

SYSTEM DYNAMIC MODELING OF IMPACT OF PERMANENT DEMAND SHOCK ON INTEREST RATE AND INFLATION

Stabilization policy is a strategy enacted by a government or its central bank that is aimed at maintaining a healthy level of economic growth and minimal price changes. Sustaining a stabilization policy requires monitoring the business cycle and adjusting benchmark interest rates as needed to control abrupt changes in demand.

In the language of business news, a stabilization policy is designed to prevent the economy from excessive "over-heating" or "slowing down". We consider a natural base model where private behavior is backward- looking.

We suppose that the economy is described by two equations, one characterizing aggregate demand and the other characterizing aggregate supply. The equation of aggregate demand indicates that output depends negatively on the previous period's real interest rate. The equation aggregate- supply suggests that the change in inflation depends positively on the previous period's output. A change in the real interest rate does not affect the output until the next period and does not affect inflation until the period after that. This means that the policy is lagging and that it affects output faster than it affects inflation.

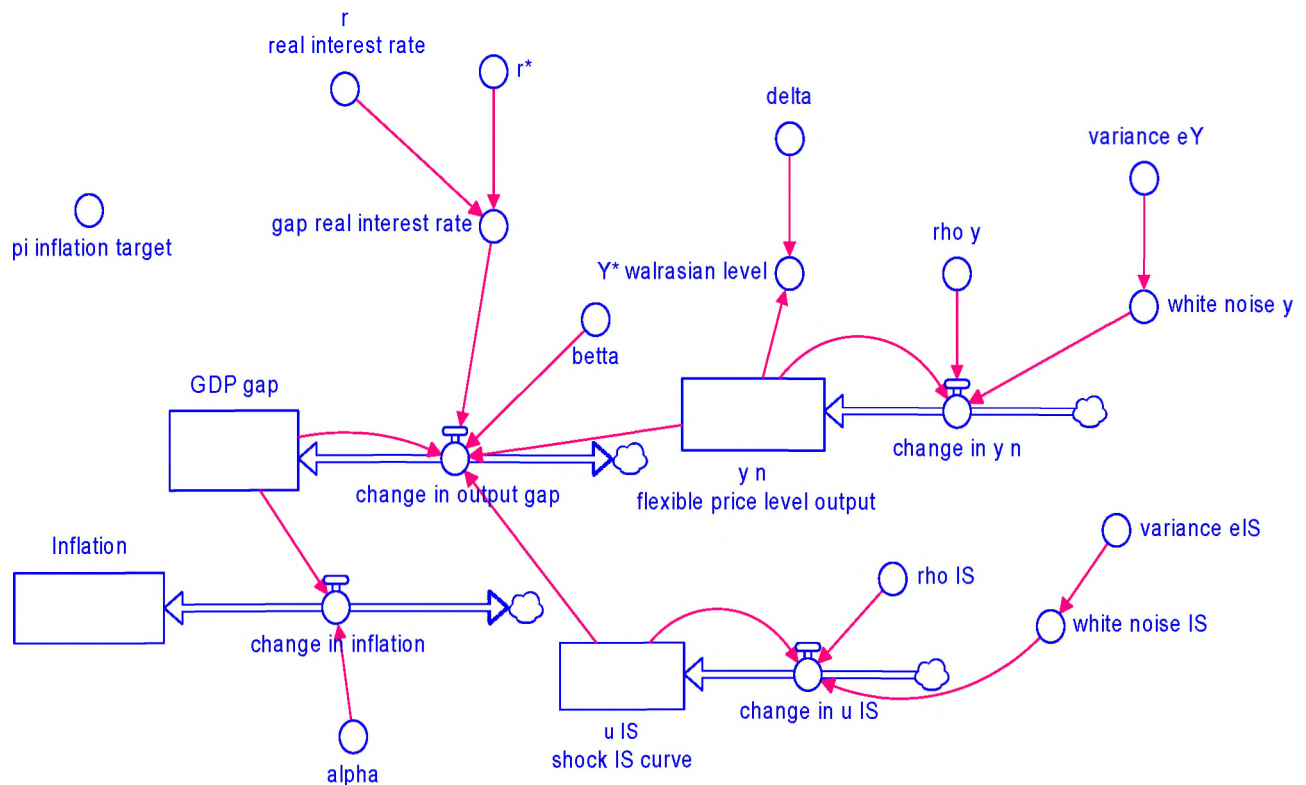


Figure 1. Simple Backward - Looking Model in System Dynamics

The model is described by such system of equation:

$$\begin{aligned}
 \text{change in } y^n &= (\rho_y - 1) * y^n \text{ flexible price level output} + \text{white noise } y & (1) \\
 \text{change in } u^{IS} &= (\rho_{IS} - 1) * u^{IS} \text{ shock IS curve} + \text{white noise IS} & (2) \\
 \text{change in output gap} &= -\beta * \text{gap real interest rate} + u^{IS} \text{ shock IS curve} - y^n & (3) \\
 & \text{flexible price level output} - \text{GDP gap} & (4) \\
 \text{change in inflation} &= \text{GDP gap} * \alpha & (5) \\
 \text{white noise } y &= \text{NORMAL}(0, \text{SQRT}(\text{variance } eY)) & (6) \\
 \text{gap real interest rate} &= r \text{ real interest rate} - r^* & (7)
 \end{aligned}$$

Also equation $y_t = -\beta r_{t-1} + u_t^{IS}$, $\beta > 0$ represent traditional curve IS.

