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Optimal Monetary Policy Framework in an Emerging Market Economy under Sanctions Pressure and Restrictions on Capital Flows

Abstract

The study evaluates the effectiveness of monetary policy regimes that can serve as the basis for economic policy strategies in emerging economies. Based on the macroeconomic gap model for Belarus, simulations of the strong shock impact on the economy using different monetary policy regimes have been implemented. The effects of capital flow restrictions on the stabilization capacity of monetary policy regimes have been examined. Given the existing sanctions and internal capital controls, the most preferable regime for Belarus is a flexible inflation targeting. In transforming the economy and political system towards the inclusivity of political and economic institutions, applying a flexible price-level targeting can be considered.

Keywords

monetary policy | inflation | price level | interest rate | gap model

JEL Codes

C32, E31, E52

1. Introduction

In Belarus, since the 1990s, monetary policy has been implemented under various regimes. For most of the historical period, the ability of the National Bank to set goals and use monetary policy instruments without government intervention was limited. As a result, except for a brief period from 2015 to mid-2020, monetary policy in Belarus tended to exacerbate negative shocks on the Belarusian economy rather than playing a stabilizing role (Kharitonchik, 2023b). Since mid-2020, the National Bank has de facto lost operational independence. Monetary policy has become discretionary, focusing on stimulating economic activity (Kharitonchik, 2023a).

The prolonged use of discretionary monetary policy in Belarus may sometimes conflict with the need to ensure macroeconomic stability. The question of stability may take precedence over the issue of economic growth due to the extremely high uncertainty of the development of the Belarusian economy and its strong vulnerability to shocks. In the case of democratic reforms in Belarus or their absence,

the activation of monetary policy tools may be required to prevent massive macroeconomic destabilization, which could have long-term negative consequences for economic growth (Ramey & Ramey, 1995; Raju & Acharya, 2020).

This study aims to assess the effectiveness of monetary policy regimes that can be considered as the basis for a monetary policy strategy. The evaluation proposes using a macroeconomic gap model, the specification and parameterization of which reflect key characteristics of the Belarusian economy and can be adapted for emerging markets economies.

Simulations of the impact on the Belarusian economy of shocks to both domestic and external economic conditions have been conducted based on the model. Additionally, simulation experiments were carried out in which the economy faced a set of random disturbances. Within these simulations, loss functions for flexible inflation targeting, flexible average inflation targeting, flexible price level targeting, and monetary targeting are calculated and compared. Special attention is given to the influence of capital flow restrictions on the effectiveness of these regimes.

The contribution of this research to the scientific literature on the issue of monetary policy regimes consists of three components. First, it explores the effectiveness of monetary policy regimes for a country with an emerging market – Belarus – unlike existing research predominantly focused on the USA, Canada, and the Eurozone. In this context, inflation and price level targeting regimes, as well as monetary targeting, which remains relevant for emerging market countries, are investigated. The second component involves the application of a macroeconomic gap model for a country with a small, non-commodity-dependent, highly state-interventionist economy, largely isolated from global capital markets, dependent on a single economic partner, and subject to strong sanctions. The third component studies the impact of strict capital flow constraints on the effectiveness of monetary policy regimes. We are not aware of scientific research exploring this problem.

The research is structured as follows: Section 2 presents the macroeconomic gap model for studying the effectiveness of monetary policy regimes. Section 3 discusses the results of simulations of the impact of domestic and external shocks on the Belarusian economy and evaluates the effectiveness of monetary policy regimes. Section 4 presents a robustness check. The conclusions are drawn in Section 5.

2. Macroeconomic model for assessing the prospects of monetary policy regimes

2.1. Structure of the Baseline Macroeconomic Model

The baseline model is a semi-structural macroeconomic gap model (Mæhle et al., 2021). Gap models have gained widespread use in the environment of international organizations and central banks, as they provide effective decision-making support in the field of monetary policy (Demidenko et al., 2016; Benes et al., 2017; Musil et al., 2018; Bokan & Ravnik, 2018; Hlédic et al., 2018; Grui & Vdovychenko, 2019; Abradu-Otoo et al., 2022).

Mathematically, a gap model is a system of equations that represents a steady state of the economy, satisfying equilibrium conditions in the long run. A gap model is based on reduced-form (log-linear)

equations of a complete DSGE model. This means that the key equations in gap models have an economic interpretation and, in contrast to econometric models, semi-structural gap models have a more robust theoretical foundation. Unlike DSGE models, gap model parameters do not impose strict structural constraints, and microeconomic variables are approximated by macroeconomic indicators. Given the limited statistical data for the Belarusian economy and the presence of multiple structural shifts, estimating structural parameters is significantly challenging. Largely due to the unreliability of statistical data, neither the economic, scientific literature nor the practice of the National Bank presents DSGE models based on actual data and satisfactorily describes them.

The advantages of gap models over full DSGE models lie in greater flexibility in approximating empirical data and accounting for country-specific features, as well as simplifying work with the model. A gap model has a flexible structure that allows incorporating expert judgments, is relatively simple to maintain, enables explaining the story of what is happening in the economy in a clear and internally consistent way, forms forecast scenarios, and develops recommendations for monetary policy design and for the application of certain measures of economic policy.

The above reasoning motivated the use of the gap model to assess the effectiveness of different monetary policy regimes in Belarus. The gap model for Belarus comprises eight blocks, four typical for countries with a small open economy (Berg, Karam & Laxton, 2006a, 2006b; Mæhle et al., 2021), and four are specific to Belarus.

The **aggregate demand block** describes the dynamics of the output gap (\hat{y}_t), which is the deviation of the real GDP (y_t) from its equilibrium level (\bar{y}):

$$\hat{y}_t = a_1 \hat{y}_{t-1} + a_2 E_t \hat{y}_{t+1} - a_3 mci_{t-1} + a_4 \hat{y}_t^* + a_5 \widehat{rwage}_{t-1} + a_6 fi_t + \varepsilon_t^{\hat{y}}. \quad (1)$$

The key factors driving the output gap are monetary conditions (mci_t), fiscal impulse (fi_t), the gap in real wages (\widehat{rwage}_t), and external demand gap (\hat{y}_t^*). Since some economic agents may make decisions based on rational expectations, the equation (1) includes the variable of expected output gap ($E_t \hat{y}_{t+1}$). The inertia component (\hat{y}_{t-1}) is incorporated into equation (1) due to the prolonged influence of economic factors on the output gap. The demand shock ($\varepsilon_t^{\hat{y}}$) approximates the impact of factors not directly considered in the model.

The fiscal policy and wages block determine the dynamics of consolidated budget expenditures in Belarus and wages.

The deviation of real non-interest budget expenditures (rfx_t) from its equilibrium level (\widehat{rfx}_t) defines the gap in budget expenditures (\widehat{rfx}_t). Due to the prolonged impact of budgetary policy on economic activity, the values of the budget expenditures gap are averaged over two quarters and used as an indicator of the fiscal impulse (fi_t).

