first step and the stage of the study on nature of inflation in Kyrgyzstan there were conducted a theoretical and empirical study of this relationship. The work consists of two sections: the first one examines theoretical foundations of the relationship between inflation and economic growth, while the second one conducts an empirical study of this relationship.

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Section 1. Theoretical and empirical bases of the relationship between inflation and economic growth

1.1. Keynesians and Phillips' model: theoretical foundations and empirical confirmation of positive relationship between economic growth and inflation

Phillips curve (a rigid relationship between inflation and unemployment) is at the heart of the Keynesian position that focuses on the problem of aggregate demand as the main factor determining the national production and employment. This model postulates that the economy may experience either inflation or unemployment, but they can not appear at the same time. English economist A. Phillips while analyzing statistical data of the United Kingdom for the period of 1861-1956 found that the increase in unemployment in the UK led to a sharp slowdown in growth of prices and wages. Basing on this analysis he suggested a curve that shows inverse relationship between the level of wages and unemployment. It was found that the increase in unemployment in the UK above 2.5-3.0 percent led to a sharp slowdown in the growth of prices and wages.

Later there were conducted studies of the relationship between unemployment and inflation in other countries, where were identified a negative correlation between those two variables. American economists Paul Samuelson and Robert Solow modified Phillips curve replacing wage rate by growth in commodity prices. As such, the curve was used for the formulation of economic policies and determination of optimal combination of inflation and economic growth.

Keynesians explain the relationship between unemployment and inflation through following assumptions:

1) workers while being in labor relations pay more attention to nominal wages and not really pay attention to real wages (this allows Keynesian to use nominal wage rates to explain above inverse relationship);
2) rates of wages are rigid, meaning that wages are not always immediately able to respond to changes in the rate of price increases;
3) in addition, Keynesians suggest that with an increase in the rate of price there occur a reduction in real wages of workers, as the nominal wage remains constant (rigidity of changes in salaries).

Basing on the above assumptions and assertions Keynesians suggest that an increase in the rate of price increases there will stimulate a reduction in real wages, which in turn reduces the cost of production. Manufacturers after noticing a decrease in their production costs will attract new workers that will reduce unemployment and increase output. From this it follows that by allowing a certain price increases there can be achieved economic growth.

It should be noted that positive relationship between economic growth and inflation can be explained not only by using the inverse relationship between unemployment and wages. For example, a directly proportional relationship between economic growth and inflation may occur as follows:

1) An increase in inflation will reduce financial resources of individuals, therefore, in order to save their own funds individuals will begin to increase their savings, which will reduce the interest rate that in turn will stimulate investments and production;
2) Inflation will move the portfolio of investment securities from financial sector to real sector, which will increase the intensity of capital investment and, therefore, will increase the rate of economic growth (Grimes, 1991).

A number of studies by different authors represent an empirical basis for the existence of a positive relationship between economic growth and inflation. For example, Lucas used data from 1951-1967 years in order to conduct a study of 18 countries among which were both

developing and developed countries. The results of the study showed that there is a positive correlation between economic growth and inflation (Lucas, 1973).

Similar positive correlation was also found in studies of Thirlwall and Barton (1971), Mallik and Chowdhury (2001), Chowdhury (2002), Black, Dowd and Keith (2001), Christina (1996), etc. Thirlwall and Barton using data from 1958-1967 found that there is a positive relationship in developed countries. The research of Mallik and Chowdhury was conducted in four Asian countries (there were used data from different periods), which also pointed to positive relationship between economic growth and inflation in these countries. In addition, Chowdhury in his study that based on data of Indonesia (1950-1997) discovered the existence of positive relationship.

1.2. Monetarists and theory of adaptive expectations: theoretical foundations and empirical evidence of negative dependence of economic growth on inflation.

In order to explain the relationship between economic growth and inflation monetarists suggested to *use real values (real wages), to take into account expectations of economic agents* (economic agents' expectations is a determining factor for monetarist) and *divide economic processes to short-term and long-term periods* (according to monetarists impact of inflation on real economic performance in the short and in the long run is different).

Monetarists share the idea of Phillips curve in the short and long terms. Phillips curve of monetarist in the short-term is almost the same as Keynesian one, where moving through it is explained on the basis of the following principles: when the actual rate of inflation is higher than the expected one unemployment rate will fall, and vice versa. Long-term Phillips curve has the form of a vertical line with the ordinate at the natural rate of unemployment.

Based on the above assumptions, the monetarists have developed the theory of adaptive expectations. It was an attempt of monetarists to explain simultaneous presence of economic slowdown and high inflation in many countries in 1970s. Thus, monetarists subdivided inflation into two periods: inflation in the short run and inflation in the long run. In the short term, monetarists agree with Keynesians and recognize the possibility of positive dependence of economic growth on inflation, but with one assumption if actual inflation is higher than expected.

In the long run the role of adaptive expectations increases till the point where expectations of economic agents become an important factor in the impact of inflation on real economic performance. Because in the long run managing agents form their expectations about costs basing on a simple extrapolation of changing inflation trends and related processes in the past that affect the future. Thus, after facing with high prices for goods and services economic agents lose hope for their decline and begin to purchase goods in excess of their current needs. In addition, workers begin to demand higher wages, which leads to an increase in producers' costs. Prices for products will grow again as manufacturers will set higher prices for their products expecting soon rise in prices for raw materials and components. As a result of the expansion of current demand (due to inflationary expectations) there will be a further boost in price increases. At the same time there will be a reduction in savings and resources for credits, which will be a limiting factor in the growth of productive investment and economic growth. The main conclusion of the monetarist doctrine is a negative correlation of economic growth and inflation.

Monetarists by emphasizing special negative role of inflation on the development of economy believe that inflation is the main problem in any economy while zero inflation is a source of stable growth. The negative impact of inflation on growth is found and confirmed in numerous empirical studies.

In addition to researches that found negative effects of inflation on economic growth there can be included researches of the following authors: Edwards (1982); Fischer (1983); Kormendi and Meguire (1985); Jung and Peyton (1986); Gomme (1991); Fischer (1983); Barro (1996); Chari, Jones and Manuelli (1996); De Gregorio (1996); Clark (1997); Andres and Hernando (1997); Alexander (1997); Paul, Kearney and Chowdhury (1997); Motley (1998); Frenkel and Mehrez (1998); Kim and Willer (2000); Faria and Carneiro (2001); Gillman, Harris and Matyas (2002); Valdovinos (2003), etc.

All of the above authors at different times were able to identify negative effects of inflation on economic growth using the data from different countries. So, Kormendi and Meguire (1985) in a joint study found a negative relationship of economic growth and inflation using data from 47 countries for the period of 1950-1977. The results showed that 1 percent increase in inflation reduces growth by 0.57 percent. The same negative relationship was revealed by Fischer in 1993, who used data from 53 developed and developing countries for the period of 1961-1973 and 1973-1981. According to the study it was found that an increase in inflation by

10 percent will reduce the rate of growth by 0.4 percent. The study of Barro, which was conducted in 1995 on the basis of 100 countries for the period of 1960-1990 also gave similar results, according to which an increase in inflation by 10 percent reduces the rate of economic growth by 0.2-0.3 percent.

Thus, having a strong evidence base that relies on empirical research monetarists brought to the fore a tough stabilization policy and a principle of "first stabilize and then increase". Monetarists' stabilization policy implies a tight control over the supply of money, as this factor is the root cause of inflation (inflation – is purely monetary phenomenon).

Since 80th of XX century to present time monetarist doctrine has preserved its popularity. During this time monetarists' recommendation of economic reforms became at the heart of economic policy in many countries. But in recent years there is an increase in criticism against monetarists. This was a result of ineffectiveness of economic policies that base on the monetarist approach. Despite the fact that financial stability is the main goal of monetarists, in almost all countries (especially developing countries), which used monetarists' recommendations, an attempt to achieve financial stability and ensure steady growth was unsuccessful. Came to replace the Keynesian doctrine and adopted by a majority as a doctrine that could solve the problem of stagflation it did not live up people's expectations.

