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МОДЕЛИРАНЕ НА ИНФЛАЦИОННИТЕ ПРОЦЕСИ В УЗБЕКИСТАН НА ОСНОВАТА НА НОВАТА КЕЙНСИАНСКА КРИВА НА ФИЛИПС

Сардор Садиков

MODELLING OF INFLATIONARY PROCESSES IN UZBEKISTAN ON THE BASIS OF THE NEW KEYNESIAN PHILIPS CURVE

Sardor Sadykov [1]

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Abstract

The paper presents the results of an empirical evaluation of various types of new Keynesian Phillips curves for modeling inflation dynamics in Uzbekistan in particular, was rated "standard" form of the new Keynesian Phillips curve, its modification for a small open economy, as well as a hybrid form of this curve, which, along with the rational (being proactive (forward-looking)) inflation expectations also considers adaptive (nasal spray (backward-looking)) inflation expectations.

According to the results of the evaluation of the new Keynesian curves of Phillips, the degree of influence of forward-looking inflation expectations and the deviation of the average marginal cost of production from the equilibrium level on inflation in Uzbekistan were determined, additional macroeconomic factors of inflation were identified, and the degree of relevance of the inflation expectations in relation to inflation and its comparison with the degree of influence on inflation of forward-looking inflation expectations was calculated.

The results of the study can be used to improve the efficiency of the development and implementation of monetary policy in Uzbekistan within the framework of the inflation targeting regime. Also, this study can serve as a basis for further modeling of economic processes in the framework of the approach of the new Keynesian theory in Kazakhstan and in other countries with economies in transition.

[1] Student of the Master's programms in Applied Economics, National Research University „Higher School of Economics“, e-mail s.sadykov@edu.hse.ru

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JEL Codes: *C36, D84, E31, E52*

After the change of power in Uzbekistan, reforms began. The new head of the Central Bank of Uzbekistan has been tasked with successfully applying the inflationary trade regime. To date, the stability and the limitation of inflation processes is the main objective of the Central Bank of the Republic of Uzbekistan, however, from September 2017, the Central Bank of the Republic of Uzbekistan Announced plans to switch to the inflation targeting regime until 2020. In this regard, the task of analyzing, modeling and forecasting the dynamics of inflation processes in Uzbekistan to effectively implement the monetary policy of the Central Bank, contributing to the stable development of the economy of Uzbekistan.

It should be noted that in the development of monetary policy within the framework of the inflation targeting regime, special attention is paid to the quantitative assessment and analysis of the relationship of inflation with the current level of inflation. This allows the regulator to create and take appropriate measures to influence the inflation expectations of economic agents to achieve the set medium-term inflation target. At the same time, it is important to assess and analyze additional macroeconomic factors of inflation. Thus, timely localization of various shocks, correctly analyzed inflation factors, in case of their causes can prevent price level jumps in the economy.

The choice of the analyzed period is explained by what happened in the beginning of 1996, and on the eve of the year, which was the starting point for the stabilization and further development of the economy after the collapse of the Soviet Union, clearly sets the task of reducing inflation. In addition, this shelter is associated with the diversification of the economy of Uzbekistan.

One of the features of this work is the use of the core inflation index in the modeling of inflation processes, which excludes the impact of administrative measures on pricing processes and the impact of volatile components such as prices for fruit and vegetable products and fuel. And in modern economic science one of the advanced directions theoretical and applied modeling of inflation dynamics the processes are a new Keynesian Phillips curve (NKPC, the New Keynesian Phillips Curve). Thus, the NKPC assessment allows to determine the degree of the impact on inflation of inflation expectations, marginal cost deviations of producers from the equilibrium level and other additional factor variables, the set of which may vary depending on the country under analysis.

The object of the study are the macroeconomic processes associated with the conduct of modern monetary policy of the Central Bank of Uzbekistan. The subject of the

study is the features of the impact of selected macroeconomic variables on the inflation process in Uzbekistan. In this regard, this paper presents the implementation of the "classical".

NKPC, as well as its various modifications for dynamics modeling inflation processes in Uzbekistan. At the same time, the goal this study was conducted to obtain answers to the following questions:

1. What is the impact of forward-looking (forward-looking) inflation expectations for current inflation in Uzbekistan?

2. As in the short term for current inflation in Uzbekistan the impact of the deviation of marginal production costs from equilibrium level approximated through the gap of the industrial production?

3. What are the additional factors of inflation in Uzbekistan?

4. Does the current inflation in Uzbekistan affect the (backward-looking) inflation expectations, and how they compare to by being proactive (forward-looking) inflation expectations?

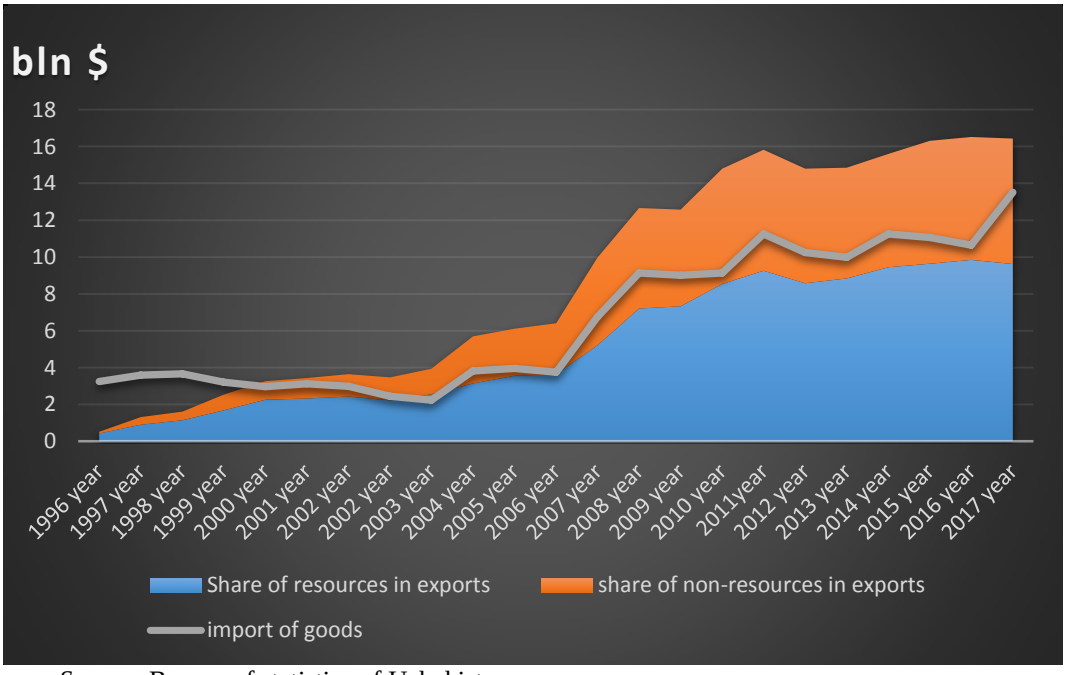
It should be noted that the answers to the previously listed questions received during this work can be applied in the future to improve the efficiency of the development and implementation of monetary policy in Uzbekistan within the framework of the inflation targeting regime. In addition, this study can serve as the basis for the subsequent modeling of economic processes in the framework of the approach of the new Keynesian theory in Uzbekistan.

For model evaluation with respect to inflation in Uzbekistan monthly empirical data from the first quarter of 1996 to the fourth quarter of 2017 were used. The generalized method of moments (GMM, the Generalized Method of Moments) was used as a method of econometric evaluation of the model. The use of GMM for estimation is associated with the emergence of the problem of endogeneity in the model due to the inclusion of forward-looking inflation expectation approximated as actual future inflation. So, in case of application to the model with endogeneity of the classical least square's method (OLS, the Ordinary Least Squares) parameter estimates will be shifted.

This work includes two chapters and six blocks: The First Chapter is the modeling of monetary policy in Uzbekistan. Macro-economic processes in Uzbekistan in 1996-2017. Main methods of applying monetary policy: a literature review. Inflationary processes in Uzbekistan Chapter. Theoretical model of monetary policy. The Theoretical aspects of the methodology of the study. Empirical results on long-term relationship between inflation, output, interest rate, exchange rate and foreign exchange reserves. The empirical model.

