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MODELING OF KEY POLICY RATE USING SYSTEM DYNAMICS APPROACH

Optimal monetary policy ensures price stability and general trust of the nation's currency. It also contributes to the stability of gross domestic product, low unemployment, and predictable exchange rates with other currencies. In Ukraine, the authority responsible for monetary policy is the National Bank of Ukraine. The NBU's monetary policy prioritizes achieving and maintaining price stability, meaning low and stable inflation, which protects the incomes and savings of the households from depreciation and enables entrepreneurs to make long-term investments in the domestic economy, creating jobs.

Under the approach of inflation targeting, the central bank commits to meet the announced quantitative inflation targets over the medium term. The National Bank of Ukraine moved de facto to inflation targeting early in 2016. The transition to inflation targeting regime was made in order to response to the shortcomings of other regimes, such as inability to use exchange rate as nominal anchor, which was a result of economic overheating or exhaustion of international reserves. Also, there was no stable relationship between money growth and inflation due to ineffectiveness of monetary aggregates objectives. Other reasons were necessity for fast disinflation, strengthening of the central bank's independence and elimination of fiscal dominance.

The NBU ensures price stability by targeting inflation and by using the floating exchange rate of the hryvnia. The main instrument of the monetary policy has traditionally been a key policy rate. The central bank uses it to affect the economy, especially to achieve inflation targets. The process of transmitting a signal from the key rate to other interest rates and, in the end, to investment, consumption, and savings decisions is called the monetary transmission mechanism (see Figure 1).

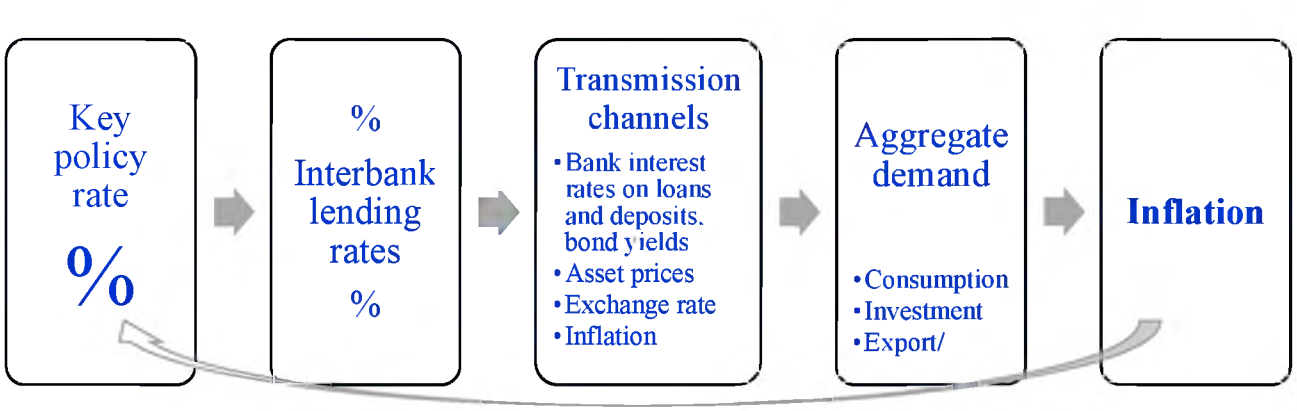

Figure 1. The diagram of monetary transmission mechanism

Initially, by changing the key policy rate, the NBU determines the level of short-term interest rates in the interbank market. In turn, the interbank rates influence aggregate demand and inflation, especially by changing the expectations of households and businesses. This influence takes place through various channels, including interest rates, the stock exchange, and foreign exchange market.

The significance of key policy rate in monetary policy induces the importance to predict how central banks should alter interest rates due to changes in the economy. The Taylor rule prescribes economic activity regulation by choosing the policy rate based on the inflation gap between desired (targeted) inflation rate and actual inflation rate; and the output gap between the actual and natural level. The rule is described by the equation:

$$i_t = \pi_t + r_t^* + a_\pi(\pi_t - \pi_t^*) + a_y(y_t - y_t^p), \text{ where}$$

i_t - target short-term nominal interest rate,

r_t^* - assumed equilibrium real interest rate,

π_t - rate of inflation,

π_t^* - desired rate of inflation (inflation target),

y_t - real gross domestic product,

y_t^p - potential output, as determined by a linear trend,

$a_\pi > 0,\ a_y > 0$ - coefficients.

As it follows from the Taylor rule, the necessary inputs to predict the policy rate are inflation, inflation target, actual GDP and potential GDP. The dynamics of these indicators during 2016-2020 years is shown on the figure 2. The time period was chosen with the regard to the fact that the key rate had little impact on bank rates before 2016. Until then, the NBU did not use it as a policy tool, since interest rates on the NBU's main transactions were not pegged to the key policy rate.

