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Econometric Analysis of the Impact of Inflation Targeting on Macroeconomic Variables: New Keynesian Model

Abstract: Many central banks adopted inflation targeting under pressure from the IMF. Adoption of inflation targeting happened on pretty favourable macroeconomic terms whose distinctive features were the absence of supply shocks, low budget deficit and foreign currency access. It was a 'period conducive to price stability' with inflation on a downward trajectory in many countries, especially developed ones, even before the introduction of inflation targeting. That could have contributed to efficiency of inflation targeting considering other monetary strategies. The most widely used model in designinig monetary policy under inflation targeting is a macroeconomic model of a small open economy from the group New Keynesian model. The results of the econometric analysis in this paper show that inflation targeting is an inefficient monetary strategy in the face of negative supply shocks (financial crises, pandemic, rising energy prices, tariffs), as it leads to rising interest rates, falling GDP, and rising unemployment. The results of the econometric analysis in this paper show that inflation targeting is an inefficient monetary strategy in the face of negative supply shocks (financial crisis, pandemic, rising energy prices, tariffs, etc.), which leads to rising interest rates, falling GDP, rising unemployment, and ultimately to an "inflationary pandemic".

Key words: inflation targeting, monetary strategy, New Keynesian model, exchange rate, interest rate, inflation.

JEL Classification: C22, E31, E52, E58.

1. Introduction

Many central banks adopted inflation targeting under pressure from the IMF. Adoption of inflation targeting happened on pretty favourable macroeconomic terms whose distinctive features were the absence of supply shocks, low budget deficit and foreign currency access. In the 1990s, macroeconomic environment was generally stable. It was a "period conducive to price stability" and inflation was on a downtrend in many countries, especially developed ones, even before inflation targeting adoption. That could have contributed to efficiency of inflation targeting considering other monetary strategies. Moreover, the question is whether systemic risks, corresponding volatility and inflation have really decreased due to inflation targeting or due to "favourable exogenous" factors.

The most widely used model in the decision-making process of monetary policy on inflation targeting (IT) is a macroeconomic model of a small open economy from the group New Keynesian model. The main feature of this model is to define the target (inflation target) and the instrument (in this case, the reference interest rate) that the central bank wants to achieve. As the inflation targeting is more transparent, this means that market participants have access to more information, making future central bank actions more predictable. Therefore, an advantage of this type of model, as compared to the classical models based on Keynesian economy, is the role of the active rational expectations.

Also, the model implies that real variables such as real interest rate and real exchange rate are about their long-term trends. Deviation from the long-term trend is called gap, which reflects where the economy currently is. It is important to note that the central bank can only affect the gaps and not long-term trends.

Some improvements are needed in the monetary strategy of targeted inflation, which would lead to better implementation results. One solution is the so-called strategy "Nominal GDP-level targeting", which is a combination of inflation targeting and economic growth. Namely, inflation targeting is no longer sufficient in the macroeconomic stabilization policy. In the aftermath of the 2008 global financial crisis, modern central banks have been closely monitoring asset price inflation rather than focusing solely on the consumer price index or headline inflation in order to prevent the buildup of financial imbalances, asset price bubbles, and the onset of a financial crisis that would be triggered by the bursting of speculative bubbles and subsequent rapid disinflation and/or deflation (debt-deflation crisis).

The rest of this paper is organized as follows: Section 2 considers a preliminary examination of literature from the relevant scientific field. The hypotheses of interest are given in Sections 3 and 4. Section 3 describes the econometric model to be used in the analysis of inflation targeting as a foreign exchange crisis generator. Section 4 considers the data, methodologies and variables used in the study. A discussion of the results and implications is given in Section 5.