Thanks to the implementation of its own development model in 1996, Uzbekistan, in the shortest period compared to other republics of the former Soviet Union, stopped the economic recession, provided macroeconomic stability and began to implement the main economic tasks associated with the structural transformation of the economy. Favorable

price conditions in the world market of hydrocarbons and gold allowed Uzbekistan to receive high revenues from exports of cotton, gold and gas. Their share of export facilities was about 90 percent in the late 90s. Gradually, the share fell to 60 percent in 2010. As a result of the significant inflow of foreign currency to the Uzbek market, the so-called current account balance in the balance of payments remained significantly positive throughout the analyzed period, thereby creating conditions for strengthening the Uzbek sum. However, officially the Uzbek sum strengthened, but on the black market the Uzbek sum lost its position, and this led to a rapid growth of imports and undermined the competitiveness of domestic goods. As shown in Fig. 1.1, the share of resource exports in total merchandise exports has been steadily increasing, reaching 65% in 2012, an increase of 30% from 45% in 2002. Imports of goods were fully covered by exports, in addition, its dynamics followed and corresponded to the dynamics of exports. The growth rate of imports of goods was higher than the corresponding values for the growth of total exports.



Source: Bureau of statistics of Uzbekistan

With the strengthening of prices for resources of Uzbek sums not strengthened, but rather fell. Producers of import-substituting industries have not been able to reduce costs to the same extent as their competitiveness. Because of high global gas and gold prices, the effects are manifested in a disproportionately high recovery in one sector of the economy, which has not had a negative impact on other sectors of production by

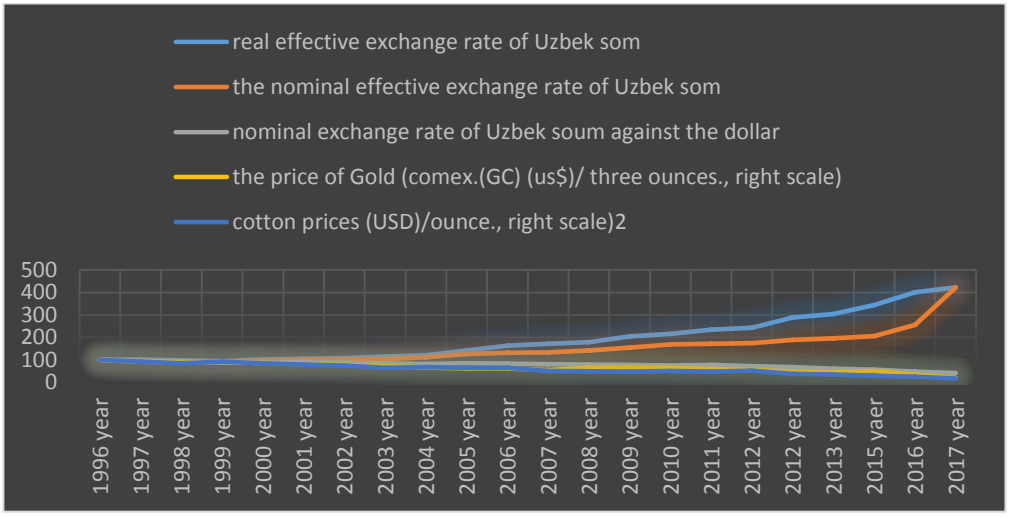
strengthening the real exchange rate. This fact was considered in the monetary policy, and the Central Bank of Uzbekistan did not react to this and did not take measures to maintain the stability of the exchange rate and control its strengthening against the dollar. However, if we define the real effective exchange rate of Uzbek sum (UZSEER) the following image:

$$\text{UZSEER} = \frac{\text{NEER x UZS}}{UZS*} \text{ where:}$$

- UZSEER real effective exchange rate of the UZB sums
- NEER nominal effective ruble exchange rate ($\frac{foreign\ currency}{\#1UZS}$)
- UZS* price index abroad
- UZS price index for Uzbekistan

It can be seen from Figure 1.2 that UZSEER has significantly strengthened during the period under review (approximately by 60 %). In connection with the crisis of 2008-2009 and a significant reduction in the price of resources (except gold) in the fourth quarter of 2008 and in the first quarter of 2009, the real effective rate of the Uzbek sums depreciated by more than 25% compared to the maximum of October 2008, but later as a result of the newly formed favorable external economic situation UZSEER began to grow again, reducing the competitiveness of domestic goods. This shows that the state of the economy depends heavily on the external conditions in the world energy markets.

Figure no. 1.2. Dynamics of the real effective and nominal rate of Uzbek soums (index, January 1996 = 100) + (strengthening)/-(depreciation), as well as the price of cotton and gold.



Sources: Bank for International Settlements on a basket of currencies, considering 48 the country, and the Asian Development Bank

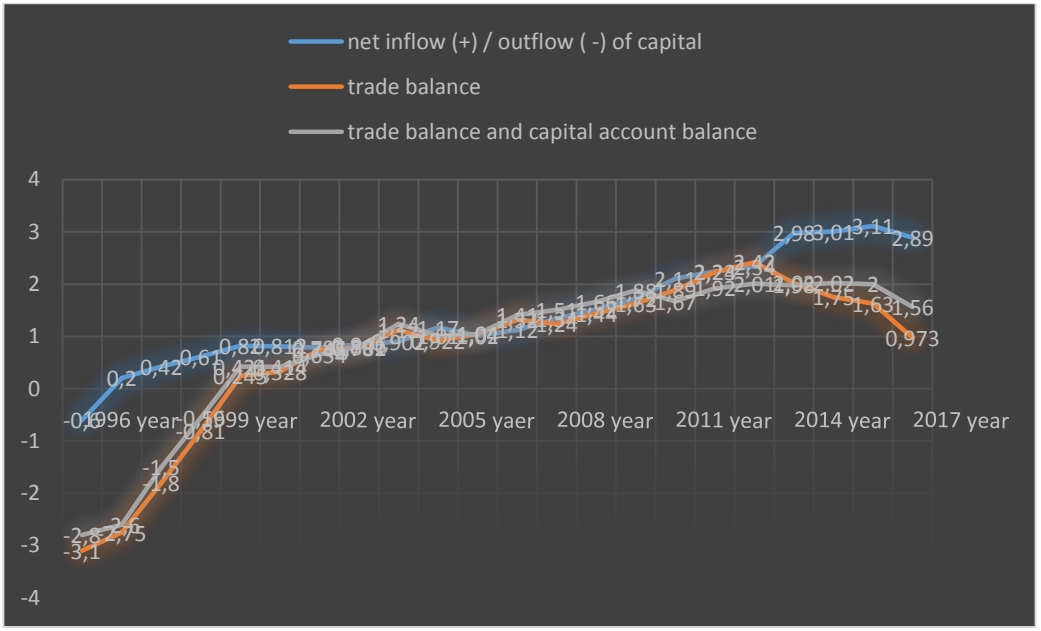
Meanwhile, there was an impairment of the nominal effective rate of the Uzbek sum, so the observed gap between the real and nominal effective rate was primarily due to the outstripping growth of prices in Uzbekistan relative to foreign (the difference in inflation levels). Before the crisis, the Central Bank of Uzbekistan carried out interventions in the domestic foreign exchange market, increasing gold and foreign exchange reserves, as the government ordered gold-mining companies to transfer part of the gold produced to the official reserve. As a result, the Uzbek sum did not strengthen, but rather fell by about 40% to the dollar, and then for 10 years since July 2008, the rate of the sum has significantly decreased 4 times. The economy's dependence on cotton, gold and gas prices raises the risk of a significant depreciation of the exchange rate as a reaction to negative price shocks, increasing its volatility. Note that after the change of power, the conversion was officially allowed to sum filed more than twice.

At the same time, in 2016, the Central Bank of Uzbekistan announced that the main goal of monetary policy is to achieve low inflation rates[1]. Subsequently, due to the influence of the favorable external situation in the world markets on the resources of the Central Bank of Uzbekistan, the principles of monetary policy were clarified, adding to the priority directions of ensuring the internal and external stability of the Uzbek sum[2].Due to the uncertainty of the price dynamics in 2015, the task was to move from the management of the exchange rate to the free floating of the Uzbek sum with the expansion of the borders of the dual-currency basket and the use of the interest rate as a more effective instrument of anti-inflationary policy.

According to the criterion of development of macroeconomic processes in Uzbekistan in 1996-2017, several periods can be distinguished, which differ in the dynamics of output, the state of the balance of payments and inflation. It is possible to consider the stages of development on 3 from 1996, ending with the analysis in 2007. Following the same logic, we will continue the study for later periods. This will require statistics on changes in real GDP, the dynamics of the main components of the balance of payments and inflation. The dependences constructed in Figure 1.3 are used to describe the main characteristics of each stage.

[1] For example, among the main directions of the unified state monetary policy for 2016: "the development Strategy of Uzbekistan by the Central Bank of the Republic of Uzbekistan in cooperation with the Government of Uzbekistan, remains to reduce inflation and maintain it at a low level. Over the next three years, the goal is to reduce inflation to below 8%."

[2] Among the main directions of the unified state monetary policy for 2017: "the monetary policy pursued in Uzbekistan is aimed at ensuring the internal and external stability of the national currency. Stable low inflation is a condition for achieving sustainable economic growth, which will significantly improve the standard of living of the population»



Sources: national bureau of statistics of Uzbekistan

The main stages in the development of macroeconomic processes in Uzbekistan in 1996-2017.