Wages are included in the model due to the significant role of administrative influence on their size and changes in the Belarusian economy (Miksjuk, Pranovich, & Ouliaris, 2015). The assumption is made that nominal wages ($wage_t$) are rigid, their growth ($\Delta wage_t$) is modeled similarly to the Phillips curve (Musil et al., 2018):

$$\Delta wage_t = aa_1 E_t \Delta wage_{t+1} + (1 - aa_1) * \Delta wage_{t-1} + aa_2 \hat{y}_t - aa_3 \widehat{rwage}_{t-1} + \varepsilon_t^{\Delta wage}. \quad (2)$$

The dynamics of wages depend on the economy's cyclical position, approximated by the output gap. The nominal wage dynamics have a negative correlation with the gap in real wages (\widehat{rwage}_t): it accelerates if real wages ($rwage_t$) are below their equilibrium level (\widehat{rwage}_t) and decelerates otherwise. Equation (2) also includes components of rational expectations ($E_t \Delta wage_{t+1}$) and persistence ($\Delta wage_{t-1}$) as explanatory factors. Factors not directly accounted for in equation (2) are approximated by the shock of nominal wage growth ($\varepsilon_t^{\Delta wage}$).

The inflation block is represented by modified New Keynesian Phillips curves. The inflation rate (π_t) is measured by the annualized growth of the composite consumer price index, which serves as the target for the National Bank of Belarus's monetary policy.

Inflation is divided into the core (π_{core_t}) and non-core ($\pi_{noncore_t}$) components. Core inflation characterizes the change in prices not subject to direct administrative regulation. Non-core inflation characterizes the change in administratively regulated prices and prices for fruit and vegetable products. The connection between core and non-core inflation is established through the relative price (rp_t), which represents the ratio of the core consumer price index (p_{core_t}) to the composite index (p_t).

Modeling core inflation (3) assumes of price stickiness in the short term, i.e., the incomplete simultaneous transformation of costs into prices.

$$\pi_{core_t} = b_1 E_t \pi_{core_{t+1}} + (1 - b_1 - b_2) * \pi_{core_{t-1}} + b_2 \pi_{imp_t} + b_3 rmc_t + \varepsilon_t^{\pi_{core}}. \quad (3)$$

The dynamics of core inflation are determined by partially rational inflation expectations ($E_t \pi_{core_{t+1}}$) and partially adaptive ($\pi_{core_{t-1}}$), imported inflation (π_{imp_t}), real marginal costs (rmc_t), and an inflationary shock ($\varepsilon_t^{\pi_{core}}$), which approximates unaccounted inflationary factors in the model.

Real marginal costs (rmc_t) approximate additional costs to produce an additional unit of output and represent a combination of the output gap, real wages gap, and the real effective exchange rate of the Belarusian ruble gap (\hat{z}_t), adjusted for the gap in relative prices (4).

$$rmc_t = k_1 \hat{y}_t + k_2 \widehat{rwage}_t + (1 - k_1 - k_2) * (\hat{z}_t - \widehat{rp}_t). \quad (4)$$

To model non-core inflation, the specification proposed in Musil et al. (2018) is utilized. According to equation (5), the dynamics of non-core inflation is linked to rational ($E_t \pi_{noncore_{t+1}}$) and adaptive expectations ($\pi_{noncore_{t-1}}$), the gap in relative oil prices (\widehat{rpoul}_t), and the gap in the real effective exchange rate (REER), adjusted for relative prices.

$$\pi_{noncore_t} = bb_1 E_t \pi_{noncore_{t+1}} + (1 - bb_1) * \pi_{noncore_{t-1}} + bb_2 \widehat{rpoul}_t + bb_3 * (\hat{z}_t + \frac{weight}{1-weight} * \widehat{rp}_t) + \varepsilon_t^{\pi_{noncore}}. \quad (5)$$

The external trade block determines the dynamics of Belarus's trade in goods and services. The specification follows the approach presented by Mæhle et al. (2021). The direct recording of foreign trade transactions distinguishes the current model from those presented for Belarus in the scientific literature (Demidenko, 2008; Demidenko et al., 2016; Musil et al., 2018; Bezborodova & Vlček, 2018; Mironchik, Novopol'tsev & Kuznetsov, 2018; Kharitonchik, 2020).

The physical volumes of exports (x_t) and imports of goods and services (m_t) are decomposed into equilibrium components (\bar{x}_t and \bar{m}_t) and gaps (\hat{x}_t and \hat{m}_t). The exports gap (\hat{x}_t) is modeled as a function of external demand, approximated by the foreign output gap (\hat{y}_t^*), and the REER gap (\hat{z}_t), characterizing the price competitiveness of Belarusian exporters, considering the persistence of the export gap (6).

$$\hat{x}_t = c_1 \hat{x}_{t-1} + c_2 \hat{y}_t^* + c_3 \hat{z}_{t-1} + \varepsilon_t^{\hat{x}}. \quad (6)$$

The imports gap (\hat{m}_t) is modeled as a function of the output gap (\hat{y}_t), which approximates the demand for imports, and the REER gap (\hat{z}_t), considering the persistence of the import gap (7).

$$\hat{m}_t = d_1 \hat{m}_{t-1} + d_2 \hat{y}_t - d_3 \hat{z}_{t-1} + \varepsilon_t^{\hat{m}}. \quad (7)$$

In addition to the physical volumes of exports and imports, their prices also influence trade balance. The model considers terms of trade, which represent the ratio of export prices to import prices. Terms of trade (\hat{tot}_t) are decomposed into an equilibrium component (\widehat{tot}_t) and a gap (\widehat{tot}_t).

The deviation of the foreign trade balance in goods and services from its equilibrium level (\widehat{bop}_t) is approximated by the gap in the physical volumes of net exports, adjusted for the gap in terms of trade (8).

$$\widehat{bop}_t = \widehat{tot}_t + \hat{x}_t - \hat{m}_t. \quad (8)$$

The exchange rate block determines the dynamics of the effective exchange rate of the Belarusian ruble (9). The nominal effective exchange rate of the Belarusian ruble (NEER; s_t) is modeled as a combination of the rate obtained from a modified version of the uncovered interest rate parity condition (s_t^{uip}) and the rate corresponding to the state of external trade, taking into account the mechanism of currency interventions by the National Bank (s_t^{bop}).

$$s_t = (1 - h_1) * s_t^{uip} + h_1 s_t^{bop} + \varepsilon_t^s. \quad (9)$$

The specification of equation (9) differs from the canonical one and those presented earlier in models for Belarus due to the consideration of the state of external trade. The inclusion of the external trade factor is associated with the deepening isolation of Belarus's financial sector and the potential difficulty of arbitrage in financial markets after February 2022, when key sectors of the Belarusian industry and the financial sector were subjected to sanctions by the United States, the European Union, the United Kingdom, and several other countries.

The exchange rate (s_t^{uip}), derived from an uncovered interest rate parity condition (10), is determined by expectations of the exchange rate in the upcoming period ($E_t s_{t+1}$) and the differential between nominal interest rates in the money market in Belarus (i_t) and abroad (i_t^*), adjusted for the risk premium ($prem_t$).

$$s_t^{uip} = E_t s_{t+1} + \frac{i_t^* - i_t + prem_t}{4}. \quad (10)$$

The exchange rate (s_t^{bop}), corresponding to the state of external trade (11), is determined by the deviation of the trade balance from its equilibrium level, considering the smoothing of exchange rate dynamics by the National Bank through currency interventions. The latter is approximated by adding the trend change in the NEER ($\Delta \bar{s}_t$) to equation (11), calculated as the sum of the inflation targets differential in Belarus (π_t^T) and trading partner countries (π_{ss}^*), and the equilibrium change in the real effective exchange rate of the Belarusian ruble ($\Delta \bar{z}_t$).

$$s_t^{bop} = s_{t-1} + \frac{\Delta \bar{s}_t}{4} - h_2 \widehat{bop}_t. \quad (11)$$