2. Literature Review

Mishkin and Kiley (2025) found that since the initial launch of inflation targeting in New Zealand and a few other countries in the early 1990s, inflation targeting has become the predominant monetary policy strategy in large advanced and emerging market economies. The emphasis on communications about the inflation outlook promotes transparency and accountability. As a result, inflation targeting central banks have, on balance, managed well the large shocks associated with the Global Financial Crisis and COVID-19. Even so, there are numerous challenges discussed in this paper that are associated with calibration and communications of forward guidance, quantitative easing/tightening, and financial stability. Borio and Chavaz (2025) used the data to track changes in the frameworks' flexibility in terms of the specification of the inflation target and the role of other objectives, i.e., employment (or output) and financial stability. While the specification of the numerical targets has become stricter (e.g., points rather than ranges), greater flexibility has taken the form of less strict (i.e., longer) horizons to achieve the targets and placing more weight on other objectives, especially employment/output. These trends are typically more pronounced in advanced economies and have widened differences with their emerging market peers. Bhalla, Bhasin and Loungani (2023) found that while the early adopters of IT (pre-2000) all saw declines in inflation rates following adoption, IT adopters since then have enjoyed such success in only about half the cases. Their country-level analysis—using the Synthetic Control Method (SCM) to compare outcomes in IT countries to a synthetic cohort—shows that IT adoption delivers significant inflation gains in about a third of the cases. Also, they found limited support for the concern that adoption of IT systematically leads to poorer growth outcomes. Krušković (2025) showed that sudden depreciation of exchange rate which results from a fall of foreign exchange reserves to a critically low level (below an optimal level) leads to currency crisis due to speculative attack. King (2024) found that inflation targeting does not constitute a new theory of the monetary transmission mechanism. However, it is believed that it does lead to the replacement of Milton Friedman's dictum that "inflation is always and everywhere a monetary phenomenon" by the new dictum that "inflation is always and everywhere a transitory phenomenon".

This had unfortunate consequences during the recent inflation. Krušković (2023) found that after the initial shock of foreign exchange reserves, the exchange rate appreciation occurs, which can be explained by the fact that a higher level of foreign exchange reserves gives investors and rating agencies a lower country risk, which can consequently lead to appreciation of the foreign exchange rate. In this way, the price reaction would be neutralized. Consequently, the growth of foreign exchange reserves leads to the growth of economic activity measured by GDP growth. Krušković (2020) showed that if there is a shock of the exchange rate, which would lead to depreciation of the exchange rate, a central bank may decide to mush instability on the foreign exchange market with foreign exchange interventions, thereby preventing the sudden exchange rate depreciation, which would then reduce the need for a large interest rate response. Namely, through foreign exchange interventions, the central bank greatly absorbs the depreciation shock and, consequently, inflation is lower. As a result of lower price growth, the need for a monetary policy response to an interest rate is also lower. Based on this example, we can see that central bank intervention in some cases can be very useful in order to correct disturbances in the foreign exchange market. Therefore, some central banks accumulate foreign exchange reserves at a very high level so as to have enough space for foreign exchange intervention, without the risk of falling foreign exchange reserves below the optimum level. Krušković (2020) showed that countries with inflation targeting have a lower rate of economic growth and higher unemployment than countries that adopted exchange rate targeting. Krušković (2017) showed that the exchange rate is a more significant transmission mechanism than the interest rate in emerging markets. Krušković and Maričić (2015) analysed the effect of accumulation of foreign exchange reserves to economic growth in emerging countries. The empirical results in this paper show that the increase in foreign exchange reserves causes the growth of GDP, while causality in the opposite direction has not been proven. Exchange rate depreciation that occurs as a result of the accumulation of foreign exchange reserves is not inflationary because it is a one-time non-persistent shock, unlike the sudden depreciation of the exchange rate that occurs as a result of maintaining an overvalued exchange rate in the long term and leads to currency crisis. The accumulation of foreign exchange reserves does not lead to inflation if the rate of accumulation of foreign exchange reserves does not exceed the rate of economic growth. Slightly higher inflation is not necessarily harmful, particularly for developing economics and emerging economics. Krušković and Maričić (2014) showed that inflation targeting has allowed countries to achieve low inflation in the very short term in the absence of negative supply side effects. As a result, financial markets have adjusted their long-term inflation expectations and incorporated them into interest rates. Risk premiums that compensate for inflation uncertainty have fallen. Bundick, Smith and Van der Meer (2024) found that inflation expectations