Between 1996 and 2003, Uzbekistan's economy developed at a moderate rate of 4 per cent per year on average.

Since 2004, because of the deepening of economic reforms aimed at creating a favorable business environment, modernization, technical and technological renewal of production, the economy of the Republic shows high and stable economic growth at the level of 7-9% per year.

Analysis of the main factors and sources of economic growth shows that the high rates of economic growth over the past 10 years (2007-2017) were due to the growth of agriculture 1.9 times (with an average annual growth for 2007-2016. - 6.5%), industry-1.7 times (5.6%), construction – 3.9 times (15.0%), services – 2.5 times (9.7%).

The data on the structure of GDP calculated by the end-use method allow for an analysis of the main proportions of GDP use, to determine the share of the cost of goods and services used to meet the needs of end-users and to increase the national wealth of the country.

In the structure of GDP use in current prices, final consumption expenditure accounts for the majority. The main share in the final consumption expenditure is household expenditure, their value ranges from 44% to 63% in 1996-2017.

During the period under review, the share of final consumption expenditure of public institutions in the GDP structure has changed significantly and has tended to decline from 20.7 per cent in 1996. up to 16.1% in 2017.

During 2001-2016, the average annual increase in final consumption expenditure was 9.6 per cent, and during the period under review this figure increased by more than 4.3 times. This is achieved mainly due to the growth of household expenditure by 5.3 times. Also, the real costs of public administration for individual and collective services increased by 2.3 times. During the period under review, the activation and expansion of the activities of public organizations (religious, charitable, etc.) contributed to a real increase in the cost of NPISH 2.3 times.

The main indicators of investment activity in the country show a constant increase in the accumulation of fixed capital through the attraction and development of domestic and foreign investments. The rate of accumulation of fixed capital in recent years (2001-2016) was about 25% of GDP, which corresponds to the level of developed and rapidly developing countries.

During 2001-2016, gross fixed capital formation increased more than 5.4 times with an average annual growth of 11.5%, outpacing the average annual GDP growth rate (7.3%) for the period under review.

Thus, it was shown that foreign economic conditions have a significant impact on the dynamics of macroeconomic variables in Uzbekistan. The monetary authorities ' policy is largely determined by the balance of payments. The Central Bank of Uzbekistan set the task of reducing inflationary pressure on the economy, but it was also important to ensure the stability of the national currency with a significant influx of foreign currency to maintain the competitiveness of domestic goods. For this purpose, the Central Bank of Uzbekistan participated in interventions in the domestic currency market, accumulating gold and foreign exchange reserves. However, during this period, the real effective rate of the Uzbek sum fell by 5 times, primarily due to the difference in the rate of inflation. Throughout the period under review, except for the crisis, inflation and the real GDP index were negatively correlated in each of the selected stages. In post-crisis development, the positive impact of the resource sector on GDP growth has increased markedly, but at the same time inflation has increased.

The emergence of the traditional version of the Phillips curve model is connected named after the English economist of New Zealand origin A. Phillips, which because of the analysis of the relationship between the level unemployment and wage growth in the United Kingdom between 1861 and 1957 revealed a strong negative relationship between these two countries unemployment rates and the indicators, but he did not give a theoretical explanation obtained result (Phillips, 1958). Later, the representative of Keynesian school R. Lipsey continued the research started by A. Phillips (A Further Analysis. Economica. 1960) and supplemented it with the theoretical explanation of the negative relationship between the unemployment rate and the wage growth rate.

Thus, according to R. Lipsey, a low unemployment rate, which means a greater demand for labor, leads to an increase in the price of labor, that is, wages. In the opposite case, when unemployment starts to rise, which is characterized by a decrease in demand for labor, wages are reduced. Subsequently, the rate of wage growth was replaced by the rate of inflation, in connection with which the definitive version was formulated a traditional Phillips curve that reflected a negative connection between inflation and unemployment:

$$\pi = -\lambda * U, \qquad (1)$$

Where π - the rate of inflation, λ - coupling coefficient between inflation and unemployment, U - unemployment.

This model proved its worth during the 1960s, when the market economy in the capitalist countries experienced the peak of its development. But with the advent of the 1970s, the Phillips curve ceased to show compliance with reality. During this period, against the backdrop of the oil embargo by OPEC countries in the United States significantly increased the level of inflation, which was accompanied by high unemployment, which was contrary to the theory within the Phillips curve.

Explanation of the causes of the current inability of the traditional curve Phillips ' describe the situation of stagflation is reflected in the works representatives of the school of new classics and monetarism. Primarily monetarists represented by M. Friedman (Friedman, 1968) and E. Phelps (Phelps, 1968, pp. 678-711) noted the need strict differentiation of economic analysis for an extended period and brief period. Thus, in long-term economic analysis, it should be considered that unemployment, like the aggregate supply, is a rigid indicator and is equal to its natural level, which can also be called a potential or equilibrium level. However, the emergence of macroeconomic shocks can lead to structural changes in the economy and, as a result, the formation of a new potential unemployment rate and total supply. In the case of short-term economic analysis, unemployment and aggregate supply are more flexible and, because of government action or short-term macroeconomic shocks, deviate up or down from their potential levels. At the same time, in a brief period, the excess of the current level of unemployment over its natural level leads to an acceleration of inflation, while the reduction of the current level of unemployment from the natural level will be a disinflation factor. New classics and monetarists called the lack of microeconomic foundations of Keynesian views on the causes of inflation as an additional reason for the inactivity of the traditional Keynesian Phillips curve in the conditions of stagflation. Thus, the new classic R. Lucas in his work (Lucas, 1976, pp. 19-46) argued that all macroeconomic models, mainly the Keynesian school, describes the relationship of aggregated indicators, are erroneous, as they do not consider the microeconomic causes and relationships, which are by their nature primary. Subsequently, this statement in economic theory was called "Lucas's critics".

Thus, the new classics and monetarists revised the traditional Keynesian curve of Phillips, including a deviation of the current unemployment rate from its potential level, as well as in as a microeconomic justification of inflation processes included inflation expectations of economic agents:

$$\pi_t = E\{\pi_t\} + \lambda * (U_t - U^N), \qquad (2)$$

where π_t is the inflation rate at time t, = $E\{\pi_t\}$ is inflation expectations at time t, λ is the ratio between inflation and unemployment gap, U_t is the unemployment rate at time t, U^N - natural (potential or equilibrium) unemployment rate.

Further discussion and debate within the Phillips curve transformed by the new classics and monetarists was to determine the nature and type of inflation expectations.

Thus, the monetarists held to the hypothesis of adaptive or retrospective expectations and argued that the expected inflation is a function of past inflation rates, or " previous experience»:

$$\pi_t = E\{\pi_t\} + \lambda * (U_t - U^N), \qquad (3)$$
$$\pi_t = E\{\pi_{t-1}\} + \nu * (\pi_{t-1} - E\{\pi_{t-1}\}),$$

where π_t - the rate of inflation at time t, $E\{\pi_t\}$ – adaptive (nasal spray) inflation expectations at time t, λ -coupling coefficient between inflation and the unemployment gap, U_t - the unemployment rate in time t, U^N - natural (potential or equilibrium) level of unemployment, $E\{\pi_{t-1}\}$ - adaptive (nasal spray) inflation expectations at time t-1, π_{t-1} is the inflation rate at time t-1, ν - the coefficient adaptation.

According to the new classics, the behavior of economic entities is completely rational, or forward-looking (forward-looking) due to the fact that they make decisions using all available information and knowing all the parameters of relevant economic functions.

As a result, economic entities do not make systematic mistakes in the formation of their expectations, which are rational. Mathematically, the Phillips curve under the new authorities is expressed in the following way:

$$\pi_t = E\{\pi_{t+1}\} + \lambda * (U_t - U^N), \qquad (4)$$

where π_t is the inflation rate at time t, $E\{\pi_{t+1}\}$ are rational (being proactive), inflation expectations at time t, λ – coupling coefficient between inflation and the unemployment gap, U_t –the unemployment rate in time t, U^N – natural (potential or equilibrium) unemployment rate.

Formulated by monetarists and the new classical Phillips curve is theoretically well explained in the current US economy situation of stagflation in the 1970s, but in the future, these views have not found empirical evidence on the basis of econometric estimates.