The reaction function of monetary policy in the baseline model is represented by a modified Taylor rule for flexible inflation targeting (12). The National Bank of Belarus declares the use of a monetary targeting regime. However, Kharitonchik's (2023b) study results show that monetary targeting was applied in 2015 – the first half of 2016. From mid-2016 to mid-2020, the National Bank used the interbank market rate as the operational target for monetary policy, and its dynamics during this period were quite accurately described by the Taylor rule for flexible inflation targeting. Since mid-2020, the National Bank has implemented discretionary monetary policy, but since the beginning of 2024, measures have been announced for a gradual restoration of rules in the implementation of monetary policy.

$$i_t = mm_1 i_{t-1} + (1 - mm_1) * (\bar{r}_t + E_t \pi_{t+4}^4 + mm_2 * (E_t \pi_{t+3}^4 - \pi_{t+3}^T) + mm_3 \hat{y}_t) + \varepsilon_t^i. \quad (12)$$

The overnight ruble interbank market loans interest rate (i_t) is calculated by adding to the neutral interest rate ($\bar{r}_t + E_t \pi_{t+4}^4$) a premium determined based on the expected deviation of inflation from the target

$(E_t \pi_{t+3}^A - \pi_{t+3}^T)$ and the position of the economy in the business cycle, approximated by the output gap (\hat{y}_t). The lagged component (i_{t-1}) ensures the smoothing of the rate dynamics, reflecting the central bank's tendency to avoid excessive volatility in rates when applying an inflation-targeting regime in practice. The shock (ε_t^i) considers the central bank's discretionary actions.

The block of interest rates on the credit and deposit market determines the behavior of interest rates on new time deposits and new market loans for organizations and the population in Belarusian rubles. Accounting for these rates allows for a more comprehensive approximation of the monetary conditions compared to gap models presented in the literature for Belarus.

The model assumes that changes in the interbank market loan rate (IBL) are transmitted to the loan interest rates following a pattern identified in Kharitonchik's research (2019). The response of the average interest rate on ruble-denominated market loans to the population and organizations (i_{l_t}) to changes in the IBL rate is incomplete and reaches its maximum within two quarters after the shock. The average rate on new ruble time deposits for individuals and organizations (i_{d_t}) is modeled similarly based on econometric analysis results.

Ultimately, monetary conditions (mci_t) approximate the impact of monetary and exchange rate policy measures on economic activity through two primary channels of the transmission mechanism: the interest rate and the exchange rate (13):

$$mci_t = m_1 * (m_2 \hat{r}_t + m_3 \widehat{r_{l_t}} + (1 - m_2 - m_3) * \widehat{r_{d_t}}) - (1 - m_1) * \hat{z}_t. \quad (13)$$

Monetary conditions are a weighted combination of interest and exchange rates components. The interest rate component is calculated as the weighted average of the gaps in real rates on assets in Belarusian rubles: the overnight interbank market (\hat{r}_t), new market loans ($\widehat{r_{l_t}}$) and new time deposits ($\widehat{r_{d_t}}$). The REER gap (\hat{z}_t) approximates the intra-temporal substitution between imported and non-imported goods and the price competitiveness of Belarusian producers.

The external sector block describes the dynamics of output gap, inflation, money market interest rates, and exchange rates in Belarus's trading partner countries and oil prices. External variables for the output gap (\hat{y}_t^*), inflation (π_t^*), and nominal interest rate (i_t^*) are effective, meaning they are weighted averages considering the

significance of the economic partner. Belarus's economic partners in the model include Russia, the EU (Eurozone for inflation and interest rate), China, and the USA, approximating the rest of the world.

Equations governing the dynamics of external sector variables for individual countries are not structural but presented as autoregressive processes with exogenously determined steady states. Unobservable components are estimated in external variables using univariate filters with expert judgments, and the transformed data are directly introduced into the model. The complete structure of the model is available upon request.

2.2. Calibration of parameters of the baseline macroeconomic model

The model parameters were calibrated to account for stylized facts of the Belarusian economy, considering changes in its functioning after 2022, such as increased financial sector isolation, shifts in trade flows towards Russia, and changes in monetary and exchange rate policies.

Recommendations for emerging market countries (Berg et al., 2006a, 2006b), values from other studies, and expert judgments were considered during calibration. The calibration was based on the period from 2013 onwards, as this period vividly revealed structural imbalances in the Belarusian economy and witnessed changes in monetary policy and exchange rate regimes. The values of model parameters are presented in Table 1. The complete parametrization is available upon request.

To assess the realism of parameters calibration, the methods proposed in Mæhle et al. (2021) were employed (results available upon request), including: 1) the economic consistency demonstrated by impulse response functions; 2) the ability of the model to explain historical dynamics of macroeconomic variables (based on Kalman smoothing); 3) the accuracy of forecasting on historical data; 4) the parameters calibration verification via Bayesian estimation.

2.3. Monetary policy reaction functions in alternative regimes

The baseline model specification assumes the implementation of a flexible inflation targeting regime by the National Bank: the central bank responds with

Table 1. Values of key model parameters

Parameter	Value	Parameter	Value
Output gap		Core inflation	
a_1	0.55	b_1	0.35
a_2	0.05	b_2	0.09
a_3	0.20	b_3	0.20
a_4	0.35	Real marginal costs	
a_5	0.10	k_1	0.45
a_6	0.15	k_2	0.25
Wages		Non-core inflation	
aa_1	0.55	bb_1	0.60
aa_2	0.40	bb_2	0.05
aa_3	0.25	bb_3	0.10
Exports		Imports	
c_1	0.45	d_1	0.40
c_2	0.45	d_2	1.00
c_3	0.25	d_3	0.10
Exchange rate		Monetary policy reaction function	
h_1	0.30	mm_1	0.60
h_2	0.90	mm_2	0.55
Monetary conditions		mm_3	0.30
m_1	0.50		
m_2	0.15		
m_3	0.35		

Source: author's calculations

the interest rate to the expected deviation of inflation from the target and smoothens fluctuations in the economic cycle (14). Such a strategy does not include historical dependence: the National Bank does not seek to compensate for previous deviations of inflation from the target.

$$i_t = mm_1 i_{t-1} + (1 - mm_1) * (\bar{r}_t + E_t \pi_{t+4}^4 + mm_2 * (E_t \pi_{t+3}^4 - E_t \pi_{t+3}^T) + mm_3 \hat{y}_t) + \varepsilon_t^i. \quad (14)$$

Flexible price level targeting implies stabilizing the price level (p_t) near the target level of prices (p_t^T). The monetary policy reaction function takes the form of (15). It assumes that the central bank seeks to compensate for previous deviations of inflation from the target to return the price level to the targeted

trajectory. The price-level target corresponds to the dynamics of prices that increase at a constant rate π_t^T , corresponding to a sustainable inflation rate (16).

$$i_t = mm_1 i_{t-1} + (1 - mm_1) * (\bar{r}_t + E_t \pi_{t+4}^4 + mm_2 * (E_t p_{t+3} - E_t p_{t+3}^T) + mm_3 \hat{y}_t) + \varepsilon_t^i. \quad (15)$$

$$p_t^T = p_{t-1}^T + \frac{\pi_t^T}{4}. \quad (16)$$

Flexible average inflation targeting has limited historical dependence (18). The central bank aims to compensate for inflation's deviation from the target over N years to return the average inflation over N years to the target level (17). At the end of N years, the

observation remains outside the averaging period and becomes irrelevant—past deviations from the target are partially compensated.

$$\bar{\pi}_t^4 = \sum_{j=-4N+1}^0 \pi_{t+j}^4. \quad (17)$$

$$i_t = mm_1 i_{t-1} + (1 - mm_1) * (\bar{r}_t + E_t \pi_{t+4}^4 + mm_2 * (E_t \bar{\pi}_{t+3}^4 - E_t \bar{\pi}_{t+3}^T) + mm_3 \hat{y}_t) + \varepsilon_t^i. \quad (18)$$

Within the simulations, two specifications of the average inflation targeting regime are applied, differing in the number of periods for averaging: two and three years, respectively. A two-year averaging period was used in the study by Buseti et al. (2021) for the Eurozone, and a three-year period in the study by Wagner et. al (2022) for Canada. In the simulations, the parameters in the reaction functions (14, 15, 18) remain the same for all monetary policy regimes.