were just as well or, in some countries, better anchored after the pandemic. This favourable outcome was broadly accompanied by perceptions of an aggressive monetary policy response to above-target inflation. Zhang and Wang (2022) found evidence that most targeters conduct dynamic inflation targeting by frequently updating inflation target bands, and their band sizes are wide-ranging across IT countries. Results from the dynamic panel and local projection regressions suggest that better IT track records do not lead to superior growth and inflation rates in the short term. Borio (2024) found that inflation targeting has done its job of helping to hardwire a low-inflation regime, even in the face of the post-Covid inflation surge. But the journey has been far from easy. Inflation targeting had to contend with the rise of financial instability, particularly exemplified in the form of the Great Financial Crisis. In the wake of that crisis, IT countries struggled to push inflation back up to point targets, and IT saw a historical erosion in the room for policy manoeuvre. Duncan, Martínez-García, and Toledo (2022) found that IT has heterogeneous effects on inflation across countries. The gains shifting the level of inflation (generally downwards) are modest and smaller in advanced economies (AEs) than are those in emerging market and developing economies (EMDEs). Second, statistically significant differences in keeping inflation close to target under IT (compared with estimated counterfactuals) can be detected more broadly in nearly half of the economies. Third, IT can be a source of economic resilience that helped cushion inflation fluctuations during the 2007-09 Global Financial Crisis with statistically significant gains mostly found among EMDEs (in two out of three of these economies). Also, they found that IT effectiveness—measured by the dynamic treatment effect and the absolute deviations of both observed and synthetic inflation from target—is significantly correlated with indices of exchange rate stability and monetary policy independence, especially among EMDEs. Perssony and and Tabelliniz (2024) showed the optimal-contract approach to the design of monetary institutions, in the light of the Zero Lower Bound (ZLB) on interest rates and the resort to Quantitative Easing (QE) in recent years. Merrino (2021) found that wages in the top half of the wage distribution are less responsive to contractionary shocks, remaining protected by skill-biased technology and strong labour unions. The effect on inequality is temporary, however, declining after one year. Policy effects are also asymmetric, with very small reactions to accommodative shocks. Over the longer term and during expansionary phases of the business cycle, monetary tightening significantly and persistently reduces all metrics of inequality. This suggests that countercyclical use of monetary policy effectively contributes to lower wage inequality. De Gregorio (2019) showed the history of chronic inflation in Latin America and described these countries' experience with inflation targets and their performance during the global financial crisis. Cabral, Carneiro and Mollick (2020) found that when allowing for the endogeneity of inflation, output gap, and the exchange rate, the

exchange rate remains positive and statistically significant (but quantitatively less) across inflation targeting countries. When the sample is partitioned into targeting and non-targeting countries, the exchange rate remains relevant in the reaction function of non-targeters. The results remain robust to splitting the sample at the time of the 2007–2009 financial crisis of and suggest that, after the crisis, central banks of emerging markets respond only to inflation movements in the interest rate reaction function.

3. Model

The most widely used model in the decision-making process of monetary policy on inflation targeting is a macroeconomic model of a small open economy from the group New Keynesian model. The main feature of this model is to define the target (inflation target) and the instrument (in this case, the reference interest rate) that the central bank wants to achieve. As the inflation targeting makes central bank more transparent, market participants have access to more information, making future central bank actions more predictable. Therefore, it is an advantage of this type of model, as compared to the classical models based on Keynesian economy, which has the role of the active rational expectations.

Also, the model implies that real variables such as real interest rate and real exchange rate are about their long-term trends. Deviation from the long-term trend is called gap, which reflects where the economy is currently. It is important to note that the central bank measures can only address the gaps and not the long-term trends.

All variables in the model that represents the level of the logarithmically, for example price level p_t obtained logarithmic base index ($p_t = \ln(P_t)$). In this case, the growth rates are simply the difference between the two values logarithmically. This is possible due to the approximation to the small enough x_t that it is $\ln(1 + x_t) \approx x_t$. The difference between the level of the rate of two consecutive periods in this case is equal to:

$$p_t - p_{t-1} = \ln(P_t) - \ln(P_{t-1}) = \ln\left(\frac{P_t}{P_{t-1}}\right) = \ln\left(\frac{P_t - P_{t-1} + P_{t-1}}{P_{t-1}}\right) = \ln\left(1 + \frac{P_t - P_{t-1}}{P_{t-1}}\right) \approx \frac{P_t - P_{t-1}}{P_{t-1}}$$

The term $\frac{P_t - P_{t-1}}{P_{t-1}}$ represents the percentage change in the price index in period t relative to period *t-1*. Rate of change of the label will be Δ in front of the model variables, except for the inflation, which will be the most common label used in the literature (π). Overlaid line above the variable name indicates that this is a

trend, while the mark ^ is used for gaps. The model will be presented quarterly and annualized, which means that the quarterly growth rate multiplied by the number 4 is going to be reduced to an annual level, in order to facilitate comparability, while the number 4 in the name of the variable means annual rate. Another feature of the model is that it is stationary, which means that all growth rates in the long run tend to an equilibrium state. Equilibrium states, which are represented in the model parameters, in the name of the exponent are marked as *ss*.

The main part of the model consists of five behavioral equations that represent aggregate demand, aggregate supply, imported inflation, uncovered interest parity and the monetary policy response. The rest of the model consists of a variety of auxiliary equations, such as the identity and autoregression processes.