If we analyze the reasons for the failure of monetarism, it is possible to identify following flaws of monetarist's doctrine: **firstly**, the priority of stabilization in economic policy, as well as the principle to gain stability at any costs have caused great damage to economic development. The principle of "growth through financial stabilization" has demonstrated its ineffectiveness in front of the "financial stability through economic growth" principle. **Secondly**, indicated inefficiency was associated with an incorrect interpretation of inflation causes. As noted above, the monetarist inflation is purely monetary in nature and is associated with an increase in money supply. Therefore, stabilization policy of monetarists in developing countries aimed at substantial reduction in money supply and was not aimed at eliminating other (non-monetary) causes of inflation. On the other hand, total reduction in money supply, which led to a decrease in solvency of population, reduction in financial resources of producers and increase in interest rates resulted in a negative impact on economic development.

1.3. New Neoclassical Synthesis: moderate inflation as a source of sustained economic growth rate

Despite the fact that many empirical studies confirm monetarists' doctrine of negative relationship between economic growth and inflation, it failed to explain the nature of economic processes (occurring during last 30 years) and has shown to be ineffective in the fight against stagflation in many countries. The reason for that is a recognition that excess money supply is the only source of inflation and priority of stabilization policy over the policy that promotes economic growth.

Practice has shown that inflation is a complex economic phenomenon, which depends not on one but on many factors. In addition, practice has proved the need of a set of measures in the fight against inflation which is not limited to the control over the money supply. The immediate fight against inflation through tough stabilization measures is not always effective in all countries. On the contrary, in some Asian countries economic policies that are directed at stimulation of production proved to be effective in promotion of economic growth and maintenance of low and stable prices.

For example, over the period 1967-1989 average inflation in South Korea was 7.4 percent while economic growth was around 6.2 percent. In China, from 1990 to 2003 despite the fact that the annual economic growth averaged to 8.2 percent the inflation rate was 5.6 percent. The same situation exists in India – during 1990-2003 with an average annual economic growth of 4 percent inflation remained at 8 percent (TDR 2005, UNCTAD). Monetary policy in these countries was aimed at creation of favorable conditions for economic growth, but not to fight the inflation. According to Trade and Development report of the UNCTAD in 2005: "**low interest rates, stable and relatively low exchange rate for the above mentioned countries favorably impacted the economy and became fundamental conditions for their development**". Thus, during the development of these countries interest rates were quite low: during the period of 1967-1986 in Korea average real interest rate (based on the key rate) was 0.6 percent, while in China over the period of 1990-2005 it remained at 3 percent. In addition to these countries, lending rates were extremely low that stimulated the formation of new capital and thus increased production. (TDR 2005, UNCTAD).

In contrast, countries of Latin America, Africa and former Soviet Union by setting a special role to financial stability and limiting money supply experienced hyperinflation and failed to ensure steady growth of the economy. Thus, the success of some Asian countries that used different ways in struggling with inflation and failure of Latin America, Africa and CIS countries have led to a rethinking of statements about the relationship between economic growth and inflation and methods to combat inflation.

Today, a new theory of neoclassical synthesis is regarded as an alternative monetarist doctrine, which is a synthesis of Keynesian and monetarist doctrines in new environment. New neoclassical synthesis is trying a new way to explain the specified relationship by using Keynesian and monetarist statement on the relationship between economic growth and inflation.

Firstly, new neoclassical synthesis (NNS) is neutral in explaining the relationship between economic growth and inflation. That is, it does not deny a positive or negative relationship between economic growth and inflation. However, moderate inflation may be a factor of sustainable growth.

Secondly, it proposes monetary policy aimed at planning the rate of inflation as the core economic policy, but warns about irregularity in constant focus of monetary policy in reduction of inflation. In some cases, monetary policy should be aimed at addressing the lack of production.

Thus, basic statements of new neoclassical synthesis representatives are as follows:

1) Basing on circumstances and time the first priority policies for economic growth and stabilization of prices may vary. That is, there is a concept in NNS of "optimal period of time",

which is used as the optimal time required to eliminate effects of shock changes and to return inflation to the target level. The success of this policy depends on the way of optimal length of time determination. For example, if central bank wants to return inflation to the target level in short period of time, meaning that optimum time is less than required, then it will lead to instability in production. Thus, NNS offers to set optimum period of time properly depending on the circumstances and nature of shock changes. If the optimum time is long this indicates the interest of the central bank to ensure stability in production. When the optimal time interval is short it becomes clear that the central bank is primarily concerned about price stability.

2) NNS determines the cause of inflation not only the excess weight, but also failure in production as one of the main factors. Thus NNS does not bind inflation with only one factor.

3) Another feature of NNS is to approve the effectiveness of the fight against inflation through interest rates. NNS proves the effectiveness of the use of interest rates as the main instrument of monetary policy, arguing the complexity and ineffectiveness in regulation of money supply in new environment.

1.4. Conclusions:

Exploring theoretical and empirical basis for the effects of inflation on economic growth it is possible to draw following conclusions:

Firstly, there is no rigid relationship between inflation and economic growth. That is, as evidenced by both theory and empirical research inflation can both positively and negatively affect the rate of economic growth. It should be noted that we are not talking about high inflation, which in any condition adversely affects the rate of economic growth.

Secondly, the degree and direction of inflation effect on economic growth depends on causes of inflation and general economic condition of the country. That is, inflation can either positively or negatively affect the rate of economic growth. For example, the cost-push inflation always negatively impacts economic growth because it reduces the competitiveness of domestic goods and services. Inflation which is associated with shock change in supply also affects the rate of economic growth due to various circumstances (natural disasters, revolution, war, accident, etc.) that reduce economic potential of the country. However, if changes in supply shock are caused not by internal, but external problems (reduction of economic potential in major importing countries), then it can have a positive impact on the economy if domestic entrepreneurs are able to take advantage of price increases of imported goods and increase their share in domestic market. If changes in the supply shock in trading partners mainly reflected in the production of intermediate goods and their prices and if the country is highly dependent on imports of intermediate goods, such inflation adversely affects the rate of economic growth as well as stimulates growth of costs, which reduces the competitiveness of domestic goods.

The extent and direction of the effect of inflation on the demand growth rate depends on general economic condition of the country. That is, if inflation is mainly due to an increase in effective demand that was caused by various external and internal factors (for example, growth in remittances, exports, government spending, as well as real wages and per capita income), this inflation may have a different impact on economic growth depending on general situation in the country. For example, if production in the country is on potential level and employment is at high level, then in situation with developed economy demand-pull inflation can provoke even greater rise in inflation and lower economic growth. There will begin competition for relatively scarce factors of production, which will trigger a rise in resource prices and cost of production. In turn, increase in production costs may adversely affect the rate of economic growth through loss of competitiveness.

If prices in the country, as well as wages are not flexible, the production is below the potential level and there is a sufficient number of entrepreneurs who are ready immediately increase production in response to increased demand and dependence on imports of consumer and capital goods is small, then the probability of a positive impact of such inflation on the rate of economic growth is very high. Firstly, this is due to the fact that small dependence of the country on imports of consumer and capital goods means that a large part of the increase in demand will be focused on domestic goods and services, thereby stimulating domestic entrepreneurs. Secondly, the availability of resources or factors of production makes it possible to expand production without increasing costs. Thirdly, price stickiness inflation reduces the real costs of production, which in the presence of relatively sufficient number of entrepreneurs stimulates growth of production.

If prices in the country are not flexible, production is below potential, but there are not enough entrepreneurs who are ready to immediately increase production in response to increasing demand for their products, as well as if the country is increasingly dependent on imports of consumer and capital goods such inflation may adversely affect the economy. Since the growth of effective demand stimulates imports more, which have a negative impact on economic growth. Thus in order to make inflation have positive effect on economic growth the government should strongly support the ability of local entrepreneurs to respond to increasing consumer demand through increasing production and preservation of competitive prices .

Thirdly, effectiveness of public policy depends on correct understanding of the nature and causes of the effects of inflation on economic growth that are set in empirical research. That is, as noted above, depending on the causes of inflation and general economic condition of the country inflation can have a different impact on economic growth. Therefore, only by correctly identifying the causes of inflation as well as by examining overall economic condition of the country it can become understandable the nature of inflation effects on economic growth and provided a concrete answer to the question regarding policies that should be adopted and to what they will lead. Therefore, to develop and implement economic policy solely on the basis of one empirical study of the effects of inflation on growth is erroneous and can lead to incorrect results. For example, if in the course of empirical research we found out that inflation has a negative impact on economic growth and not figuring out the nature of this relationship chose stabilization policy and launched harsh economic policies, but if inflation is caused by underproduction and there are not enough producers in the economy (who require widespread public support) capable of satisfying high-level needs of the domestic market, such policy will further exacerbate the situation. So, in this case it would be appropriate to conduct expansionary policy to solve the problem of underproduction and stabilize prices.