The monetary targeting regime assumes that the central bank seeks to maintain the money supply at the intermediate target level to achieve the inflation target. Given the intermediate money supply target, the interest rate on the money market becomes endogenous and settles at a level that balances the money supply and demand.

Nominal money (nm_t) is an observable variable – a broad aggregate of the money supply. Real Money (rm_t) is calculated by adjusting the nominal money by the consumer price index (p_t).

The economy's demand for real money balances (19–20) is represented by the real money demand function based on real GDP (y_t), the equilibrium velocity of money (\bar{v}_t) and the deviation of the nominal interest rate from its neutral level (nominal interest rate gap; \hat{i}_t).

$$\widehat{rm}_t = rm_t - (y_t - md_1 \hat{i}_t - \bar{v}_t). \quad (19)$$

$$\Delta rm_t = \Delta y_t - md_1 \Delta \hat{i}_t - \Delta \bar{v}_t - md_2 \widehat{rm}_{t-1} + \varepsilon_t^{\Delta rm}. \quad (20)$$

The demand for money increases with an increase in real GDP with a coefficient of 1.00. The equilibrium velocity of money characterizes stable changes in money demand, which may be related to technological

innovations and/or prolonged and inertial changes in the degree of the National Bank's credibility. The velocity of money negatively correlates with money demand with a value equal to 1.00.

The nominal interest rate gap is a factor explaining the fluctuations in the cyclical component of the velocity of money. It can approximate the speculative motive for holding money and/or short-term fluctuations in the National Bank's credibility. A negative correlation between the nominal interest rate gap and money demand is assumed. Parameter md_1 . It characterizes the semi-elasticity of money demand to the interest rate, and its value is calculated at 0.105 (Pelipas & Tochitskaya, 2023).

At any given time, the observed demand for money may deviate from the “desired” (or long-term) level determined by the abovementioned factors. Therefore, the equation (20) includes the variable \widehat{rm}_{t-1} . Temporary deviations of money demand from the long-term level are caused by short-term liquidity shocks, which are approximated by the shock $\varepsilon_t^{\Delta rm}$ in equation (20). The speed of adjustment of money demand to the long-term level is determined by the parameter md_2 , assumed to be 0.60 (Musil et al., 2018).

It is assumed that the dynamics of the money supply correspond to the intermediate target of the National Bank (Δnm_t^T). The intermediate target is set according to equation (21) as a function of changes in potential GDP ($\Delta \bar{y}_t$) and the equilibrium velocity of money ($\Delta \bar{v}_t$), the inflation target (π_t^T), and a shock ($\varepsilon_t^{\Delta nm^T}$), where the discretionary actions of the National Bank are approximated. This intermediate money supply target specification assumes that monetary policy will automatically loosen or tighten when the economic system deviates from the equilibria.

$$\Delta nm_t^T = \pi_t^T + \Delta \bar{y}_t - \Delta \bar{v}_t + \varepsilon_t^{\Delta nm^T}. \quad (21)$$

Monetary targeting assumes that the National Bank supports the money supply at an intermediate target level. As a result, the interest rate on the money market i_t^{MT} , which balances the demand and supply of money at the intermediate target level, is determined by equation (22).

$$\Delta nm_t^T = \pi_t + \Delta y_t - md_1 * ((i_t^{MT} - \bar{i}_t) - \hat{i}_{t-1}) - \Delta \bar{v}_t - md_2 \widehat{rm}_{t-1} + \varepsilon_t^{\Delta rm}. \quad (22)$$

2.4. Modeling the impact of strict capital flow restrictions

In the absence of free capital flows, the exchange rate becomes insensitive to changes in interest rates. The value of the national currency, under total capital flow restrictions, will be determined by the state of foreign trade and the mechanism of currency interventions by the central bank. Therefore, modeling scenarios of complete capital restrictions involves increasing the value of the parameter h_1 in equation (9) from 0.30 to 1.00. The parameters in the central bank's reaction functions remain unchanged because, under capital flow restrictions, the central bank still can implement independent monetary policy.

3. Efficiency of Monetary Policy Regimes in Scenario Simulations

3.1. Design of simulations

To evaluate the effectiveness of monetary policy regimes, simulations are implemented for two types of strong macroeconomic shocks in scenarios deemed realistic.

In the first case, a scenario of a sharp deterioration in domestic economic conditions is simulated. The calibration for this scenario is based on the actual dynamics of Belarus's macroeconomic indicators in the first and second quarters of 2022 when the Belarusian economy faced a powerful negative sanctions shock. In the initial simulation period, negative gaps are introduced in output, physical volumes of exports and imports amounting to 6.7%, 13.5%, and 21.9%, respectively. The Belarusian ruble weakens by 8.9% in terms of the nominal effective exchange rate, and there is an increase in the annualized quarterly core inflation by 21.9 p.p.

The second scenario envisions a sharp deterioration in economic conditions in Russia, to which the dependence of the Belarusian economy has increased in 2022-2023. The calibration for this scenario is based on the dynamics of Russia's macroeconomic indicators in the fourth quarter of 2014 to the second quarter of 2015, when the Russian economy experienced a sharp decline in output, coupled with the devaluation of the national currency and a spike in inflation. The simulation

incorporates the formation of a negative output gap in Russia of 2.3% in the first period, expanding by 0.8 p.p. in the second period. Additionally, there is an increase in the annualized quarterly inflation rate in Russia by 10 p.p. in the first period and an additional 8.4 p.p. in the second period. The interbank rate in Russia is raised by 4.1 p.p. in the first period and an additional 4.4 p.p. in the second period. Furthermore, there is an increase in the risk premium for investments in assets denominated in Belarusian rubles by 5.3 p.p. in the first period.

Both scenarios for each monetary policy regime are simulated twice: within the framework of the baseline model specification and for the model specification with capital flow restrictions. In all simulations, the economic system is in a steady state until the shock occurs, and the shock itself is unexpected – economic agents have no information about the shock until its occurrence.

3.2. Criterion for the effectiveness of monetary policy regimes

As a criterion for the effectiveness of alternative monetary policy strategies, a quadratic loss function (28) is employed:

$$L_t = 0.5(\pi_t^4 - \pi_t^T)^2 + 0.5(p_t - p_t^T)^2 + \lambda \hat{y}_t^2 + \gamma(i_t - i_{t-1})^2. \quad (28)$$

The quadratic functional form aligns with the academic literature (Woodford, 2003; Svensson, 2020) and assumes that the central bank perceives large deviations in macroeconomic variables as much costlier than their small volatility.