Since the 1980s, the subsequent development of the theory of inflationary processes based on the Phillips curve has become the main theme in the works of representatives of the new Keynesian school. At the same time, the starting point of their research was the

work of new classics. Thus, the new Keynesians retained in the theory of the Phillips curve rational (forward-looking) inflation expectations as a factor of microeconomic justification, but at the same time claimed the heterogeneity of economic entities, so that it was concluded that different economic entities adjust prices and form expectations at different times. In General, according to the" standard " new Keynesian curve of Phillips, which was first fully formulated by G. Calvo (Calvo, 1983, pp. 383-398) and subsequently developed by J. Roberts (Roberts, 1995, pp. 975-984), N. Mankiw, R. Reis (Mankiw, 2002, pp. 1295-1328), the current inflation is a function of the expected forward-looking inflation and the deviation of the average marginal cost of production from the equilibrium level:

$$\pi_t = E\{\pi_{t+1}\} + \tau * \underline{mc}_t ,$$

where π_t - the rate of inflation at time t, $E\{\pi_{t+1}\}$ - rational (forward) inflation expectations at time t, τ -coupling coefficient between inflation and the deviation of average marginal costs from equilibrium level, $\underline{mc}_t$ - deviation of average marginal cost from the equilibrium level at time t.

Later in the work of A. Razin, C. Yuen (Razin, Yuen, 2002) was shown a modification of the "standard" new Keynesian Phillips curve for the versus open economy.

Now, for open economies, the current inflation under the neo-Keynesian approach was further explained by exchange rate indicators, inflation in trading partners, and other macroeconomic factors that explain the power of inflation:

$$\pi_t = E\{\pi_{t+1}\} + \tau * \underline{mc}_t + \eta' * X_t$$

where π_t is the inflation rate at time t, $E\{\pi_{t+1}\}$ are rational (forward-looking) inflation expectations at time t, τ - the relationship between inflation and the deviation of the average marginal cost from the equilibrium level, $\underline{mc}_t$ - the deviation of the average marginal cost from the equilibrium level at time t, X_t - vector-a column of additional explanatory factors for the small open economy (exchange rate, imported inflation, money supply, etc.), η - vector-a string of coefficients with additional explanatory factors.

Since the formation of the "standard" new Keynesian curve of Phillips, the assumption that economic entities have certain inflation expectations has been questioned. It was concluded that the economic category of "inflation expectations" is a significantly complex process, which is incorrect to explain in terms of only one specification (Rozmainsky, 1995, pp. 114-118), as presented in the "standard" new Keynesian curve of Phillips. In this regard, a hybrid new Keynesian curve of Phillips emerged, which, along with forward-looking inflation expectations, also takes into account inflation expectations:

$$\pi_t = E\{\pi_{t+1}\} + \pi_{t-1} + \tau * \underline{mc}_t$$

where π_t - the rate of inflation at time t, $E\{_{\pi t+1}\}$ - rational (forward) inflation expectations at time t, π_{t-1} -adaptive (nasal spray) inflation expectations at time t, τ - coupling coefficient between inflation and the deviation of average marginal costs from

equilibrium level, $\underline{mc}_t$ - deviation of average marginal cost from the equilibrium level at time t.

According to this Phillips curve formulated and tested in the works of J. Roberts (Roberts, 1997, p. 173-196) (Roberts, 1998), J. Galí, M. Gertler, D. López-Salido (Galí, Gertler, López-Salido, 2005, pp. 1107–1118), some economic entities, in particular firms, form inflationary expectations in an adaptive way, and the other part of them are oriented to rational expectations.

Currently, in addition to the new Keynesian Phillips curve, there is also the post-Keynesian Phillips curve, the analysis and description of which is beyond the scope of this study.

In modern scientific and applied research on the factors and dynamics of inflation, the new Keynesian Phillips curve has become one of the most widely used approaches to modeling inflation in both developed and developing countries. So, the empirical evaluation of the new Keynesian Phillips curve for the United States are represented in the work of J. Rudd, and K. Whelan (Rudd, Whelan, 2005, pp. 1167–1181), the UK – N. Batini, B. Jackson, S. Nickell (Batini et al, 2005, pp. 1061-1071), for the Eurozone countries – in the work of F. Rumler (Rumler, 2007, 18:427), for India – in the work of J. Sahu (Sahu, 2013, pp. 2634-2647), for China – Ch.Zhang, Y. Murasawa (Zhang, Murasawa, 2011, pp. 2462-2468), for Russia – in the work of A. Sokolova (Sokolova, 2014, pp. 61-67). At the same time, there are currently no publications of the results of empirical studies within the approach of the new Keynesian Phillips curve in relation to Uzbekistan.

Since the reduction of inflation is a priority direction of monetary policy, we will focus on the nature of this process in detail, identifying the main monetary and non-monetary factors.

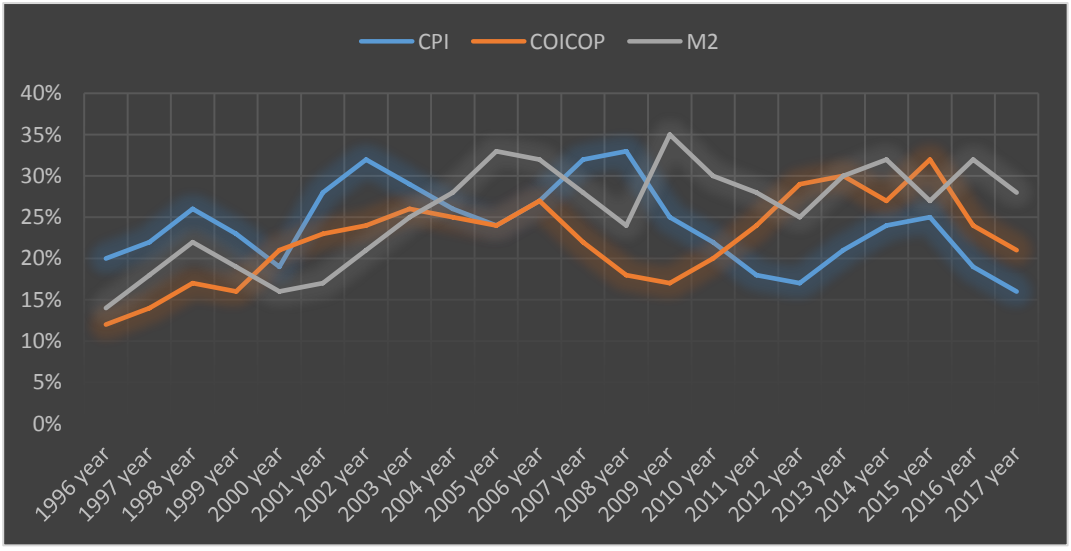
The high and sustained inflation that has been observed for a long period of time has had a negative impact on the development of the country and has been one of the major obstacles to achieving balanced economic growth. In theory, this is because inflation reduces the efficiency of the pricing system, as relative prices change relative to long-term fundamentals. Due to the relative differences in the price rigidity of different goods and services, the intertemporal preferences of economic agents are distorted, so resources are allocated less efficiently. Also, higher inflation is less predictable due to greater volatility and creates conditions for inefficient "rent struggles", as it becomes more profitable for economic agents to delay payments in time (Summers 1991).

Currently, the CPI in the Republic of Uzbekistan uses a consumer set of goods and services out of 350 items divided into three major groups: food products (96 items), non-food products (188 items) and services (66 items). Thus, the consumer set, on the basis of which the CPI is calculated, is a single sample for all regions of the country of the groups of goods and services most often consumed by the population of the country.

It should be noted that in addition to the price factor (i.e. the actual change in the prices of goods and services), the CPI calculation is influenced by the specific weight of specific goods and services. Thus, the consumer price index aggregates (averages) the movement of prices for all variety of goods and services across the country.

The inflation process in Uzbekistan is quite complex. As figure 1.4 shows, the approach in which monetary factors associated with disproportionate growth of the money supply are the main reason for the formation of inflationary processes does not explain the inflationary process. Thus, from 1998 to 2007, there was a steady high rate of inflation with a significant constant increase in the money supply from 25% to 60% year on year. Meanwhile, from the beginning of 2008 to the middle of 2009, there was an opposite trend, when the average inflation of 15% was superimposed on the negative growth of M2, which reached more than 15% in the annual value. In the post-crisis period until 2010, the situation was again the opposite, when M2 gained momentum with increasing rates of inflation. The discrepancy between the monetary theory of inflation can be explained by the effect of the money supply on inflation with some lag, the value of which, depending on the stage under consideration, is about 1 year. However, the stability of the core inflation component is difficult to explain by sharp movements in the money supply.

Figure no. 1.4. COICOP, CPI and M2 monetary aggregate growth rate (in % to the corresponding period of the previous year)



Sources: from the calculations of the author according to ADB

Imbalances in the economy, due to its long development under the influence of the command and administrative system.

- Small export sector with strong import dependence.
- The collapse of economic ties as a result of the collapse of the USSR.
- Decline in gross domestic product (GDP).
- Inflation expectations of the population.