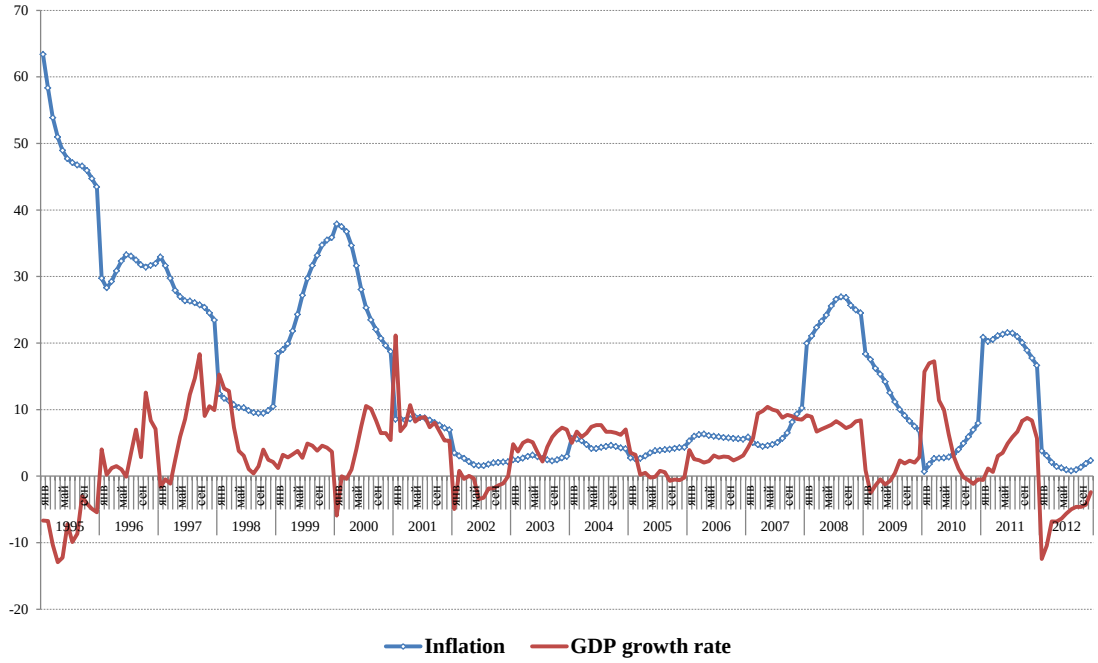
Conversely, if we have found a positive relationship between inflation and economic growth without knowing the reasons for such a connection and begun to neglect inflation and pursue expansionary policy: but if a positive relationship can be seen in connection with the approach of production to the potential level, such a policy might cause high inflation, which can be a cause of economic crisis.

Section 2. Empirical study of relationship between inflation and economic growth rate in Kyrgyzstan

2.1. Inflation and economic growth

The aim of the study is to identify the relationship between the dynamics of economic growth (GDP growth – GDP) and price changes (changes in CPI – CPI). The dynamics of these variables used in this study is from January 1994 to November 2012. To carry out the analysis of temporal data there was used monthly data in the form of growth rate of variables, calculated as a percentage to the previous year.

Picture 1. The dynamics of inflation and GDP growth
(rates, since the beginning of the year to the corresponding period of the last year)



Consumer price index (CPI) is used as a measure of inflation as a period to the corresponding period of the previous year; GDP growth rate was used as an indicator of economic growth as a period to the corresponding period of the previous year. Below are the main characteristics of data series.

Table.1. Main characteristics of data series.

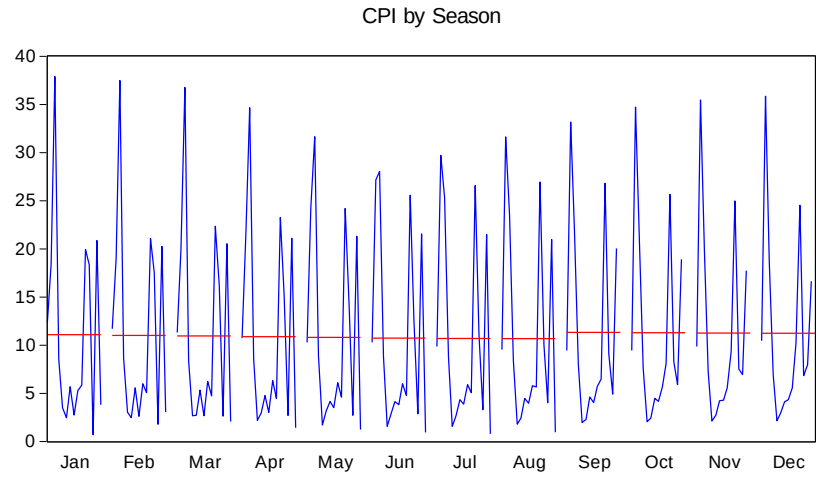
	CPI	GDP
Mean	134.748	101.787
Median	109.854	103.124
Maximum	721.383	121.158
Minimum	100.699	65.950
Std. Dev.	90.669	9.100
Skewness	4.666	-1.881
Kurtosis	25.091	7.666
Jarque-Bera	5439.455	339.768
Probability	0.000	0.000
Observations	227.000	227.000

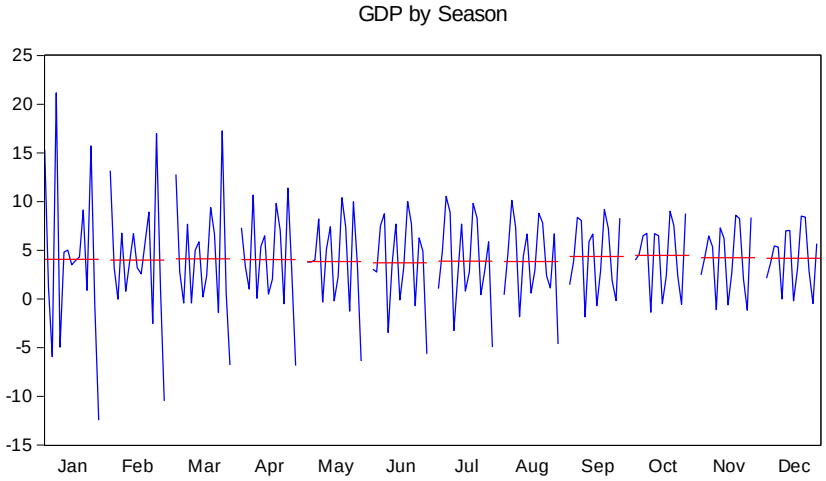
Seasonality analysis showed that all data series do not have seasonality problem, as the parameters of months included in the analysis were not statistically significant thus the null hypothesis of seasonality absence is taken.

Table.2. Analysis of seasonal fluctuations.

T-statistics probability of every month parameters		
	CPI	**GDP**
January	0.4348	0.6064
February	0.4947	0.5889
March	0.5448	0.5807
April	0.5932	0.5831
May	0.6573	0.5902
June	0.7167	0.6692
July	0.7831	0.7481
August	0.8363	0.8646
September	0.8917	0.9322
October	0.946	0.9485
November	0.9927	0.9319

Visual inspection of following graphs representing seasonality, which also indicate the absence of seasonal fluctuations in series.





2.2. Model construction of a relationship between inflation and economic growth

Construction of the model starts with an assessment of variables stationarity. To do this all of the data series are tested for the presence of unit roots. For this evaluation there was used a simple Dickey-Fuller (DF – Dickey Fuller) and extended Dickey-Fuller (ADF – Augmented Dickey Fuller) test.

In the first stage by the use of simple Dickey-Fuller equation there were identified types of extended Dickey-Fuller equations. As can be seen from the table below the ranks of CPI and GDP have statistically significant constant term and trend. Therefore, for testing the stationary of series there should be used the equation with constant term and trend.

Table 3. Check for the presence of a trend and constant term (Dickey-Fuller test)

	GDP	CPI
Constant term	96.73599 ***(0.0000)***	203.1200 ***(0.0000)***
Parameters of the trend	0.044701 ***(0.0000)***	-0.605065 ***(0.0000)***

The probabilities of T- statistics are in parentheses

The results of ADF-test of the initial time series (Table 4.) indicate that they are the rows of the I(0) form, meaning that they are stationary in levels.