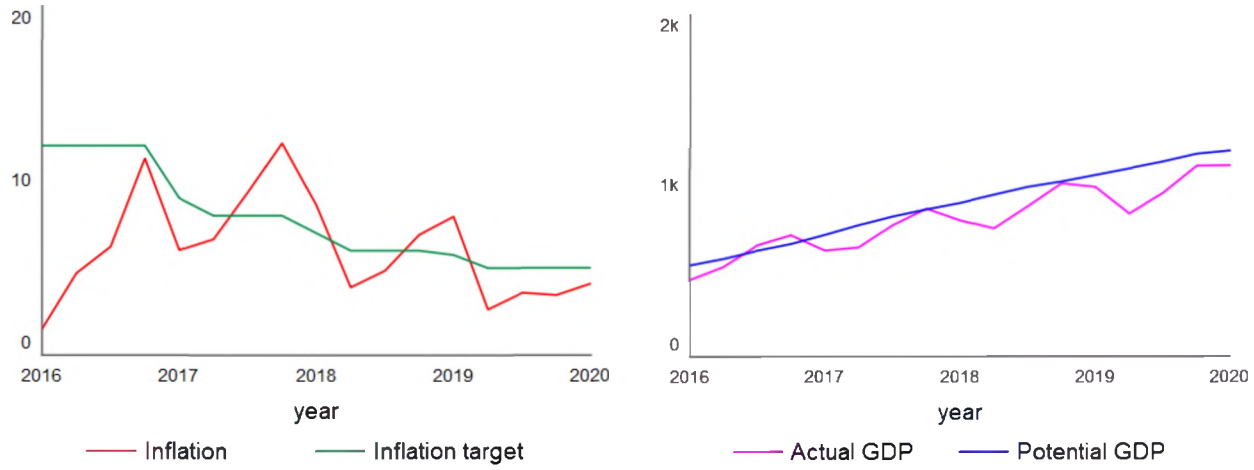

Figure 2. Inflation and GDP dynamics in Ukraine

As transmission via any channel takes some time, time lags in key policy rate transmission should be taken into consideration. According to the NBU, in Ukraine it takes 9–18 months for a change in the NBU's key policy rate to have a major effect on inflation. Therefore, central banks often change the key rate at times when the need for that shift is not obvious based on available inflation data. For example, central banks often reduce key rates amid growing current inflation or hike rates when inflation is on the decline. This is because central banks focus mainly on the most probable future trends rather than on current inflation.

Since the milestone of system dynamics is to understand the behavior of complex systems over time, system dynamics modeling is a valuable instrument to understand dynamics of key policy rate. The model analyzed below test behavioral hypothesis of key policy rate based on the modified Taylor rule and Ukrainian historical data. The stock of the model is the key policy rate, and the flow represents its change. Figure 3 shows the structure of the model.

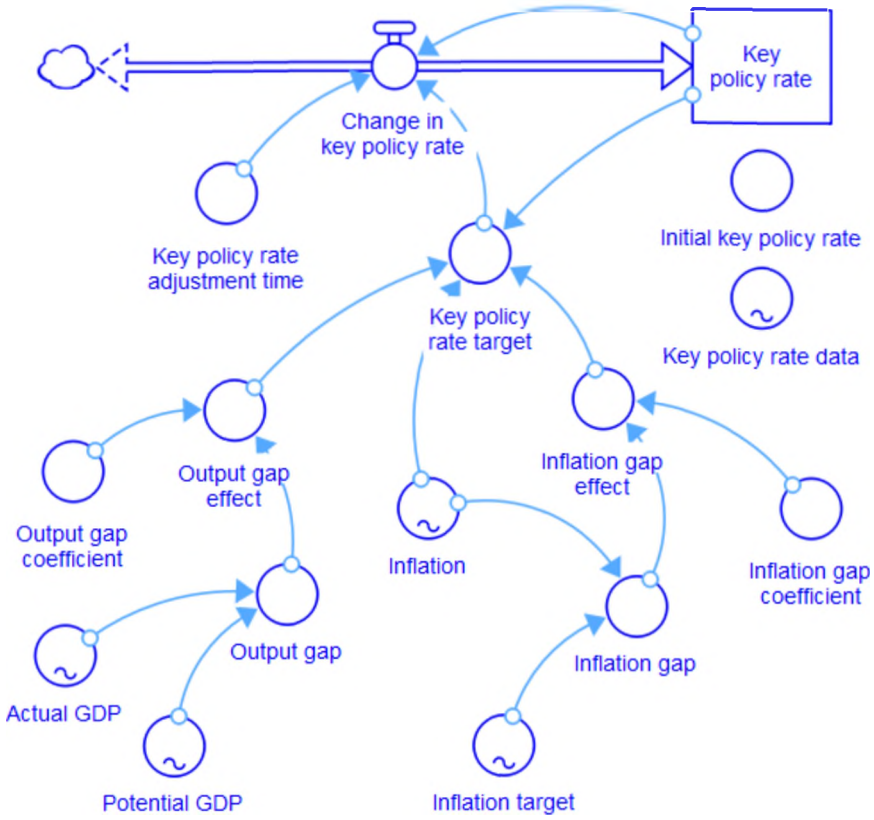

Figure 3. The model of key policy rate dynamics

There are 16 variables in the model. Exogenous variables, i.g. those whose value is determined outside the model and is imposed on the model, include inflation, inflation target, and actual GDP. Their values were taken from historical quarterly data from 2016 to 2020 published on the official site of the National Bank of Ukraine and the State Statistics Service of Ukraine. Initial key policy rate, which is equal to 22%, is the key policy rate in 1st quarter of 2016. Inflation and output gap coefficients are assumed to equal 0,5, and key policy rate adjustment time equals 1 quarter. Endogenous variables are determined by relationships with other variables within the model. The table 1 summarizes all the variables in the model and their relationships.