However, non-monetary inflation concepts cannot explain the actual dynamics of inflation in Uzbekistan. The increase in assets of the Halyk Bank (former Sberbank of the USSR) in all cases leads to an increase in the money supply, which means an increase in effective demand. As a result, the level of commodity prices is increasing. (A reduction in the volume of credit issue contributes to a reduction in the rate of inflation.) It increases when the population flees from the national currency, due to low confidence in the ruble and inflationary expectations of the population.

Repayment of inflationary expectations of the population, increasing confidence in the sum.

This measure was necessary, as already in 2013 inflation was caused by:

1. 45 % - inflation expectations;
2. 25 % - increase in fuel prices;
3. 20% increase in the total money supply;
4. 7% rise in prices of agricultural products;
5. 3 % - other factors.

If you look at the work of Russian economists modeling of inflation factors for the Russian economy was carried out in the works of A. Baranov and I. Somova (2009), A. Porshakov and A. Ponomarenko (2007). We present the main conclusions of the research. A. Baranov and I. Somova (2009) consider the specifications of the inflation model with the inclusion of only monetary factors (money supply, the exchange rate of RUB/USD, the rate of MIBOR), and with the addition of non-monetary components (inflation expectations, expenses of the consolidated budget of Russia, tariffs of natural monopolies).

Table no. 1.1. Factors determining the growth of CPI in 1996-2017

independent variable	coefficient value	t-statistics	p-value	Characteristic of the equation
$\Delta GDPR_t$	1.002	2.0112	0.020	$R^2_{adj} = 87.25$
$\sum_{j=1}^{2} \Delta \pi_{t-j}$	-0.0402	-10.004	0.000	F(5.21) =38.24[0.000]
ΔEX_t (with a lag of 4 quarters)	0.257	2.845	0.010	
ΔM_t (with a lag of 4	0.0227	1.642	0.015	AR(1) =0.075[0.0757]

quarters)				
Δi_t (with a lag of 4 quarters)	-0.0221	-1.478	0.005	

Sources: author's calculations

It turned out that the evaluation of the model in Uzbekistan according to the specification of only monetary variables gives an insignificant regression (for example, $R^2_{adj} = 21.25$, all coefficients are insignificant except for the exchange rate). At the same time, the combination of monetary and non - monetary factors into one regression allows to improve the model, in which all the coefficients are significant at the 5% level (except for the money supply factor, which is on the verge of significance with the p-value equal to 5.8%, but this can be explained by the possible multicollinearity problem, since the money supply, exchange rate and interest rate correlate with each other). The evaluation results are presented in Table 1.1.

The factor of inflation expectations has the greatest impact on inflation growth in the short term. It is concluded that in the conditions of Uzbekistan it is impossible not to take into account the monetary component of inflation, but its study should be carried out in conjunction with non-monetary components. The idea of estimating the effect of the money supply on inflation is not absolute A. Parshakov and A. Ponomarenko (2007) realized the values (as an increase in the money supply), and in the deviation from the equilibrium values (a "natural" level) in their study. Also, non-monetary factors associated with changes in the marginal costs of producers can be added to the specification, and vector autoregression of error correction according to quarterly data from January 1996 to December 2017. The calculated monetary gap ratio was 0.02, which means that the excess of the actual M2 volume over the natural level by 1% leads to an increase in inflation by 0.02 PP. This result is different in its stability with differences in the calculation approaches. However, this relationship is statistically significant, and" the acceleration of inflation rates (relative to the growth rates of costs of producers), as a rule, occurred in those periods when the supply of money in the economy was excessive" (Porshakov and Ponomarenko, 2007, p. 74). Therefore, the authors establish that non-monetary factors are more important, but at the same time, together with monetary components, they complement each other well in the formation of inflation processes, so you need to take into account their joint action. It is important to note that due to the process of de-dollarization, the natural amount of money supply increased, and this had a restraining effect on prices.

The negative consequences of inflation processes include a decrease in real incomes of the population, the depreciation of savings of the population, the loss of producers ' interest in the creation of quality goods, the restriction of the sale of agricultural products in the city by rural producers due to the fall in interest. In anticipation of increase in food prices, deterioration of conditions of life mainly at the

representatives of social groups with the firm incomes (pensioners serving, students, which incomes are formed for the account state budget). In advanced market economies, inflation can be seen as an integral part of the economic mechanism. However, it is not a serious threat, because there are worked out and widely used methods of limiting and regulating inflation. In recent years, the United States, Japan, Western Europe is dominated by the trend of slowing inflation even deflation.

Inflation management is one of the main problems of monetary and economic policy in Uzbekistan as a whole. It is necessary to take into account the complex, multifactorial nature of inflation. It is based not only on monetary but also other factors. Despite the importance of reducing government spending, the gradual compression of monetary emissions requires a wide range of anti-inflationary measures.

One of the important tasks in the empirical evaluation of the NKPC is the choice of an indicator that will reflect the dynamics of inflation in the estimated model. In most cases, the increase in the consumer price index is used as such an indicator (Rudd J., Whelan K. New tests of the new-Keynesian Phillips curve. Journal of Monetary Economics. Batini N., Jackson B., Nickell S. An open-economy new Keynesian Phillips curve for the U.K. Journal of Monetary Economics. Rumler F. Estimates of the Open Economy New Keynesian Phillips Curve for Euro Area Countries. Open Econ Rev.). Along with this, the GDP deflator and the industrial producer price index are used (Galí J, Gertler M, López-Salido D. Robustness of estimates of the hybrid New Keynesian Phillips Curve. Journal of Monetary Economics. Sahu J. Inflation dynamics in India: A hybrid New Keynesian Phillips Curve approach. Economics Bulletin. Rudd J., Whelan K. New tests of the new-Keynesian Phillips curve. Journal of Monetary Economics.). Another methodological issue in assessing the NKPC is to determine the empirical indicators for forward-looking inflation expectations and the deviation of the average marginal cost from the equilibrium level. As indicators of forecast inflation expectations, the actual historical inflation at the time of t+n is most often used (Sahu J. Inflation dynamics in India: A hybrid New Keynesian Phillips Curve approach. Economics Bulletin.), where t - is the "Current" time for which the NCC is estimated, n- is the number of future periods of time (months, quarters) ahead of the "Current" time t. In addition, if there is a sufficiently long sample of the results of surveys of economic agents regarding inflation expectations, then as an indicator of forward-looking inflation expectations in the NKPC model, one can apply quantified values of the results of these surveys. In turn, the NKPC equation uses GDP gap estimates for quarterly models to empirically reflect the deviation of the average marginal cost from the equilibrium level (Galí J, Gertler M, López-Salido D. Robustness of estimates of the hybrid New Keynesian Phillips Curve. Journal of Monetary Economics. Rudd J., Whelan K. New tests of the new-Keynesian Phillips curve. Journal of Monetary Economics. Rumler F. Estimates of the Open Economy New Keynesian Phillips Curve for Euro Area Countries. Open Econ Rev. Zhang Ch., Murasawa Y. Output gap measurement and the New

Keynesian Phillips curve for China. Economic Modelling.) or estimates of the output gap of industrial production for monthly models (Rudd J., Whelan K. New tests of the new-Keynesian Phillips curve. Journal of Monetary Economics.).

In the work carried out in the framework of this study, food and non-food inflation in Uzbekistan were used as indicators of inflation. This choice is based on an attempt to model the dynamics of price changes exclusively for traded goods, in order to determine not only the internal economic but also the external economic factors of inflation in Uzbekistan. The indicator of forward-looking inflation expectations by analogy with the works (Sahu J. Inflation dynamics in India: A hybrid New Keynesian Phillips Curve approach. Economics Bulletin. Sokolova A.V. Inflation expectations and the Phillips curve: the rating on the Russian data. Money and credit.) was the actual values of food and non-food inflation in Uzbekistan in the next period of time. As a proxy indicator of the deviation of the average marginal costs from the equilibrium level, the gap in the real volume of industrial production in Uzbekistan was used.

To achieve the objectives of this study, three different types of NKPC models were evaluated.

To begin with, we considered the evaluation of empirical NKPC in the" standard " form for two types of inflation in Uzbekistan:

$$\pi_t^f = C_1 + \beta_1 E\{\pi_{t+1}^f\} + \lambda_1 y_t^{gap} + \varepsilon_{1t}$$
$$\pi_t^{nf} = C_2 + \beta_2 E\{\pi_{t+1}^{nf}\} + \lambda_2 y_t^{gap} + \varepsilon_{2t} \quad (8)$$

where π_t^f is the level of food inflation in Uzbekistan at time t; π_t^{nf} - level of non - food inflation in Uzbekistan at time t; $E\{\pi_{t+1}^f\}$ - forward-looking expectations of food inflation in Uzbekistan at time t; $E\{\pi_{t+1}^{nf}\}$ - forward-looking expectations of non-food inflation in Uzbekistan at time t; y_t^{gap} is the deviation of the average marginal cost from the equilibrium level at time t; C_1, C_2 - constants of equations; ε_{1t} , ε_{2t}– equation errors.