Table 4. The results of unit roots presence

		GDP[1]	CPI[1]
		ADF-statistics: -4.040342 (0.0088)	ADF-statistics: -8.862745 (0.0000)
Significance level	1%	-3.999180	-3.999552
	5%	-3.429834	-3.430013
	10%	-3.138449	-3.138555

[1] – includes an intercept and a trend;
() – the probability of T- statistics

Given that all the series were stationary in levels, we can begin to construct a model and to determine the quantitative relationship between them. The first step in constructing the model is to determine the direction of causality between variables, that is, to determine which came first: inflation or economic growth.

Analysis of cause-and-effect relationship

To determine the cause-and-effect relationship between inflation and economic growth **Granger causality test was used.** Granger causality test is used to test empirically a statistically significant relationship between two variables and to determine the direction of the relationship. Analysis of cause-and-effect relationship between CPI (period to period) and economic growth (GDP growth during the period) is carried out using the following two equations:

$$GDP_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i GDP_{t-i} + \sum_{i=1}^{m} \beta_i CPI_{t-i} + \varepsilon_t \quad (1)$$

$$CPI_t = \chi_0 + \sum_{i=1}^{m} \chi_i CPI_{t-i} + \sum_{i=1}^{m} \delta_i GDP_{t-i} + v_t \quad (2)$$

Granger causality test results (Table 5.) indicate the presence of a unidirectional causal relationship between CPI and economic growth. That is, calculated F-statistics shows that «βi» parameters of the first equation (1) at 5 percent level of significance were not equal to zero. Conversely, «δi» parameters of the second equation (2) were not statistically significant. Thus, Granger causality test showed that CPI is the cause and consequence of economic growth. More precisely, the dynamics of CPI towards the economic growth rate has a one-way causal relationship, which is apparent from third to fifth lag. However, in first two lags there is a clear mutual influence of the variables on each other. Thus, the model will be specified by the following way: inflation is the cause, while economic growth is a consequence.

Table 5. Analysis of cause-and-effect relationship between GDP and CPI:

Granger causality test results:			
Lags	Causality direction	F-statistics	P-value
1	CPI ⟶ GDP	8.09905	0.0048
	GDP ⟶ CPI	9.31186	0.0026
2	CPI ⟶ GDP	3.51607	0.0314
	GDP ⟶ CPI	3.29188	0.0390
3	CPI ⟶ GDP	3.26626	**0.0222***
	GDP ⟶ CPI	1.36660	0.2539
4	CPI ⟶ GDP	2.39013	**0.0519***
	GDP ⟶ CPI	0.89545	0.4675
5	CPI ⟶ GDP	1.77364	**0.0961***
	GDP ⟶ CPI	0.60181	0.6986

** - Significant at 5-10 % significance level*

Regression analysis (Section 1)

Stationary of data series in levels, as well as the existence of a causal relationship between inflation and economic growth make it possible to carry out a regression analysis to calculate parameters of variables. In the first stage a regression analysis between CPI and economic growth is conducted.

It should be noted that in the regression analysis specially created dummy variable (DV) are used as exogenous variables besides the inflation. This is done in order to separately evaluate the impact of inflation on economic growth during various shocks. Given that young Kyrgyz economy is going through crises that are related to various internal and external shocks, it is important to assess how inflation affects the rate of economic growth during such crises. In this case, the binary variable «DV» has two values "0" and "1", where "0" values of DV reflect normal periods, while "1" – times of crisis. Thus, we have identified and included following shock periods to the model:

1. In 1994-1995 years economic instability, the period of high volatility of macroeconomic indicators;
2. May-December 2005 – negative impact of March 24, 2005 events;
3. January-July 2009 – negative impact of global financial and economic crisis;
4. August 2010 - February 2011 – negative impact of poor harvest of wheat and a ban on exports of wheat and flour outside the Customs Union;
5. January-November 2012 – Low gold production at "Kumtor" mine.

Below are the results of the regression estimates of the relationship between CPI and economic growth (Table 7). At first glance it seems that the model is statistically adequate, because the parameters of all variables are statistically significant and the determination coefficient R^2 is 77.5 per cent, meaning that fluctuations in CPI account for about 77 percent of economic growth fluctuations.

Table 7. Results of regression analysis:

Dependent Variable: GDP
Method: Least Squares
Date: 12/15/12 Time: 13:34
Sample (adjusted): 1994M01 2012M11
Included observations: 227 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI	-0.060038	0.003448	-17.41015	0.0000
DV	-9.367692	0.707485	-13.24084	0.0000
C	112.3532	0.516261	217.6287	0.0000

R-squared	0.775073	Mean dependent var	101.7871
Adjusted R-squared	0.773065	S.D. dependent var	9.100483
S.E. of regression	4.335264	Akaike info criterion	5.784570
Sum squared resid	4209.972	Schwarz criterion	5.829834
Log likelihood	-653.5487	Hannan-Quinn criter.	5.802835
F-statistic	385.9390	Durbin-Watson stat	0.528325
Prob(F-statistic)	0.000000		

Further analysis showed the presence of some problems in the regression analysis that needed to be solved. The determination coefficient R^2 was higher than the calculated Durbin - Watson value, raising suspicions regarding the correctness of the determinant R^2 value. Thus, in order to confirm or reject it there was performed analysis for the presence of high level autocorrelation. By using LM-test for autocorrelation analysis there was found the presence of autocorrelation in the model of the first level “AR (1)”, which confirms our suspicion and requires the removal of autocorrelation. To eliminate the autocorrelation there was used Autoregressive transformation of the first order (the method of Cochran-Orkata).

Now let’s estimate the results of the regression analysis (Table 8). As we can see, the coefficient of determination is lower than in the first estimate, and the estimated value of the Durbin-Watson is greater than the coefficient of determination and is close to "2" (which indicates the absence of autocorrelation). Regarding the parameters of the equation, we can say that they are statistically significant in the regression models, as the p-values of all parameters are less than 5 percent level of significance.

Table 8. The results of regression analysis:

Dependent Variable: GDP_1-(0.731188*GDP_1(-1))
Method: Least Squares
Date: 12/17/12 Time: 09:57
Sample (adjusted): 1994M02 2012M11
Included observations: 226 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI_1-(0.731188*CPI_1(-1))	-0.074993	0.012195	-6.149379	0.0000
DV	-2.840188	0.483458	-5.874731	0.0000
C	1.802014	0.228645	7.881266	0.0000

R-squared	0.321391	Mean dependent var	0.625431
Adjusted R-squared	0.315305	S.D. dependent var	3.554462
S.E. of regression	2.941185	Akaike info criterion	5.008688
Sum squared resid	1929.077	Schwarz criterion	5.054093
Log likelihood	-562.9817	Hannan-Quinn criter.	5.027012
F-statistic	52.80675	Durbin-Watson stat	2.034900
Prob(F-statistic)	0.000000		

Testing of Regression Models on autocorrelation of high level (Table 10) shows that there is no autocorrelation in the model. Here was used a Breusch-Godfrey test, which checks a high degree of autocorrelation.

Table 10. Checking the autocorrelation by using Breusch-Godfrey test:

Results of LM – test:	
p-value obs*R^2 LM – test:	
AR(1)	(0.7807)
AR(2)	(0.3411)
AR(3)	(0.5325)
AR(4)	(0.6794)
AR(5)	(0.7428)

Testing of the model on the lack of descriptive error confirms the acceptance of null hypothesis that there are no descriptive errors that indicate functionally acceptable construction of the model and choice of variables.