The challenge in comparing the effectiveness of monetary policy regimes lies in the fact that each loss function is specific due to different target variables (Svensson, 2020). Therefore, using an ad-hoc loss function (Buseti et al., 2021), assuming the inclusion of variations in inflation and output, appears debatable. To overcome this issue in this study, the loss function considers the inflation indicator and the price level. It also considers that for economic agents, additional costs are associated with prolonged changes in the overall price level in the economy and their short-term fluctuations.

As a result, the optimal monetary policy involves minimizing losses, approximated by a weighted sum

of squared variations in the price dynamics indicator (the average between deviations of year-on-year inflation (π_t^4) and the price level (p) from their stable values), the output indicator's variation (deviation of GDP from the equilibrium level – output gap (\hat{y})) and the nominal money market interest rate's variation (change in the interest rate (i_t) compared to its value in the previous period).

Including the interest rate in the loss function aims to account for the adverse consequences of rate volatility for economic agents, especially the potential negative effects of abrupt and substantial changes on financial and macroeconomic stability (Woodford, 2003; Alstadheim & Røisland, 2017; Dorich et al., 2021; Wagner et. al., 2022). The significance of interest rate volatility in the loss function for emerging market economies appears ambiguous. On the one hand, the γ parameter might be lower than developed countries due to economic agents adapting to higher historical interest rate variability. On the other hand, the resilience of emerging market economies to shocks may be much weaker compared to developed countries. Additionally, the level of central bank credibility in emerging market countries may be lower compared to developed countries, and high interest rate volatility may not contribute to strengthening its signaling function and gaining trust in the central bank. Taking these considerations into account, this study applied a set of $\gamma=[0.25;0.50;0.75]$ when calculating loss functions. In accordance with Buseti et al. (2021), the parameter λ , determining the significance of the output gap in the loss function is set to 0.50.

The resulting indicator is the average value of the loss function over twelve consecutive periods from the shock impact. This corresponds to a three-year time horizon relevant for monetary policy. Monetary policy does not directly impact long-term economic growth and other equilibrium macroeconomic variables, the dynamics of which are determined by structural factors. Therefore, considering time horizons beyond the medium term is less relevant for assessing the effectiveness of monetary policy regimes.

3.3. Results of simulation of a scenario of worsening domestic economic conditions

Table 2 presents the standard deviations of the output gap $\sigma(\hat{y})$, year-on-year inflation $\sigma(\pi^4)$, price level $\sigma(p)$, and changes in the nominal interest rate $\sigma(\Delta i)$, as well

Table 2. Simulation results of a scenario of worsening domestic economic conditions: Baseline model specification

Indicator	Monetary policy regime				
	FIT	AIT (2Y)	AIT (3Y)	PLT	MT
$\sigma(\hat{y})$	2.8	2.9	2.8	3.2	3.5
$\sigma(\pi^4)$	5.0	5.1	5.2	5.3	4.4
$\sigma(p)$	8.5	7.7	8.1	6.5	5.3
$\sigma(\Delta i)$	1.2	0.8	0.7	1.1	12.1
$L(\gamma=0.25)$	52.8	47.5	50.8	40.7	66.3
$L(\gamma=0.50)$	53.2	47.7	50.9	41.0	103.0
$L(\gamma=0.75)$	53.6	47.8	51.1	41.3	139.7

Source: author's calculations.

Note: Here and further, standard deviations are calculated for the deviations of the relevant variables from their equilibrium levels. Standard deviations and loss functions are calculated over a horizon of twelve quarters after the shock (including the period of occurrence of the shock). Here and further, FIT – flexible inflation targeting; AIT (2Y) and AIT (3Y) – flexible average inflation targeting with an averaging period of two and three years, respectively; PLT – flexible price level targeting; MT – monetary targeting.

as the resulting values of the loss function (L) within the simulation of the scenario of a sharp deterioration in domestic economic conditions based on the baseline model specification for different monetary policy regimes.

Applying flexible price level targeting ensures the lowest losses in the scenario of deteriorating domestic economic conditions. This is attributed to the much smaller deviation of the price level from the target level in this regime compared to the alternatives. The monetary targeting regime can achieve even lower volatility in prices and inflation compared to flexible price level targeting. However, this is achieved through extremely high interest rate volatility and, consequently, increased output volatility (Figure 1). Therefore, losses increase significantly when employing monetary targeting if the strong volatility of the interest rate has negative consequences for the economy.

The flexible inflation targeting regime provides the lowest output volatility and lower inflation volatility compared to flexible average inflation targeting and price level targeting (Figure 1). However, since there

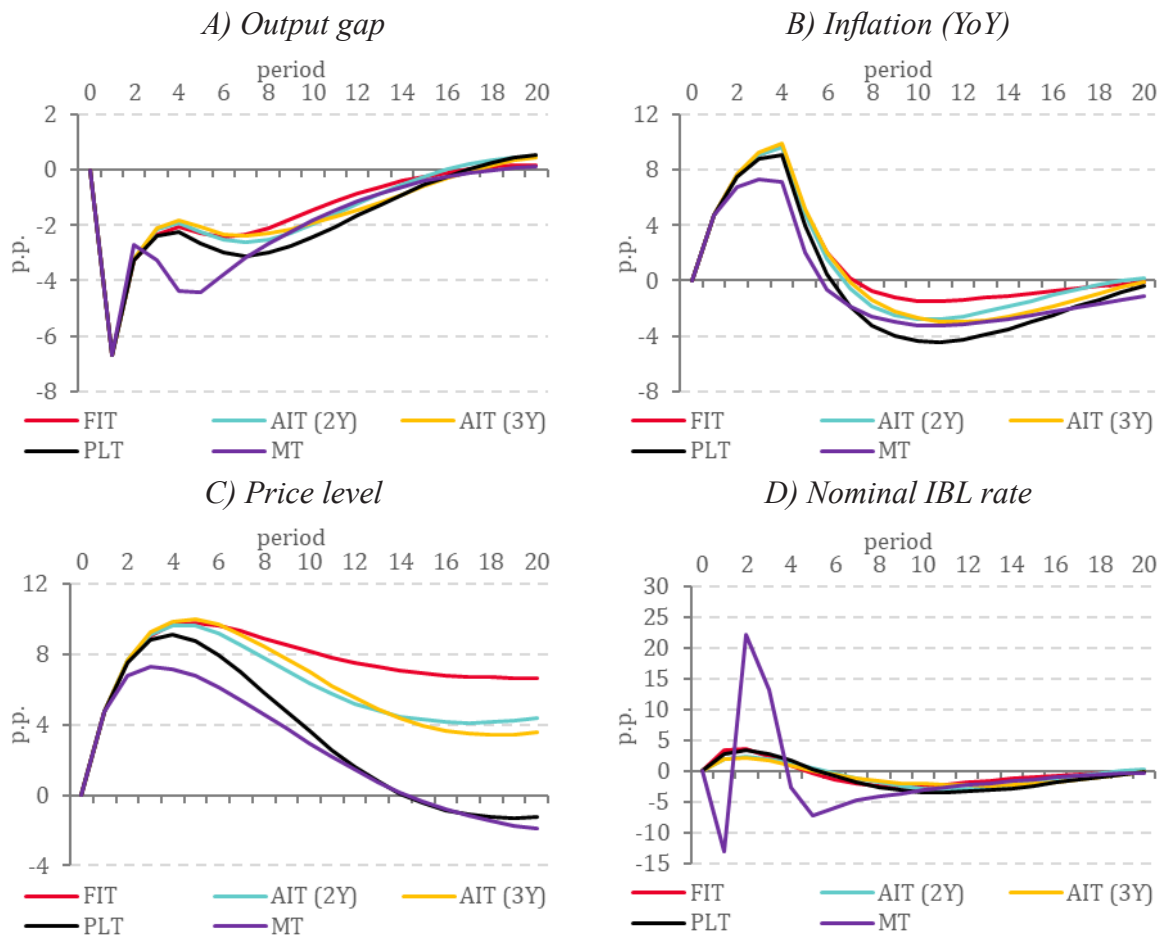


Figure 1. Reaction of macroeconomic indicators to the shock of deterioration in domestic economic conditions: Baseline model specification
Source: author's calculations
Note: Here and further, the figure shows impulse response functions in the form of deviations of variables from sustainable equilibrium levels

is no historical dependence in inflation targeting, deviations in the price level become constant and increase total losses.