Then, for the conditions of Uzbekistan, an empirical assessment of NKPC for a small open economy was made:

$$\pi_t^f = C_1 + \beta_1 E\{\pi_{t+1}^f\} + \lambda_1 y_t^{gap} + \varepsilon_{1t} + v_1(L)\,\Delta m_t + \rho_t \pi_t^{\text{imp\_}f} + \eta_1(L)\Delta e_t^{nom} + \varepsilon_{1t}.$$
$$\pi_t^{\text{nf}} = C_2 + \beta_2 E\{\pi_{t+1}^{nf}\} + \lambda_2 y_t^{gap} + \varepsilon_{2t} + v_2(L)\,\Delta m_t + \rho_t \pi_t^{\text{imp\_nf}} + \eta_2(L)\Delta e_t^{nom} + \varepsilon_{2t}. \quad (9)$$

where π_t^f is the level of food inflation in Uzbekistan at time t; π_t^{nf} - level of non - food inflation in Uzbekistan at time t; $E\{\pi_{t+1}^f\}$ - forward-looking expectations of food inflation in Uzbekistan at time t; $E\{\pi_{t+1}^{nf}\}$ - forward-looking expectations of non-food inflation in Uzbekistan at time t; y_t^{gap} is the deviation of the average marginal cost from the equilibrium level at time t; $(L)\,\Delta m_t$ -lags of changes in the money supply in

Uzbekistan; $\pi_t^{\text{imp\_}f}$,$\pi_t^{\text{imp\_nf}}$ - import of food and non-food inflation at a time t; $(L)\Delta e_t^{nom}$ - lags of change in the nominal exchange rate of sums; - is the deviation of the average marginal cost from the equilibrium level at time t; C_1, C_2 - constants of equations; ε_{1t} , ε_{2t}– equation errors.

The third specification of the empirical assessment of inflation model in Uzbekistan was the hybrid form of NKPC:

$$\pi_t^f = C_1 + \beta_1 E\{\pi_{t+1}^f\} + \tau_1 \pi_{t-1}^f + \lambda_1 y_t^{gap} + \varepsilon_{1t} + v_1(L)\,\Delta m_t + \rho_t \pi_t^{\text{imp\_}f} + \eta_1(L)\Delta e_t^{nom} + \varepsilon_{1t}.$$

$$\pi_t^{\text{nf}} = C_2 + \beta_2 E\{\pi_{t+1}^{nf}\} + \tau_1 \pi_{t-1}^{nf} + \lambda_2 y_t^{gap} + \varepsilon_{2t} + v_2(L)\,\Delta m_t + \rho_t \pi_t^{\text{imp\_nf}} + \eta_2(L)\Delta e_t^{nom} + \varepsilon_{2t}. \quad (10)$$

where π_t^f is the level of food inflation in Uzbekistan at time t; π_t^{nf} - level of non - food inflation in Uzbekistan at time t; $E\{\pi_{t+1}^f\}$ - forward-looking expectations of food inflation in Uzbekistan at time t; $E\{\pi_{t+1}^{nf}\}$ - forward-looking expectations of non-food inflation in Uzbekistan at time t; π_{t-1}^f- backward looking expectations of food inflation in Uzbekistan at time t; π_{t-1}^{nf} $-$ - back looking expectations of non-food inflation in Uzbekistan at time t; ; y_t^{gap} is the deviation of the average marginal cost from the equilibrium level at time t; $(L)\,\Delta m_t$ -lags of changes in the money supply in Uzbekistan; $\pi_t^{\text{imp\_}f}$,$\pi_t^{\text{imp\_nf}}$ - import of food and non-food inflation at a time t; $(L)\Delta e_t^{nom}$ - lags of change in the nominal exchange rate of sums; - is the deviation of the average marginal cost from the equilibrium level at time t; C_1, C_2 - constants of equations; ε_{1t} , ε_{2t}– equation errors.

Due to the fact that the equations use the actual inflation values as a proxy indicator of forward inflation expectations in the next period, there is a problem of endogeneity, which is expressed in a strong correlation of errors of the equations and the proxy indicator of forward inflation expectations. Therefore, in this paper, to obtain unbiased estimates of the parameters of the equations, the generalized method of moments (GMM) was applied, which allows to cope with the problem of endogeneity. At the same time, the implementation of GMM requires a set of instrumental variables that will have a strong correlation with the proxy indicator of forward-looking inflation expectations and a weak correlation with the errors of the equations. Based on theoretical judgments, lags of changes in the nominal exchange rate of sums were used as instrumental variables for the estimated equations ($(L)\Delta e_t^{nom}$), lags of food and non-food inflation imported in Uzbekistan ($(L)\pi_t^{\text{imp\_}f}$, $(\text{L})\pi_t^{\text{imp\_nf}}$)), lags of changes in the money supply in Uzbekistan ($(L)\,\Delta m_t$), lags of price changes in industry in Uzbekistan ((L)Δppi_t) and lags of changes in world gas prices ((L)$\Delta pgas_t$). These instrumental variables were selected as factors that form the forward-looking inflation expectations of economic entities in Uzbekistan.

To evaluate the equations, the paper used monthly empirical data on macroeconomic variables (table 1 of the Annex) from January 1996 to December 2017 (a total of 84 observations for each variable), they were downloaded from statistical databases of the Bureau of statistics, Central Bank of Uzbekistan and Bank for International Settlements (BIS). Since there is no data on monthly changes in real GDP in Uzbek statistics, we use the proxy variable of the industrial production index (PPI) for our purposes.

As indicators of food (π_t^f) and non-food inflation (π_t^{nf}) in Uzbekistan was used the first difference of the logarithms of the monthly seasonally-adjusted price indices for food and non-food goods in Uzbekistan (to January 1996). The rate gap real industrial output in Uzbekistan was used as a proxy indicator of deviations of average marginal costs from equilibrium level (y_t^{gap}). The gap in real industrial production was calculated as the ratio of seasonally adjusted index of physical volume of industrial production (y_t) in Uzbekistan (in%, month to the previous month) to its potential level, which in turn was estimated using a one-dimensional filter Hodrick-Prescott. First difference of logarithms of the monthly nominal exchange rate of dollar to sums($\Delta e_t^{nom\_USD}$) were used as proxy indicators model variable Δe_t^{nom}. Empirical indicators of the imports of food and nonfood inflation were selected, respectively, the first difference of the logarithms of seasonally-adjusted price indices for food ($\pi_t^{imp\_f}$) and non-food items ($\pi_t^{imp\_nf}$). Also, the first differences in the logarithms of seasonally adjusted values of the price index of enterprises-producers of industrial products in Uzbekistan (to the base of January 2012), the volume of broad money supply in Uzbekistan (in billion sums at the end of the quarter and exchange prices for resources (in dollars). (US$, quarter-on-quarter) were used as empirical indicators, respectively, for explanatory and instrumental variables, Δppi_t, Δm_t , $\Delta pgas_t$. It should be noted that the Census x-12-ARIMA procedure was used as a method to eliminate seasonality of time series.

An extended Dickey-fuller test (ADF) was performed to test these empirical variables for the presence of a single root. According to the results of this test, it was found that all variables are stationary (table 1), which does not contradict the condition of using GMM to evaluate the equations.

Table no. 1. Results of the extended Dickie-fuller test (ADF).

Symbol variable	**t-statistic**
π_t^f	4.228***
π_t^{nf}	-2.040*
Δm_t	-4.466***
y_t	-4.266***
$\Delta e_t^{nom\_USD}$	-4.008***
$\pi_t^{imp\_f}$	-4.148***

$\pi_t^{imp\_nf}$	-3.331***
Δppi	-3.125***
$\Delta pgas_t$	-4.012***

Note: ***, * * and * signs indicate the stationarity of time series, respectively, at 1%, 5% and 10% significance levels

Also, the calculations of descriptive statistics indicators of the named empirical variables were additionally made. The results of these calculations are presented in table 2.

Table 2 of the Annex presents the results of the evaluation of the "standard" NKPC form (equation (8)) using fourteen instrumental variables for food inflation and thirteen instrumental variables for non-food inflation. At the same time, the sets of instrumental variables include lags of food inflation in Uzbekistan, non-food inflation in Uzbekistan and its lags, the nominal exchange rate of the us dollar to the sum and its lags, the nominal exchange rate of the dollar to the sum and its lags, the prices in industry in Uzbekistan and its lags, the world gas prices, as well as the money supply in Uzbekistan and its lags.

Table no. 2. Descriptive statistics of the variables used.