Table 11. Testing the model on the lack of descriptive error:

		p-value of the test **Ramsey RESET**: (0.2258)
Significance level	1%	absent
	5%	absent
	10%	absent

The constancy or equality of error variances is essential for the quality of the regression model. The constancy of error variances is called homoscedasticity, while inconstancy –

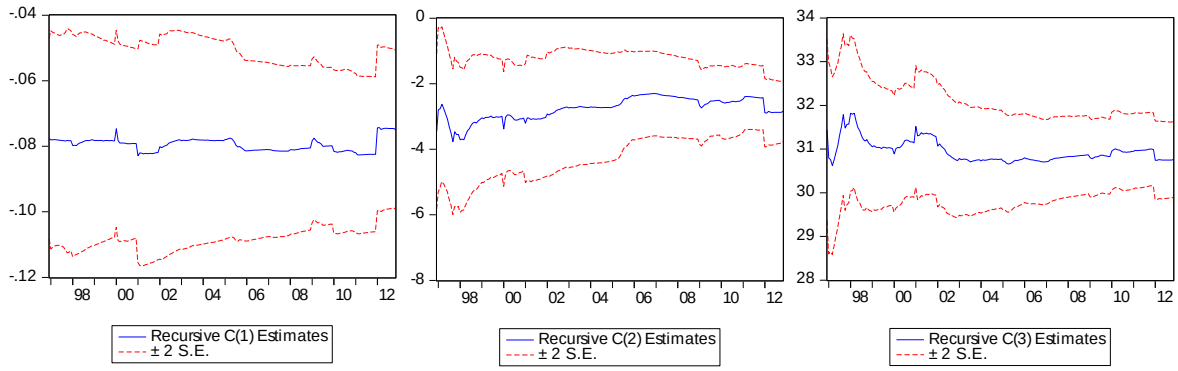
heteroscedasticity. Here was used a simple and most commonly used test for homoscedasticity – White's test. In accordance with the results of this test (Table 12) there was confirmed homoscedasticity of the model residuals at all levels of significance.

Table 12. Testing for the presence of homoscedasticity residuals:

		White HeteroskedasticityTest: obs*R-squared= 0.754555 Probability(0.6857)
Significance level	1%	homoscedasticity
	5%	homoscedasticity
	10%	homoscedasticity

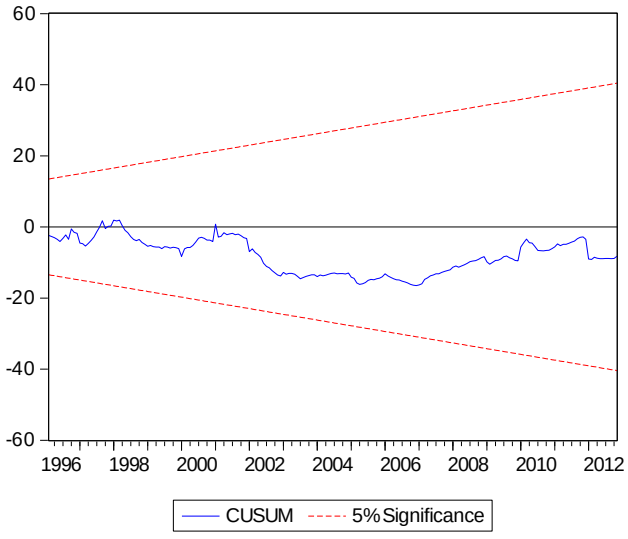
Below in Figure 1 are recursive estimates of regression coefficients and residuals of the model with a 95 percent calculated confidence interval. Graphs show that residuals of the model do not significantly extend beyond the 95 percent confidence interval, indicating stability of model coefficients to changes in the size of the sample for evaluation that allows to conclude a stability of the model.

Picture 2. Recursive estimation of regression coefficients and residuals of the model:



The stability of the model and stability of its predictive capability are checked on the basis of *CUSUM* test. There are pictures below, which show the amounts of model's recursive residual. The figure shows that the recursive residuals do not significantly exceed 95 percent confidence interval, indicating the stability of the model and its high predictive ability.

Picture 3. Sum of recursive residuals of the model (CUSUM test)



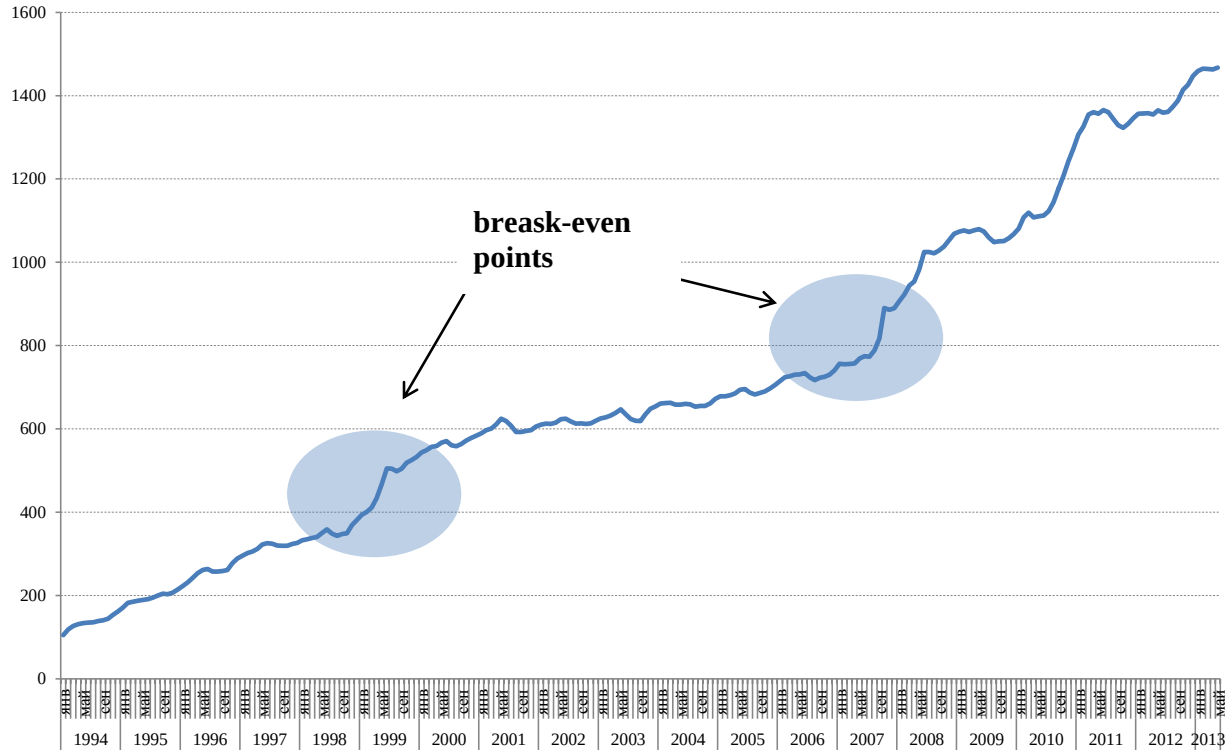
Summarizing all the tests it can be said that the model is statistically adequate and stable. The regression results indicate that CPI affects the rate of economic growth in the period under review (1994-2012). In particular, the increase in consumer prices (from period to period) by one unit is accompanied by a negative contribution to GDP growth rate of -0.075 units. In times of crisis the negative impact of CPI on economic growth rate increases and is -2.84 units. Autonomous growth of GDP is 1.8 percent. In accordance with the parameters of the model the resulting fluctuations in CPI explain about 32 percent of GDP fluctuations.

Regression analysis (Section 2)

The regression modeling that is indicated above is common to the whole sample that is **average response** of economic growth rate to changes in inflation over the period from 1994 to 2012. The structure of the economy of Kyrgyzstan from 1994 to 2012 **was not uniform** and relationship of inflation and the rate of economic growth is different in different periods as evidenced by the dynamics of CPI in Kyrgyzstan from 1994 to 2012. Figure 3 below shows the break points in the trend of inflation, which in turn indicates structural changes in the economy.