The application of flexible average inflation targeting allows for achieving the lowest interest rate volatility. However, it lags behind the flexible price level targeting regime in the ability to return prices to an equilibrium trajectory. Additionally, averaging inflation over a two-year horizon results in lower losses than averaging over a three-year period.

Under strict capital flow restrictions, the most effective response to a sharp deterioration in domestic economic conditions is the flexible inflation targeting regime (Table 3).

Strict capital controls are equivalent to the active use of currency interventions by the central bank to smooth excess exchange rate volatility. As a result, the deviation of the price level from the equilibrium

trajectory is less significant in this simulation compared to the baseline model specification. Consequently, the ability of inflation targeting to stabilize output, inflation, and interest rates effectively makes losses in this regime the lowest (Figure 2).

Overall, losses in response to a sharp deterioration in domestic economic conditions are significantly lower under strict capital flow restrictions. This can be explained by the lower volatility of the exchange rate and its faster stabilization after a sharp depreciation during the shock period. From a model perspective, strict capital flow restrictions can also be interpreted as the central bank's active use of currency interventions to smooth exchange rate volatility. Simulation results indicate that during sharp exchange rate adjustments, currency interventions may be justified to counteract the rapid increase in devaluation and inflation expectations, which could negatively impact financial stability. However, currency interventions should be

Table 3. Simulation results of a scenario of worsening domestic economic conditions: Strict restrictions on capital flows

Indicator	Monetary policy regime				
	FIT	AIT (2Y)	AIT (3Y)	PLT	MT
$\sigma(\hat{y})$	2.9	3.1	3.1	3.2	3.3
$\sigma(\pi^4)$	5.2	6.0	5.9	6.3	5.7
$\sigma(p)$	6.0	5.7	5.8	5.6	4.7
$\sigma(\Delta i)$	1.3	1.1	1.0	1.4	13.9
$L(y=0.25)$	35.9	39.3	39.5	41.3	80.6
$L(y=0.50)$	36.3	39.6	39.7	41.8	128.8
$L(y=0.75)$	36.8	40.0	40.0	42.3	177.0

Source: author's calculations.

employed only to smooth volatility and should not oppose the formation of exchange rate dynamics consistent with its equilibrium trajectory in the medium term.

3.4. Results of simulation of a scenario of worsening external economic conditions

When facing a negative external shock, the monetary targeting regime demonstrates the greatest stabilization capacity (Table 4). However, similar to the shock of deteriorating domestic economic conditions, the stabilization of inflation and the price level in the monetary targeting regime is achieved through high interest rate volatility (Figure 3). The required variability of the interest rate may generate nonlinear

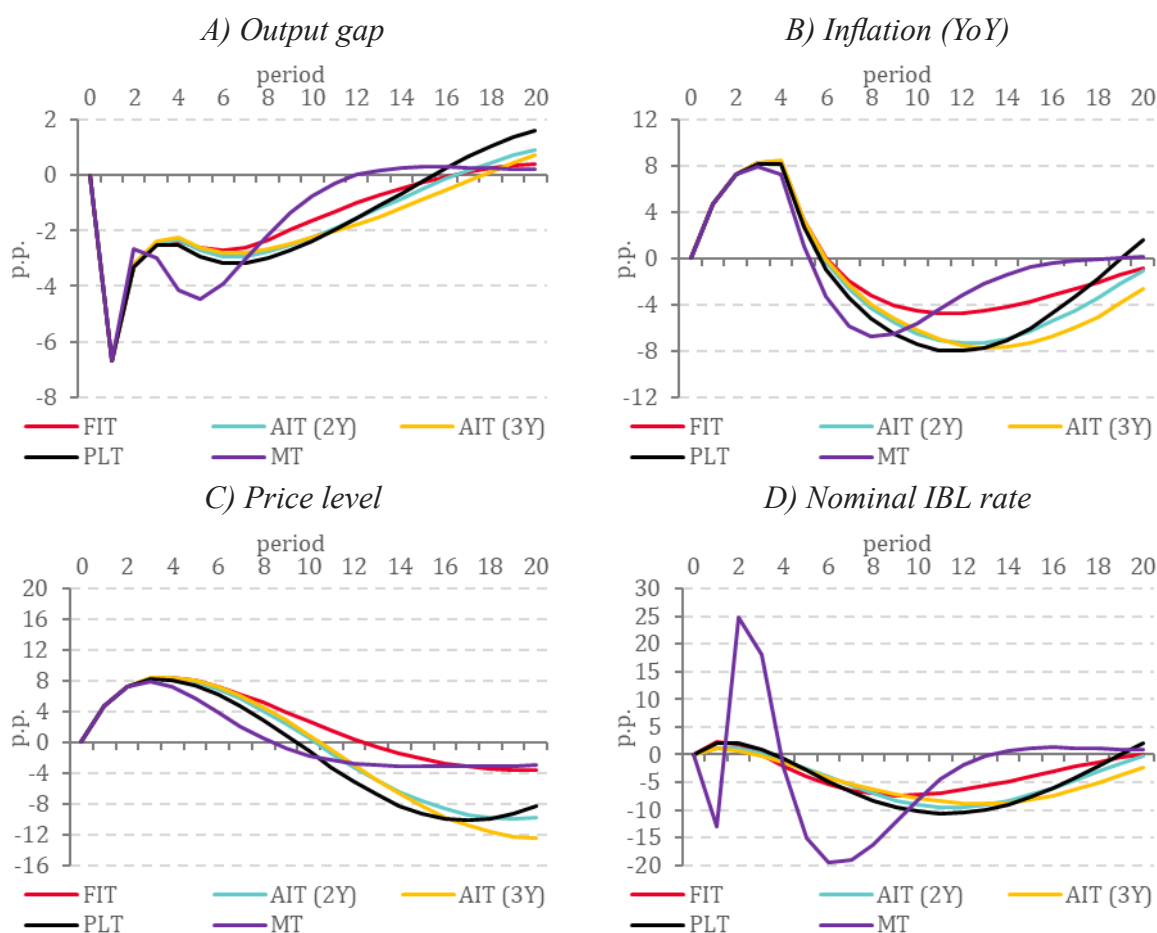


Figure 2. Reaction of macroeconomic indicators to the shock of deterioration in domestic economic conditions: Strict restrictions on capital flows
Source: author's calculations.