Symbol variable	Average	Median	Maximum	Minimum	Standard deviation
π_t^f	0.60	0.36	4.02	-0.32	0.62
π_t^{nf}	0.76	0.28	8.64	-0.25	1.22
Δm_t	0.80	0.60	10.12	-2.12	2.48
y_t	-0.02	0.00	3.42	-4.12	1.28
$\Delta e_t^{nom\_USD}$	1.42	0.12	42.06	-4.20	3.98
$\pi_t^{imp\_f}$	0.84	0.70	5.48	-0.12	0.42
$\pi_t^{imp\_nf}$	0.52	0.40	3.92	0.04	0.68
Δppi	0.02	0.52	4.86	-9.04	2.45
$\Delta pgas_t$	-1.88	-0.12	21.12	-32.02	8.86

Note: all variables are presented in percentage points

The elasticity of food and non-food inflation to forward-looking expectations was estimated at 0.36 and 0.30, respectively, and they are also statistically significant. It can be concluded from this that forward-looking expectations affect food and non-food inflation in Uzbekistan to varying degrees. At the same time, food inflation is more affected by forward-looking expectations than non-food inflation. Also, the estimation of equations (8) (table 2 of the Annex) showed that the quantitative assessment of the impact of the gap in the average marginal cost of production on food inflation in Uzbekistan is 0.24, while for non-food inflation this value is 0.56. Thus, it turns out that the gap in the average marginal cost of production has a greater impact on non-food inflation than on

food inflation. But the actual data of the stat Bureau of Uzbekistan, according to which at the end of 2017 the share of domestic production in the consumption of food and non-food products in Uzbekistan amounted, respectively, 82% and 28% (table 3), contradict the results of this assessment. Thus, based on the actual patterns of consumption of food and non-food items, the impact of the gap in the average marginal cost of production on food inflation should be higher than the impact on non-food inflation. It is likely that the reasons for the evaluation results are the poor quality of the estimated equations (8) (table 2 of the Appendix). Thus, the determination coefficients (R-squared) for the equations of food and non-food inflation were only 0.17 and 0.12, respectively, and the values of J-statistical indicators for both equations were statistically insignificant. In this regard, it was decided that in order to further assess the inflation model of Uzbekistan within the NKPC, additional explaining macroeconomic factors should be taken into account. For this purpose, the NKPC specification was chosen as an equation for a small open economy (equation (9)), the empirical evaluation of which is shown in table 3 of the Annex.

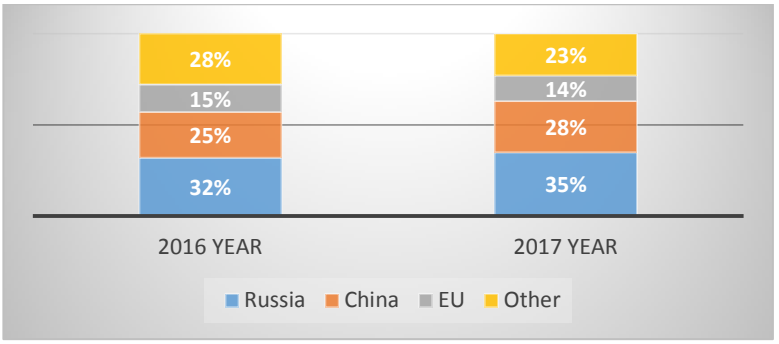
Table no. 3. Structure of consumption of goods in Uzbekistan.

Type of goods	Articles of food		nonfood goods	
Year	2016	2017	2016	2017
Share of domestic production, %	80 %	82 %	25 %	28 %
share of imports	20 %	18 %	75 %	72 %

Source: Ministry Of Foreign Trade

In assessing the NKPC for the small open economy (table 3 of the Annex) according to the theoretical equation (9), indicators of the dynamics of the money supply in Uzbekistan (monetary inflation factor), food and non-food inflation (inflation import factor), the nominal exchange rate of the dollar to the sum (exchange rate policy factor) were added to the previous explanatory factors. The number of instrumental variables for both the food inflation equation and the non-food inflation equation has been reduced to 9 (table 3 of the Annex). The set of instrumental variables remained the same as in the estimation of equations (8), except for the change of the order and number of lags corresponding to the maximization of the values of R - squared and J - statistic indicators. Along with this, the influence of the gap of average marginal costs for both types of inflation in Uzbekistan in the new specifications proved to be statistically insignificant, resulting in the conclusion about the absence of significant relationships between the indicators of business activity and inflation. In turn, the evaluation of the new specification of the NKPC revealed a statistically significant strong dependence of inflation in Uzbekistan on factors such as imported inflation, lagged change in the domestic money supply and lagged values of the exchange rate of the sums. Thus, the elasticity of food inflation in Uzbekistan to imported inflation, approximated through

food inflation in Russia, is 0.51, and the elasticity of non-food inflation to imported inflation, also approximated through non-food inflation in Russia, is 0.52. The elasticity of the price level change in Uzbekistan to the change in the money supply with the lag of the 2nd quarter is 0.14 for food products and 0.25 for non-food products. The degree of influence of the dynamics of the nominal exchange rate of the dollar to the sum with the lag of the 1st quarter on food and non-food inflation in Uzbekistan is estimated, respectively, as 0.07 and 0.05. From a theoretical point of view, the high sensitivity of inflation in Uzbekistan to inflation in Russia (imported inflation), as well as the statistical significance of the impact of the nominal exchange rate of the ruble to the sum on Uzbekistan's consumer prices, are explained by two factors. First, the domestic consumer market of Uzbekistan is largely dependent on transfers from Russia, and second, the largest share of consumer imports by countries (from 30% to 40% in Russia) is in the structure of Uzbekistan's consumer imports (figure 2.1). Regarding the quality of the estimated equations, it is worth noting that compared to the previous specification, the R-squared index has significantly increased (for the food inflation equation – from 0.17 to 0.77, for the non – food inflation equation-from 0.12 to 0.73). At the same time, the values of Prob(J-statistic) also decreased, but still remain high, so that the null hypothesis of simultaneous equality of all coefficients estimated in the equations is accepted at the 10% level of significance. In other words, the estimated equations have weak statistical quality. Also, according to the analyzed assessment (table 3 of the Annex), the dependence of inflation in Uzbekistan on the indicator of imported inflation is higher than on the indicator of forward-looking expectations. But it is theoretically assumed that the elasticity of domestic inflation in Uzbekistan to forward inflation expectations and imported inflation should be approximately equal. This assumption is because the rate of imported inflation is included in the list of instrumental variables, which in turn affect the formation of forward-looking expectations. In other words, the value of inflation expectations cannot be less than the size of the factors that affect their formation. In this regard, it was suggested that inflation in Uzbekistan, in addition to forward-looking expectations, has an impact on expectations, and the total impact on inflation should be approximately equal to or greater than the impact of imported inflation.



Source: Ministry of Foreign Trade

Thus, due to the reasons described above, it was decided to make an additional empirical assessment of the NKPC in accordance with the theoretical equations (10), which are presented in the form of a hybrid NKPC for a small open economy, where along with rational expectations, adaptive expectations are taken into account.

Table 3 of the Appendix shows the results of evaluation of hybrid NKPC for small open economy (equation (10)). In this estimate, the average marginal cost gap was excluded from the equations due to statistical insignificance in the previous estimate (table 3 of the Annex). But to account for the adaptive (nasal spray) inflation expectations equation was included the actual value of food and nonfood inflation with a lag of 1 quarter. The number of instrumental variables remained unchanged for the food inflation equation and fell to 7 for the non-food inflation equation. At the same time, the list of instrumental variables has not changed and includes lags of food and non-food inflation in Uzbekistan of nominal exchange rates of the us dollar to the sum of prices in industry in Uzbekistan, world gas prices and money supply in Uzbekistan.

The final results of the assessment of a hybrid NKPC for a small open economy in relation to inflation in Uzbekistan show that the impact of inflation expectations is statistically significant, but slightly weaker than the impact of forward-looking expectations (table 4 of the Annex), while their total value is comparable to the impact of imported inflation. The presence of both forward-looking and forward-looking inflation expectations in Uzbekistan is explained by the asymmetry and imperfection of information possessed by economic entities. At the same time, it was statistically confirmed that an important inflation factor in Uzbekistan is also a two-month lag in the change of the broad money supply, the impact of which on inflation is commensurate with the influence of inflation expectations. In conclusion, it should be noted that the assessment of a hybrid NKPC for a small open economy in relation to the conditions of Uzbekistan was the most qualitative in comparison with the previous two estimates, both in terms of the R-squared indicator and the values of the Prob (J - statistic). In this regard, it was concluded that the modeling of inflation dynamics in Uzbekistan according to the assessment presented in table 4 of the Annex is as close as possible to reality.