Picture 4. Consumer price indices in Kyrgyzstan

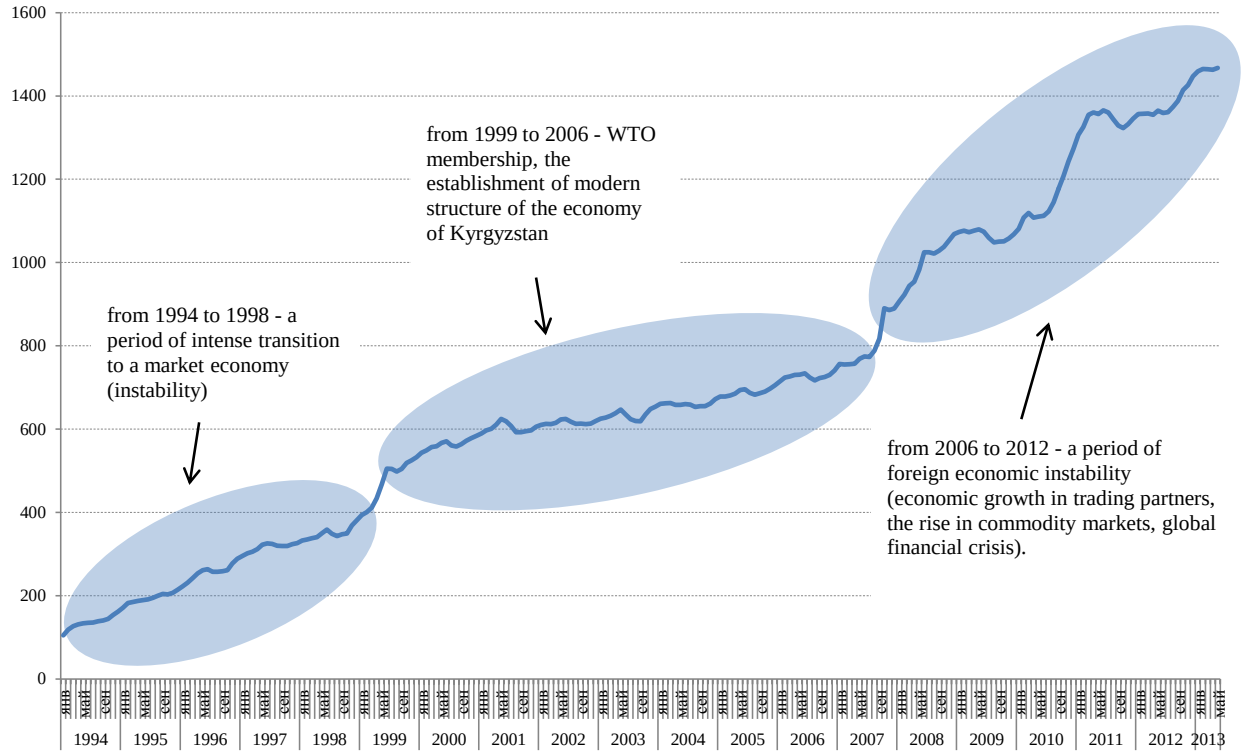
(rates, the December of 1993 = 100 percent)



Given the historical stages of development of Kyrgyz economy, in our view it would be logical to divide the economy from 1994 to 2012 into three periods:

1. from 1994 to 1998 – a period of intense transition to a market economy (instability);
2. from 1999 to 2006 – WTO membership, the establishment of modern structure of the economy of Kyrgyzstan;
3. from 2006 to 2012 – a period of foreign economic instability (economic growth in trading partners, the rise in commodity markets, global financial crisis).

Picture 5. Periods of economic development in Kyrgyzstan
(rates, the December of 1993 = 100 percent)



Further we will try to analyze the relationship between inflation and GDP growth rates in these periods.

1. Analysis of the relationship between inflation and economic growth rates from 1994 to 1998 – instability

Table 13. Relationship between inflation and economic growth rates from 1994 to 1998
(including the conversion of Cochran-Orkata)

Dependent Variable: GDP_1-(0.742517*GDP_1(-1))
Method: Least Squares
Date: 12/17/12 Time: 10:39
Sample (adjusted): 1994M02 1998M12
Included observations: 59 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI_1-(0.742517*CPI_1(-1))	-0.080068	0.016867	-4.746894	0.0000
DV	-2.943305	0.989542	-2.974412	0.0043
C	2.040849	0.550907	3.704525	0.0005

R-squared	0.507997	Mean dependent var	-0.395768
Adjusted R-squared	0.490425	S.D. dependent var	4.570409
S.E. of regression	3.262564	Akaike info criterion	5.252413
Sum squared resid	596.0822	Schwarz criterion	5.358051
Log likelihood	-151.9462	Hannan-Quinn criter.	5.293650
F-statistic	28.91019	Durbin-Watson stat	2.010799
Prob(F-statistic)	0.000000		

Table 14. Test results on the lack of descriptive error, heteroscedasticity of residuals, autocorrelation in the model (1994-1998):

		Ramsey RESET Test:	**White HeteroskedasticityTest:**	**Breusch-Godfrey LM Test[1]:**
		Log likelihood= 4.875 Probability(0.1074)	N*R-squared= 3.064592 Probability(0.216)	N*R-squared= 1.6360 Probability(0.4413)
Significance level	1%	H_0	H_0	H_0
	5%	H_0	H_0	H_0
	10%	H_0	H_0	H_0

2. Analysis of the relationship between inflation and economic growth rates from 1999 to 2006 - WTO membership, the establishment of modern structure of Kyrgyz economy

Table 15. Relationship between inflation and economic growth rates from 1999 to 2006
(including the conversion of Cochran-Orkata)

Dependent Variable: GDP_1-GDP_1(-1)*0.494442
Method: Least Squares
Date: 12/17/12 Time: 10:40
Sample: 1999M01 2006M12
Included observations: 96

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI_1-CPI_1(-1)*0.494442	-0.091774	0.049774	-1.843826	0.0684
DV	-4.005626	0.746050	-5.369109	0.0000
C	3.068846	0.415388	7.387905	0.0000

R-squared	0.236859	Mean dependent var	1.923143
Adjusted R-squared	0.220447	S.D. dependent var	2.934269
S.E. of regression	2.590733	Akaike info criterion	4.772510
Sum squared resid	624.2065	Schwarz criterion	4.852646
Log likelihood	-226.0805	Hannan-Quinn criter.	4.804902
F-statistic	14.43236	Durbin-Watson stat	2.069866
Prob(F-statistic)	0.000003		

Table 16. Test results on the lack of descriptive error, heteroscedasticity of residuals, autocorrelation in the model (1999-2006):

		Ramsey RESET Test:	**White HeteroskedasticityTest:**	**Breusch-Godfrey LM Test:**
		Log likelihood= 2.036 Probability(0.3613)	N*R-squared= 0.302995 Probability(0.8594)	N*R-squared= 2.25584 Probability(0.3237)
Significance level	1%	H_0	H_0	H_0
	5%	H_0	H_0	H_0
	10%	H_0	H_0	H_0

[1] Here and throughout the paper, Breusch-Godfrey LM Test tests the hypothesis that there is no autocorrelation of the **second** level, Durbin-Watson stat shows the absence of autocorrelation of the **first** level.

3. Analysis of the relationship between inflation and economic growth rates from 2007 to 2012 – a period of foreign economic instability

Table 17. Relationship between inflation and economic growth rates from 2007 to 2012
(including the conversion of Cochran-Orkata)

Dependent Variable: GDP_1-GDP_1(-1)*0.689844
Method: Least Squares
Date: 12/17/12 Time: 10:40
Sample (adjusted): 2007M01 2012M11
Included observations: 71 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI_1-CPI_1(-1)*0.689844	0.185449	0.096259	1.926557	0.0582
DV	-3.284654	0.760801	-4.317364	0.0001
C	1.394175	0.549991	2.534908	0.0136

R-squared	0.277552	Mean dependent var	1.128208
Adjusted R-squared	0.256304	S.D. dependent var	3.290794
S.E. of regression	2.837909	Akaike info criterion	4.965347
Sum squared resid	547.6536	Schwarz criterion	5.060953
Log likelihood	-173.2698	Hannan-Quinn criter.	5.003367
F-statistic	13.06222	Durbin-Watson stat	1.373147
Prob(F-statistic)	0.000016		

Table 18. Test results on the lack of descriptive error, heteroscedasticity of residuals, autocorrelation in the model (2007-2012):

		Ramsey RESET Test:	**White HeteroskedasticityTest:**	**Breusch-Godfrey LM Test:**
		Log likelihood= 1.084 Probability(0.5814)	N*R-squared= 0.398197 Probability(0.8195)	N*R-squared= 3.6508 Probability(0.1612)
Significance level	1%	H_0	H_0	H_0
	5%	H_0	H_0	H_0
	10%	H_0	H_0	H_0

The results of the regression analysis of the relationship of inflation and economic growth for the period from1994 to 1998 and from 1999 to 2006 indicate a negative relationship between these indicators, which is largely due to the consequences of "painful" transformation of the economy in 1994-1998 and a period of stabilization of Kyrgyz economy in 1999-2006.