Table 4. Simulation results of a scenario of worsening external economic conditions: Baseline model specification

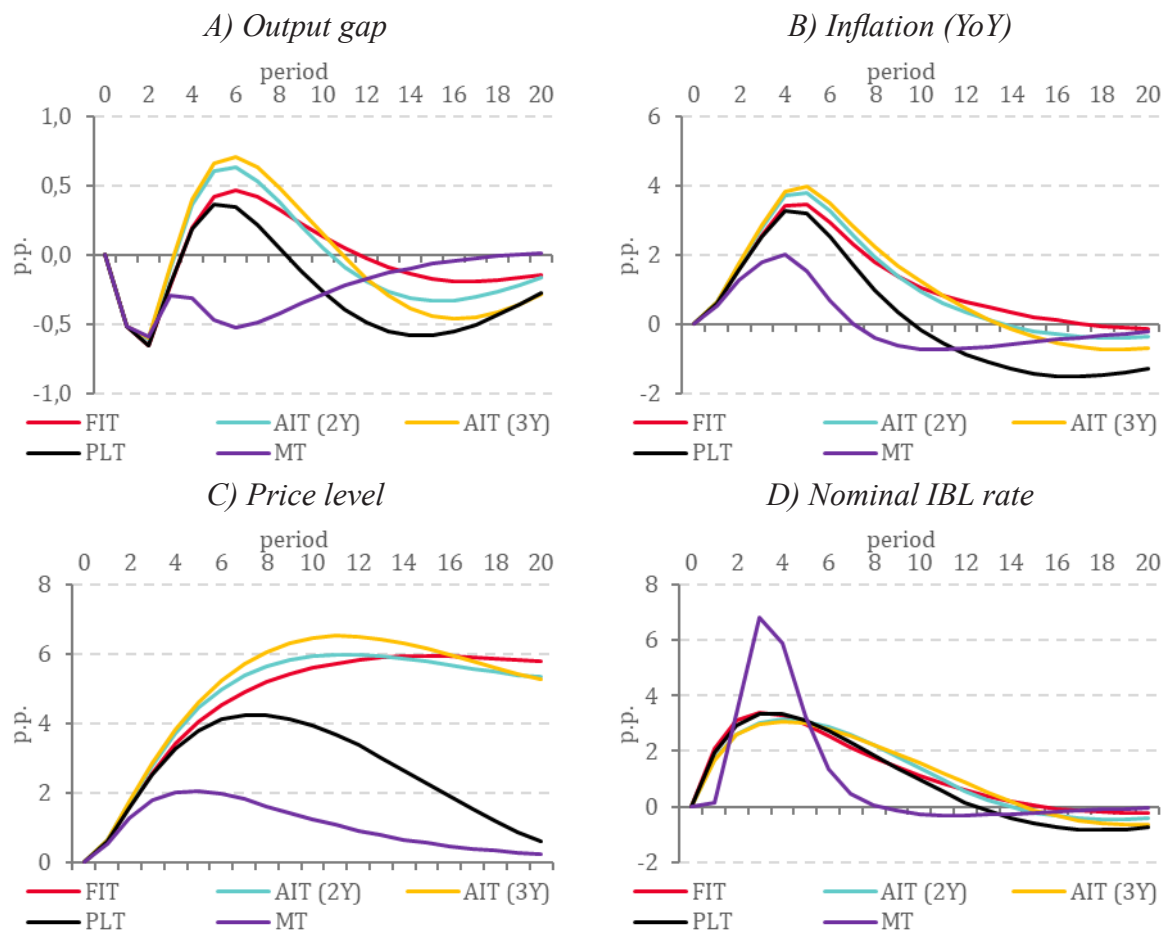
Indicator	Monetary policy regime				
	FIT	AIT (2Y)	AIT (3Y)	PLT	MT
$\sigma(\hat{y})$	0.4	0.4	0.5	0.4	0.4
$\sigma(\pi^d)$	2.1	2.3	2.5	1.9	1.1
$\sigma(p)$	4.4	4.8	5.1	3.5	1.5
$\sigma(\Delta i)$	0.7	0.6	0.6	0.7	1.7
$L(y=0.25)$	12.3	14.2	16.2	8.0	2.6
$L(y=0.50)$	12.5	14.3	16.3	8.1	3.3
$L(y=0.75)$	12.6	14.4	16.4	8.3	4.1

Source: author's calculations

negative effects for the economy that are beyond the scope of the proposed macroeconomic model. In the context of emerging market economies, such effects may include surges in inflation and devaluation expectations, which could adversely affect financial and macroeconomic stability.

The flexible price level targeting regime exhibits better stabilization capacity when simulating a shock of deteriorating external economic conditions compared to the flexible inflation targeting and flexible average inflation targeting regimes. Moreover, the required adjustment of the interest rate in the price level targeting regime is much smaller than in the monetary targeting regime (Figure 3). Flexible inflation targeting allows for smaller losses than flexible average inflation targeting (Table 4).

Under strict capital flow restrictions, flexible price level targeting becomes the most effective response to the shock of worsening external economic conditions

**Figure 3.** Reaction of macroeconomic indicators to the shock of worsening external economic conditions: Baseline model specification

Source: author's calculations

Table 5. Simulation results of a scenario of worsening external economic conditions: Strict restrictions on capital flows

Indicator	Monetary policy regime				
	FIT	AIT (2Y)	AIT (3Y)	PLT	MT
$\sigma(\hat{y})$	0.3	0.3	0.3	0.3	0.4
$\sigma(\pi^d)$	1.2	1.3	1.3	1.1	1.2
$\sigma(p)$	2.4	2.6	2.8	1.9	1.1
$\sigma(\Delta i)$	0.4	0.3	0.3	0.4	2.1
$L(y=0.25)$	3.7	4.3	4.8	2.4	2.6
$L(y=0.50)$	3.7	4.3	4.9	2.5	3.7
$L(y=0.75)$	3.8	4.3	4.9	2.5	4.8

Source: author's calculations

(Table 5). In this case, the effectiveness of monetary targeting decreases, especially when giving significant weight to interest rate volatility in the loss function. Overall, the interest rate trajectory in the monetary targeting regime looks “undesirable” for the central bank, as sharp increases and decreases in the rate are challenging to communicate (Figure 4). With strict capital flow restrictions, inflation targeting becomes relatively more effective.

4. Assessing the robustness of the results

The presented simulations of the impact of shocks on domestic and external economic conditions show the conditional effectiveness of monetary policy regimes in large-scale yet realistic scenarios. To verify the obtained results, conducting an unconditional