The equation $\pi_t = \pi_{t-1} + \alpha(y_{t-1} - y_t^n)$, $\alpha > 0$ represent accelerations Phillips curve. The next two equations

$$\begin{aligned}
 u_t^{IS} &= \rho_{IS} u_{t-1}^{IS} + \varepsilon_t^{IS}, -1 < \rho_{IS} < 1, \\
 y_t^n &= \rho_Y y_{t-1}^n - \varepsilon_t^Y, 0 < \rho_Y < 1
 \end{aligned}$$

describe the behavior shocks to the IS curve and to the flexible-price level of output.

We assume that ε_t^{IS} and ε_t^Y are independent white- noise process.

If in this model put permanent shock in ε_t^{IS} , we have such dynamics:

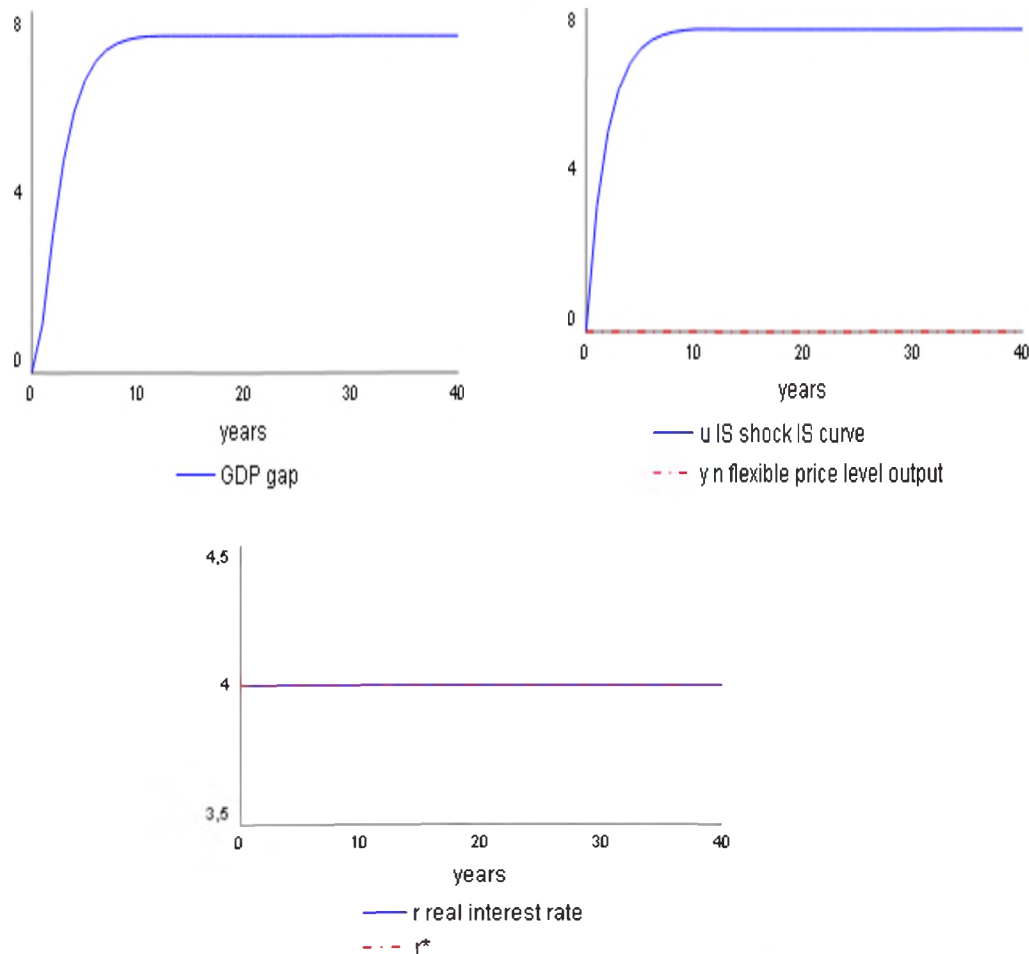


Figure 2. Permanent shock in ε_t^{IS}

Inflation is a quantitative measure of the rate at which the average price level of a basket of selected goods and services in an economy increases over a period of time. So that permanent shock in ε_t^{IS} causes GDP to deviate from its natural level, this leads to higher inflation. As a result, we are moving away from the desired level of inflation (target).

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MODELLING OF SIMPLIFIED INFLATION TARGETING SYSTEM

In 2015 year in Ukraine was implemented the inflation targeting policy of the National Bank of Ukraine (NBU). This policy is based on the two-side connection between the inflation level, measured as the Consumption Price Index (CPI), and the key policy rate. This connection works due to the monetary transmission mechanism, which acts through the finance, aggregate supply, and GDP gap channels from the rate to the inflation and through the expected inflation backwards. This model is simplified, so that only inflation, key policy rate and expected inflation are interconnected.

Expected inflation is the smoothed inflation, so that it comes with 1-month lag. Inflation gap is also put in this model as the connector between the inflation and the policy rate. It is considered as the difference between the expected inflation and the inflation target, set at 5 as it is in the Ukraine. Also, the model includes the neutral interest rate which is 1% when the inflation is at its target. The adjustment time of inflation changes is put 6 months because inflation slowly adjusts to the rate changes, whether the rate can change much faster, so its adjustment time is 1 month.

This model can show what would be if the NBU wanted to make its inflation target lower. This is modeled with the 1-basis point step of the target in the 6th month, so that the target is 4 after 6th month.