Mechanisms of transition to market economy and its consequences (1994-1998 – Price liberalization, the destruction of old structure of the economy) at the same time stimulated high inflationary background and reduced the potential for economic growth. Thus, the link between economic growth and inflation in this period was characterized by inversely proportional dependence. In particular, 10 percent increase in consumer prices is caused by a negative contribution to GDP growth of 0.8 percent, where the inflation fluctuations during this period were explained by an average 50 percent growth in GDP fluctuations. Average consumer price growth in this period was about 58 percent, GDP declined by an average of 1.28 percent.

In 1999-2006 there was also noted inverse relationship between inflation and economic growth. Parameters of this dependence are characterized as follows: 10 percent increase in inflation caused negative contribution of 0.9 percent, but inflation fluctuations described about 23 percent of fluctuations in economic growth. During this period Kyrgyz economy was characterized by stabilization of development conditions. Kyrgyzstan's membership in WTO led

to the formation of modern structure of the economy: the development of trade, transport and communications. For example, if in 90th the share of trade in GDP was around 10 percent, later in 2006 this indicator came to 18.4 percent, the sector of "communication and transport" increased by two times – from less than 3 percent of GDP in the end of 90th to 6.1 percent in 2006. For the same period the share of agriculture in GDP declined from 35 percent till 28.7 percent. Average increase of GDP in this period was 3.9 percent, while average increase in consumer prices was around 10 percent.

In 2007-2012 the relationship between economic growth and inflation changed and was characterized by a positive relationship that is: the rise in consumer prices during this period was accompanied by a rise in economic activity. Thus, the elasticity index of inflation and GDP growth amounted to +0.185, in other words, an increase in inflation by 1.00 percent followed by 0.18 percent growth in GDP on average over the period from 2007 to 2012.

In the discussed period can be emphasized certain years which are vividly characterized by positive correlation of inflation and economic growth. For example, in 2007-2008 Kyrgyzstan's economy showed dynamic growth, the development of such industries as construction, transport and communications, trade and industry. Increased economic activity in Kyrgyzstan at the time was largely provided by the growing demand for exports from the country's main trading partners (Russia, Kazakhstan), the rapid growth of remittances in Kyrgyzstan (mainly from Russia) and an increase in investment activity in Russia and Kazakhstan on the territory of our country.

The growth of economic activity in Kazakhstan and Russia was defined by significant increase in prices for major exports of these countries (food and energy), which in turn stimulated the growth of consumer prices both in Kyrgyzstan and in the region.

Overall GDP growth in 2007-2008 was more than 8 percent annually, while annual rate of inflation in these years was more than 20 percent.

However, positive relationship between inflation and economic growth in the economy can exist only in the presence of a certain stock, that is, additional capacity of the economy, which can be employed in the event of a demand, or other favorable conditions for selling/marketing. In other words, manufacturers will be able to increase the output in response to the rise in prices only when there is not brought in play production factors. Assessment of such stocks may serve as indicator of *GDP gap*.

GDP gap – the difference between actual GDP and its potential amount. It is calculated as the ratio of the actual and potential GDP: $GAP_t = \frac{GDP_t}{GDP\_POT} - 1$ where:

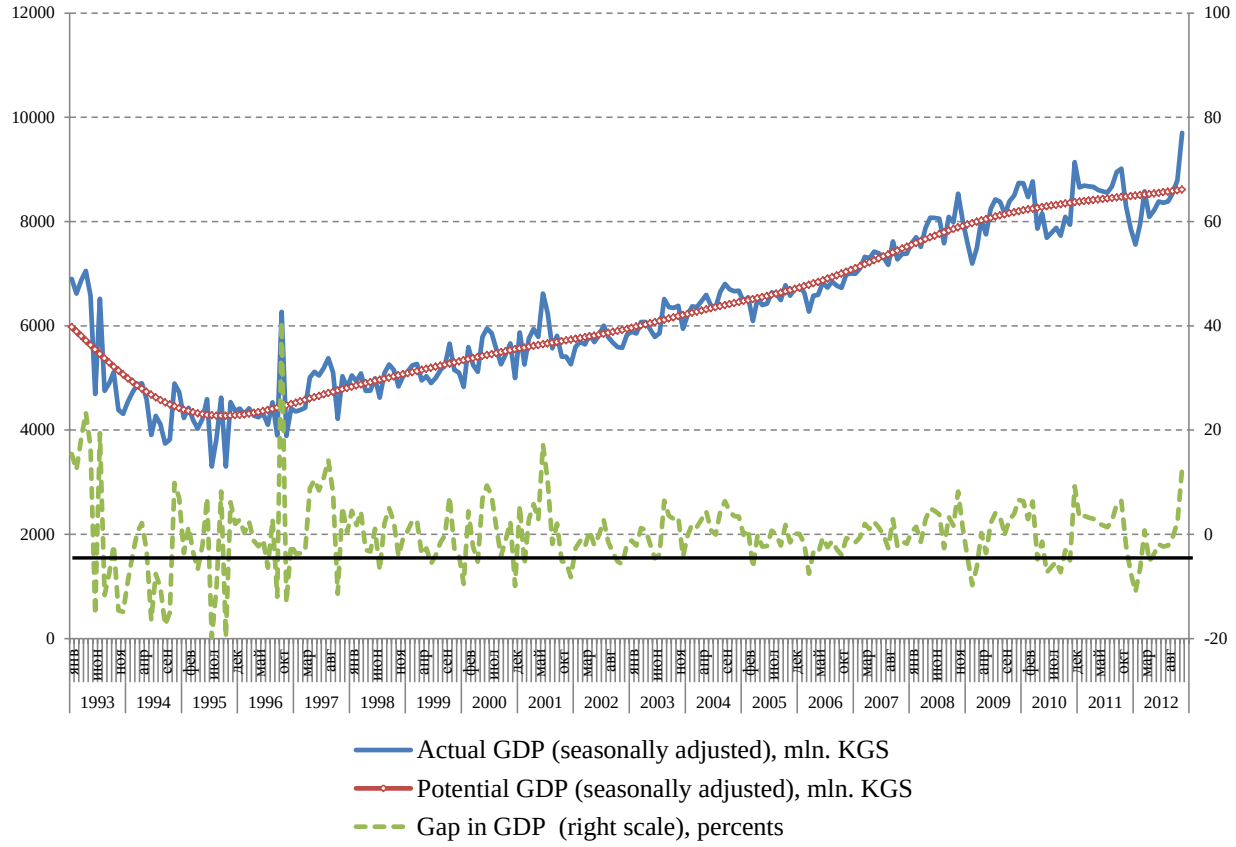
GAP_t – the gap in GDP at time t;

GDP_t – actual GDP at time t;

GDP_POT – potential GDP.

Potential GDP – is GDP that is maximum attainable with **full** use of all available resources. In this paper, a reasonable estimate of potential GDP in Kyrgyzstan can be obtained based on the Hodrick-Prescott filter (Hodrick-Prescott filter). Obtained based on the Hodrick-Prescott filter gap of Kyrgyzstan's GDP is represented in the following figure:

Picture 6. GDP gap in Kyrgyzstan (1993-2012)



GDP gap in the analyzed period is showing the fact that in most cases the output gap was negative. That is, the actual level of GDP was less than the potential and the economy did not use the full potential of its capacity.

Table 19. GDP gap in Kyrgyzstan (1993-2012)

	Actual GDP, mln. KGS	Potential GDP, mln. KGS	Gap in GDP percent
1993	65 820,8	66 118,0	-0,4
1994	52 601,8	56 071,6	-6,2
1995	49 748,8	51 673,9	-3,7
1996	53 273,2	52 588,4	1,3
1997	56 088,9	56 019,1	0,1
1998	56 434,6	59 424,4	-5,0
1999	59 016,7	62 447,4	-5,5
2000	61 909,3	65 346,6	-5,3
2001	63 823,9	67 819,2	-5,9
2002	65 828,6	70 091,7	-6,1
2003	69 387,3	72 994,2	-4,9
2004	74 665,9	76 128,3	-1,9
2005	76 060,7	79 039,1	-3,8
2006	80 430,7	82 731,6	-2,8
2007	87 669,5	87 735,0	-0,1
2008	93 368,0	92 890,2	0,5
2009	96 514,1	96 942,5	-0,4
2010	95 512,7	99 562,7	-4,1
2011	100 882,7	101 253,2	-0,4