Let's start the analysis with the construction of VAR models, not imposing on it no restriction (VAR (p)), which include 5 endogenous variables: π_t , Δy_t, e_t ,r_t, ΔFX_t, following. Choose the vector of exogenous variables and the optimal value of the autoregressive order p in UVAR using information criteria.

We considered different sets of exogenous variables and chose the following: π_t^{gas}, π_t^* and fictitious variables ID, CRISIS and IT, responsible for the stages of development of macroeconomic processes. As shown in Chapter 1, the raw material structure makes the Russian economy susceptible to changes in resource prices so the inclusion of oil π_t^{gas} allows to control these shocks. Since the model uses the nominal exchange rate, but the competitiveness of domestic products is determined by the real exchange rate, therefore the inclusion of π_t^* makes it possible to consider the reaction of the economy (primarily output) to external price shocks. Moreover, the obtained equation directly contains π_t^*. The time trend turned out to be generally insignificant, so we do not consider it.

Annex 3 presents the results of choosing the autoregressive order p. According to the Schwartz criterion (effective for large samples, since it is asymptotically correct), the optimal value for p is 2, and according to the Akaike criterion – 4, which is better used for small samples. Wald's test for the exclusion of lags denies the joint hypothesis of the exclusion of the 4th lag, so choose p = 4. Diagnostic tests for the normality of residues and the presence of ARCH effects give acceptable results on the correctness of the specification. The results of the Granger test at a 5% significance level suggest that inflation is influenced by output and exchange rate. The exchange rate and the output act on each other in both directions, with international reserves also being the Granger cause for the exchange rate, which is quite intuitive, since the accumulation of reserves allows sterilizing excess export earnings, thereby affecting the exchange rate. Also, on international currency reserves affect the issue and the real interest rate. Signs, interpretation of effects and reaction to shocks will be considered in the built model of the VECM model. To do this, we first conduct a Johansen test for the presence of cointegration ratio between the analyzed endogenous variables.

Analysis of cointegration relations. The Johansen test is based on various assumptions about the deterministic trend. We assume that the variables follow a stochastic trend. The results of two types of test (LR test and maximum eigenvalue count test) are available in Appendix 4.

The results show that even at 80% of the significance level we can't deny the presence of no more than 3 co-integration ratios, but at 1% level deny the presence of 2 or less. Therefore, we can confidently conclude that there are 3 long-term dependencies. In addition, under alternative assumptions, the stability of the output is maintained.

Next, we choose which relations we will analyze as co-integration. To do this, we use the results of the causal test, economic principles and the model of Chapter 2. To

identify cointegration vectors, it is necessary to introduce at least 2 zero restrictions on the endogenous parameters in each of the cointegration equations.

As the results of the Granger test show, the issue and exchange rate affect inflation. For the exchange rate, this is due to changes in the prices of imported goods, which are included in the consumer basket, and for output – known result of the Phillips curve. We are going to consider the impact of these variables, so we will introduce the following restrictions: $\theta_r = 0, \theta_{FX} = 0$. The causal relationship between the real interest rate and international currency reserves in the direction of inflation is less obvious, so the restrictions are justified in terms of economic principles. Therefore,

$$\pi_t = \theta_t, \Delta y_t + \theta_e, \Delta e_\pi + \varepsilon_\pi \quad (3.1)$$

where it is expected that: $\theta_y > 0, \theta_t > 0$

Let's assume that the real interest rate follows the Taylor rule, which is represented as:

$$r_t = \alpha(\Delta y_t - y^*) + b(\Delta e_t - e^*) + c(\pi_t - \pi^*) + \varepsilon_{rt} \quad (3.2)$$

where a, b, C are the parameters showing how the real rate changes when the output, exchange rate and inflation deviates from the targeted values, respectively. In the most General case, the exchange rate is not included in the equation, and it is expected that a, c > 0. Intuitively, when inflation is higher than the target value, the Central Bank increases the nominal interest rate by a greater amount than inflation in order to "cool" the economy, so the real rate rises from the Fisher equation. Similarly, for the release. At the same time, since we considered the theoretical model of the Central Bank's target function, which depends on the exchange rate and inflation, instead of output, we analyze the impact of the exchange rate. Therefore, we introduce a restriction a > 0 and investigate as a second cointegration relation:

$$r_t = \alpha + b\Delta e_t + c\pi_t + \varepsilon_{rt} \quad (3.5)$$

where a_0 a is some constant. The expected signs b < 0, c > 0.

In the third co-integration ratio, reserves will be modeled because, as it was found, both inflation, and output, and the real interest rate are the reasons for the Granger for reserves. We propose the following intuition to explain this fact: inflation may lead to the fact that the attractiveness of the accumulation of reserves falls due to their impairment in real terms, the growth of output in Uzbekistan conditions associated with a favorable price external environment, so the chosen policy of excessive foreign exchange earnings sterilized in reserves.

$$\Delta FX = d_0 * g * \pi_t + h * \Delta y_t + \varepsilon_{\Delta FX} \quad (3.5)$$

where it is expected that g<0, h>0

Since we followed the same methodology as Homes and Ohnsorge (2005) in modeling inflation, and for the transfer effect, our results generally coincided with the results of the theoretical model, we will use the authors ' estimates for the earlier period 1996:4-2004:1. It follows that, at sufficiently high levels, the reduction of the transfer

effect was an additional obstacle to the reduction of inflation as an optimal response to this change in the transfer effect. Therefore, the Central Bank of Uzbekistan could not cope with a sufficiently high and stable inflation, even with the optimal chosen monetary policy.

This work is devoted to the modeling of macroeconomic processes in Uzbekistan's economy, the results of which determine the causes of the continuing high and stable inflation, while since 1998 the main goal of the proclaimed unified state monetary policy is to reduce the rate of price growth.

The external economic conditions determined by the state of the world hydrocarbon markets have a significant impact on the development and dynamics of macroeconomic processes, affecting the balance of payments of Uzbekistan. According to the results of the study, a model of inflation in Uzbekistan was obtained on the basis of the new Keynesian Phillips curve (NKPC). This was appreciated various modifications of this curve, including the standard NKPC, the NKPC for a small open economy and a hybrid form of the NKPC for a small open economy, which, along with rational expectations are considered, and adaptive expectations. The empirical assessment was carried out on stationary time series with January 1996 to December 2017 by applying the generalized method of moments (GMM).

Results of the NKPC assessments in relation to the dynamics of inflation processes in Uzbekistan have demonstrated the impact of forward-looking and forward-looking expectations of economic entities on inflation in Uzbekistan. So, being proactive and nasal spray expectations have a significant impact on the current inflation, the degree of influence of lookahead expectations slightly above the influence of nasal spray expectations. Presence of both forward-looking and forward-looking inflation expectations in Uzbekistan is explained by the asymmetry and imperfection of information possessed by economic entities. But at the same time, the fact that forward-looking expectations still prevail over the forward-looking expectations suggests that in Uzbekistan, most of the economic entities can make more rational decisions, having and analyzing information about resource prices, inflation in Russia, the exchange rate of sums to the us dollar, statements and measures implemented by the Central Bank of Uzbekistan, etc. Also, the results of empirical estimates showed that at the present time the impact on inflation in Uzbekistan of such a "classical" component of the new Keynesian Phillips curve as the deviation of average marginal costs from the equilibrium level is absent. This may be explained by the fact that most of the goods from the consumer basket in Uzbekistan are imported, so that their prices are not affected by domestic production costs. At the same time, the predominance of import component in the structure of Uzbekistan's consumption, mainly from Russia, explains the empirical result of the NKPC assessment, according to which inflation in Russia and the change in the nominal exchange rate of the dollar to the sum are identified as significant factors of

inflation in Uzbekistan. At the same time, as an" internal " macroeconomic factor of inflation in Uzbekistan, the doped dynamics of the broad money supply is determined.

Thus, according to the results of the study, it can be concluded that the measures of the regulator aimed at the formation of appropriate forecast inflation expectations can play an important role in achieving the inflation target within the framework of the inflation targeting regime conducted by the Central Bank of the Republic of Uzbekistan. At the same time, for effective inflation targeting in Uzbekistan, it is also necessary to take measures to localize the shocks of the nominal exchange rate of the dollar to the sum and Russian inflation, if they occur, as well as to increase control and the degree of impact on the volume of the broad money supply.

Further directions of development of the theoretical model presented in this paper can be the addition of inflation expectations and additional analysis of how the failure of the Central Bank to follow the pre-announced inflation values affects the parameters of the model. As a result, there may be a problem of dynamic inconsistency (time inconsistency problem), when the public understands that the declared targets for inflation will not be achieved, so expectations will change, and the decline in inflation will be relatively "expensive" policy. In the empirical part, we can consider how the choice of different proxies for the release and the introduction of alternative restrictions affect the stability of the estimates.

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