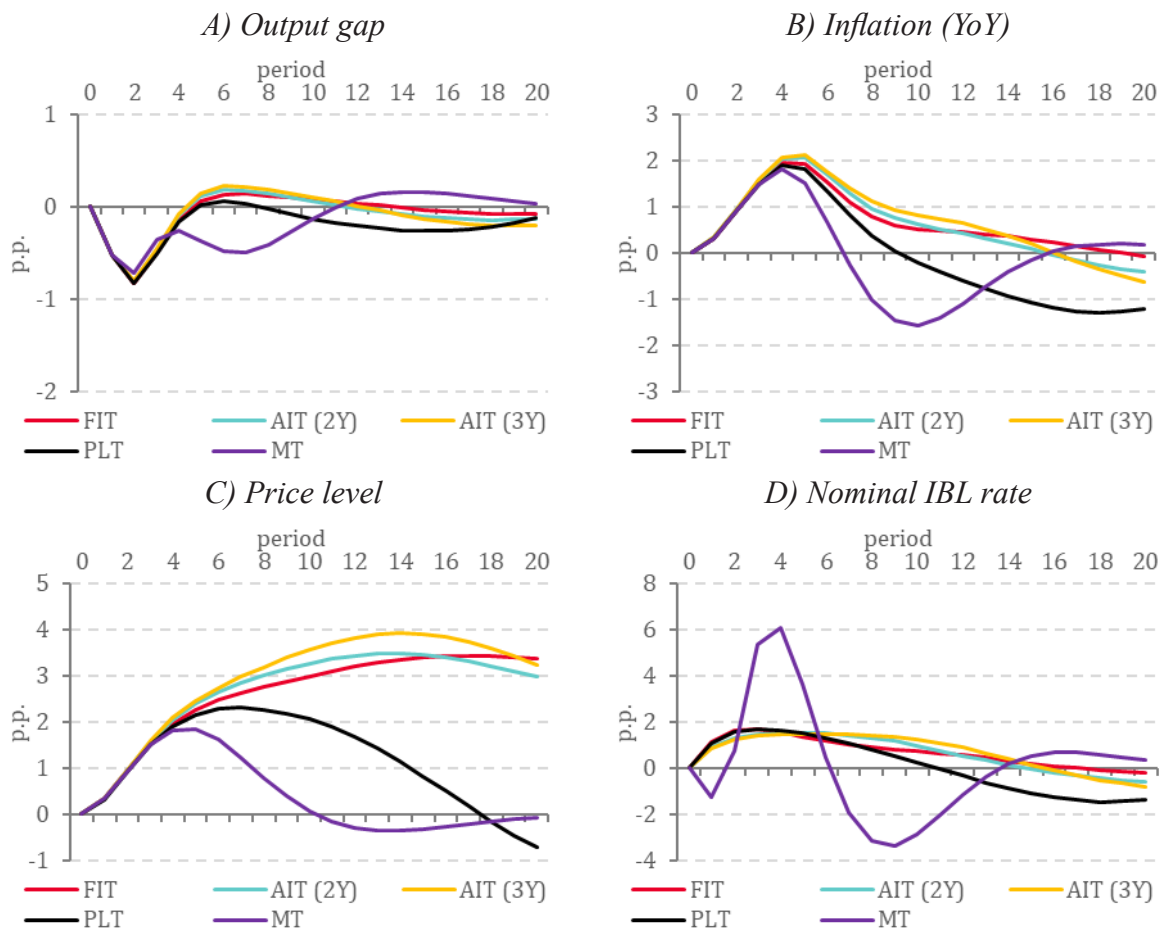


Figure 4. Reaction of macroeconomic indicators to the shock of worsening external economic conditions: Strict restrictions on capital flows
Source: author's calculations

Table 6. Efficiency of monetary policy regimes in an unconditional simulation experiment: Baseline model specification

Indicator	Monetary policy regime				
	FIT	AIT (2Y)	AIT (3Y)	PLT	MT
($\gamma=0.25$)	2.3	3.6	4.7	1.6	2.8
$L(\gamma=0.50)$	2.1	3.4	4.5	1.5	3.5
$L(\gamma=0.75)$	2.1	3.4	4.2	1.5	3.8

Source: author's calculations

Note: the table presents the average values of the ranks of monetary policy regimes

analysis that does not explore specific scenarios is also advisable.

For such an analysis, simulation experiments were implemented for each model specification (baseline and strict restrictions on capital flows). The economy, in which the National Bank applies one of the considered monetary policy regimes, faces a random shock of unit magnitude over twelve consecutive periods (a three-year time horizon relevant for monetary policy). To ensure many possible shock combinations in the analysis, simulations for each regime and model specification were performed ten times.

For each simulation, the losses according to the loss function (28) were calculated for the respective monetary policy regimes. Within each of the ten simulations (for a specific model specification), the monetary policy regimes were ranked in descending order of their stabilization ability – from the lowest loss value to the highest. The resulting indicator of the regime's effectiveness is the average value of its rank. The ranking was used instead of averaging loss function values to exclude the distorting influence of high-amplitude shock combinations on the results.

The simulation experiment results within the baseline model specification (Table 6) confirm the high efficiency of the flexible price level targeting regime for stabilizing the economic system under the influence of macroeconomic shocks.

The second most effective is the flexible inflation targeting regime, while the flexible average inflation targeting regimes demonstrate the lowest stabilization ability. The monetary targeting regime potentially has a high capacity to smooth inflation volatility, price levels, and output during the shock impact period. However, this comes at the cost of significantly

Table 7. Efficiency of monetary policy regimes in an unconditional simulation experiment: Strict restrictions on capital flows

Indicator	Monetary policy regime				
	FIT	AIT (2Y)	AIT (3Y)	PLT	MT
($\gamma=0.25$)	2.7	3.9	4.9	1.7	1.8
$L(\gamma=0.50)$	2.4	3.7	4.7	1.6	2.6
$L(\gamma=0.75)$	2.3	3.6	4.5	1.5	3.1

Source: author's calculations

Note: the table presents the average values of the ranks of monetary policy regimes

increasing interest rate volatility: the average rank of monetary targeting noticeably decreases when assigning greater importance to interest rate changes in the loss function (Table 6), and the volatility of the interest rate in this regime is on average more than six times higher compared to other considered monetary policy regimes.

The conclusions about the comparative effectiveness of monetary policy regimes, in general, remain unchanged when the simulation experiment is conducted under conditions of strict capital flow restrictions (Table 7).

5. Conclusion

This study analyzed the effectiveness of monetary policy regimes in Belarus. A macroeconomic gap model was developed for the analysis, and its specification and parameterization reflect the key characteristics of the Belarusian economy, making it suitable for economies with emerging markets.

The results of simulations on the impact of shocks to both domestic and external economic conditions, as well as unconditional analyses within simulation experiments affecting the economy with a set of random disturbances, show that the most effective monetary policy strategy for Belarus could be flexible price level targeting. Monetary targeting can also be effective for stabilizing inflation and price levels. However, this effectiveness is achieved through extremely high volatility in interest rates, which may have significant nonlinear negative effects on macroeconomic and financial stability beyond the proposed macroeconomic model. The most stabilizing

regimes under strict capital flow restrictions are flexible inflation targeting and flexible price level targeting.

In the case of Belarus, the use of flexible inflation targeting appears to be the most preferable. Given existing sanction limitations and internal and external measures to control capital flows, flexible inflation targeting may be the most effective monetary policy strategy in the face of strong economic shocks. The application of monetary targeting may be challenging, as the extremely high volatility in interest rates it generates may hinder public trust in the National Bank and have unfavorable consequences for financial and macroeconomic stability.

During the transformation of the Belarusian economy and political system towards the inclusivity of political and economic institutions, considering the application of a flexible price level targeting regime is advisable. Effective application of a flexible price level targeting regime requires a return to reasonable rules in the conduct of monetary policy, a clear communication policy of the National Bank, and a high degree of the National Bank's credibility. Given the current political regime and approaches to economic policy in Belarus, this seems extremely unlikely. Consequently, price level targeting requires a transformation of political and economic institutions.

This study focuses on model simulations of the stabilizing capacity of monetary policy regimes, deliberately omitting issues related to the likely complexity of the National Bank's communications with the public under a flexible price level targeting regime and potential difficulties in gaining credibility in this regime.

Another limitation of this study is the linearity of the macroeconomic gap model used. Nonlinear reactions may occur during strong shocks, which are beyond the scope of the proposed model.

It's also essential to consider that structural interconnections in the economy may change during significant political and economic transformations in Belarus. This may require adjustments to the specification and parameterization of the macroeconomic gap model. However, the proposed approach to assessing the effectiveness of monetary policy regimes will remain valid.

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