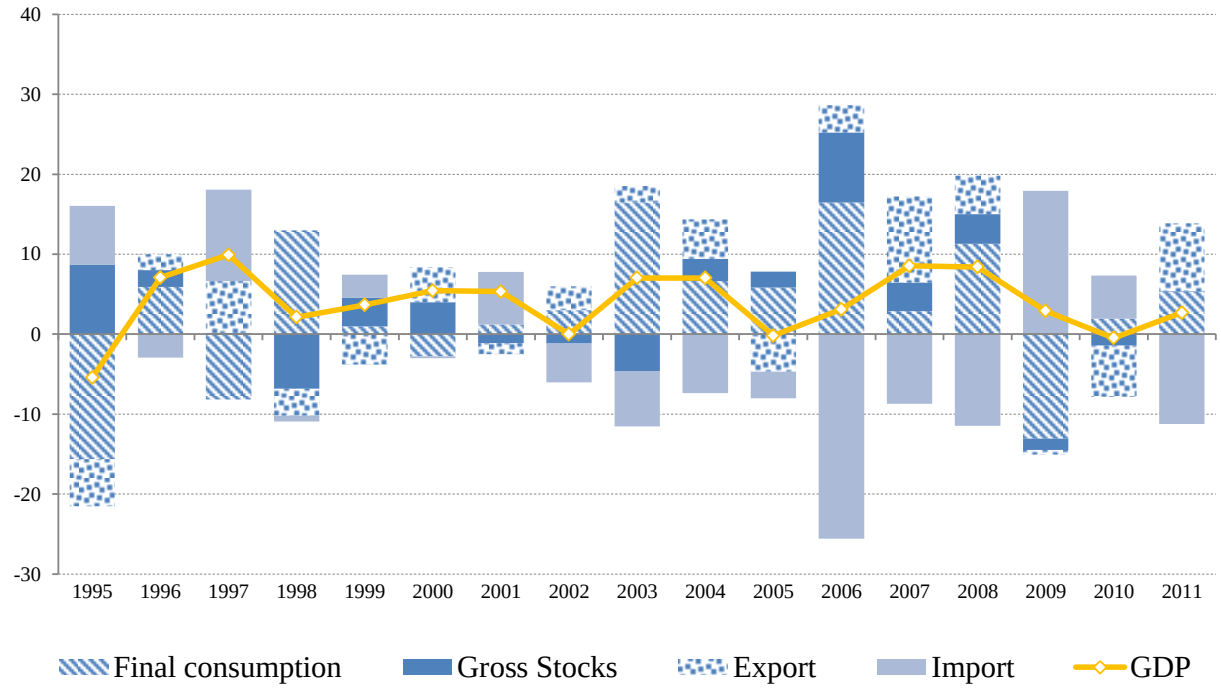
Therefore, positive relationship between economic growth and inflation is possible in all the analyzed period.

Conclusion

Negative relationship between inflation and economic growth that was revealed on average for the period from 1994 to 2012 was largely due to the predominance of special conditions in Kyrgyz economy and monetary causes of inflation in this period.

The collapse of the Soviet economic structure and economic relations between former Soviet republics led to high dependence on imports of Kyrgyzstan's economy, including consumption and investment. Moreover, with the entry of Kyrgyzstan into WTO and the simultaneous membership in EurAsEC the trade sector received rapid development that is the growth export that is emerging through the re-export from China to the Eurasian Economic Community also formed by imports. In other words, all the sources of economic growth (consumption, investment and exports) are formed at the expense of imports.

Picture 7. Dynamics of Economic Growth in Kyrgyzstan (1995-2011)
(percent)



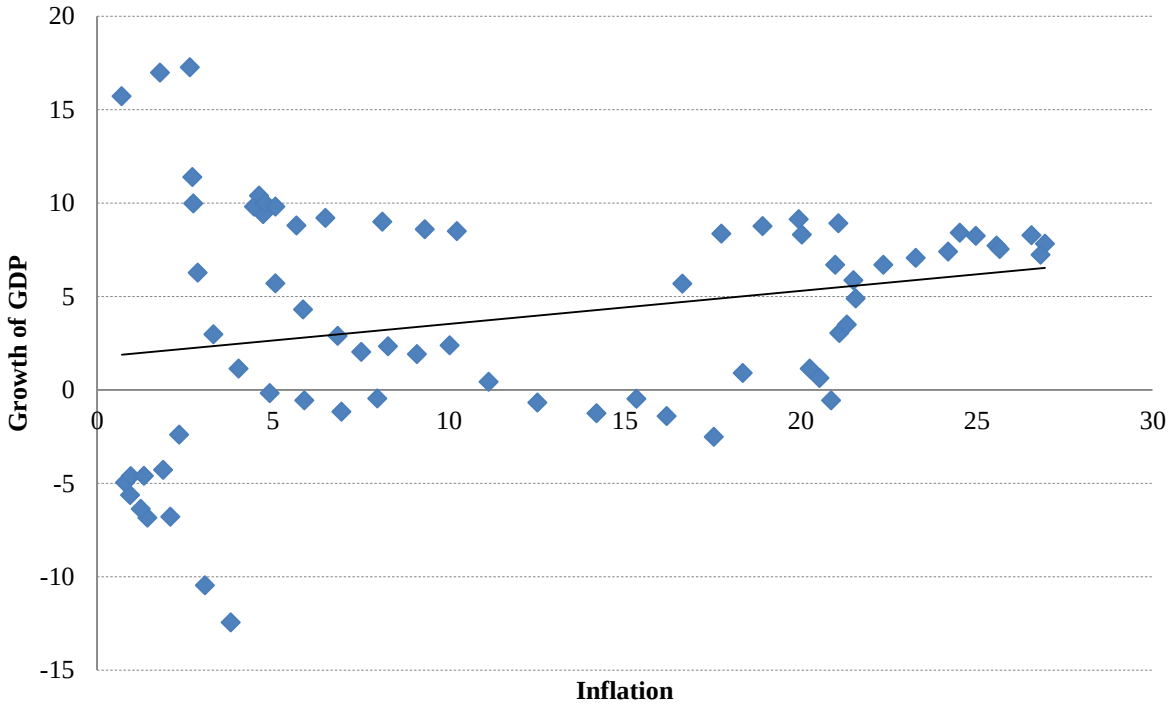
The marginal propensity to consume is at a very high level in Kyrgyz economy, respectively, the share of savings in income of economic agents is low (about 5 percent by authors' calculations).

Thus, in the case of price level growth economic agents will be less able to compensate for the rising costs of maintaining the current level of consumption at the expense of their savings. If the rise in prices in the economy develops due to increase in the cost of imports, which happens in most cases, then most of the income of the economy will go out of the country without taking part in economic growth. On the whole, the increase in the price level reduces the amount of consumer and investment demand in the economy of Kyrgyzstan, which in turn stimulates economic slowdown. This dependence has led to a negative link between economic growth and inflation in the economy of Kyrgyzstan in 1994-2006.

However, recently income growth in the economy, which is emerging due to the growth in workers' remittances made some adjustments in the relationship of economic growth and inflation. Thus, a positive link between economic growth and inflation that occurred in 2007-2012 was due to the fact that the causes of inflation and economic growth in Kyrgyzstan may be one and the same, namely the growth of economic activity in the countries that are our major

trading partners (they are also the countries, which are main recipients of labor migration from Kyrgyzstan). Thus, economic growth in trading partners, which stimulates the growth of remittances occurs mainly due to increase in prices on world commodity markets, which in turn stimulates the growth of consumer prices.

Picture 8. The relationship between economic growth and inflation in 2007-2012
(percent)



On the part of the national accounts the positive link between economic growth and inflation is as follows: the growth in remittances in Kyrgyzstan, as a consequence of economic growth in recipient countries, labor migration, fully compensates rising cost of Kyrgyz imports as a result of rising prices on the world commodity markets. Thus, the growth of remittances helps to maintain the current level of consumption and investment and even increase their volume, which in turn will stimulate economic growth.

In our view the relationship between economic growth and inflation will remain positive as long as the income from remittances will have a significant impact on the amount of gross disposable income of Kyrgyz economy. To date the share of remittances is about 25 percent of gross disposable income of Kyrgyz economy.

Summarizing the information regarding the relationship between economic growth and inflation, it is safe to say that there are some tight connections between these parameters. Inflation can both positively and negatively affect the rate of economic growth, as evidenced by both theory and empirical research and as was previously noted there is a need in studies on the relationship between inflation and economic growth rate but are not sufficient for the development of effective economic policy.

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