Aggregate demand in the model represented by equation output gap ($\hat{y}_t$), which represents the deviation of GDP from the equilibrium level (trend). Aggregate demand is affected primarily by the output gap from the preceding period the output gap in the previous period ($\hat{y}_{t-1}$), then the monetary conditions index (mci_t) and demand shocks (ε_t^y). The output gap in the previous period, reflecting inertia in the movement of aggregate demand, means that if in the previous period aggregate demand was high, probably this trend will continue in the following. Monetary conditions index was measured by the real interest rate gap ($\hat{r}_t$) and the real exchange rate gap ($\hat{z}_t$). A positive value of monetary conditions index indicates that monetary policy is restrictive, which slows aggregate demand, and vice versa, expansionary monetary policy (the negative value of the index of monetary conditions) stimulates aggregate demand. If the output gap is positive, the economy is expanding, while a negative output gap is a contraction.

$$\hat{y}_t = \rho_y \cdot \hat{y}_{t-1} - \theta_y \cdot mci_t + \varepsilon_t^y \tag{1}$$

$$mci_t = \alpha \cdot \hat{r}_t + (1-\alpha) \cdot (-\hat{z}_t) \tag{2}$$

Inflation development is presented by the Phillips curve, which represents the relationship between aggregate supply and aggregate demand. Inflation (π_t) is the change in price in one observation period (quarter) and depends on the price change in the past (π_{t-1}), basic (expected) inflation ($E\pi_{t+1}$), import prices (π_t^m), aggregate demand ($\hat{y}_t$) and the real exchange rate gap ($\hat{z}_t$).

$$\pi_t = \beta_1 \cdot \pi_{t-1} + \beta_2 \cdot E\pi_{t+1} + (1-\beta_1-\beta_2) \cdot (\pi_t^m - \Delta\bar{z}_t) + \beta_3 \cdot \hat{y}_t + \beta_4 \cdot \hat{z}_t + \varepsilon_t^\pi \tag{3}$$

Previous inflation reflects the inertness of price changes. If prices are increased in the past, we can expect this trend to continue for some time. Core inflation is the rational expectations of market participants about future price movements.

In the model, we assumed that the rational expectations formed on the basis of current trends of annual inflation and inflation expectations from the previous period.

$$E\pi_{t+1} = \rho^{ep} \cdot E\pi_t + (1-\rho^{ep}) \cdot \pi 4_t \quad (4)$$

Imported inflation is the price change in the external environment, adjusted for exchange rate changes. Transition countries often have lower prices than the developed countries, and therefore prices must rise faster in order to reach a level in developed countries (the Balassa-Samuelson effect). This price convergence presented an upward trend in the real exchange rate $\Delta\bar{z}_t$.

In addition to the above-described elements, the output gap and the real exchange rate gap have more influence on inflation, which normally represent the marginal cost of production. The output gap, a measure of aggregate demand affects inflation so that when the gap is positive, the economy is booming, which means that aggregate demand increases and has inflationary effect. Conversely - if the economy is in a recession, the economy is below the long-term trend (a negative output gap), aggregate demand is low and has disinflationary effect.

Gap of the real exchange rate is often omitted from the Phillips curve. However, if the model describes an open economy, this gap represents the net cost of imports. When the real exchange rate gap is positive, the prices of imported goods are relatively higher than the domestic, which has inflationary effect, and vice versa.

The sum of the coefficients in front of the previous inflation, inflation expectations and imported inflation is equal to the unit and, in the steady state, all these elements tend to equalize. This is normally a requirement that the model is stable. An additional necessary condition is that the gaps in real variables (marginal production costs) close, meaning that their value in the steady state is equal to zero. Let's consider isolated only the part that represents a linear combination and the equilibrium state, which means that variable changes do not change over time, and mark the time we left out:

$$\pi = \beta_1 \cdot \pi + \beta_2 \cdot E\pi + (1-\beta_1-\beta_2) \cdot (\pi^m - \Delta\bar{z})$$

Since the main objective of the central bank is to anchor inflation expectations in line with that it will strive to steady state inflation (π). Rearranging this equation, we obtain the following equality:

$$(1-\beta_1-\beta_2) \cdot \pi = (1-\beta_1-\beta_2) \cdot (\pi^m - \Delta\bar{z})$$

which tells us how the central bank sets the inflation target. Therefore, in accordance with the theory, according to which domestic and international prices tend to equalize, the inflation target should be set at a level that is equal to the foreign target of inflation adjusted for long-term price convergence.

Imported inflation is modeled in a simple way as a linear combination of imported inflation in the previous period and foreign inflation (π_t^*) adjusted for the change in the nominal exchange rate (Δs_t). The inertia of the movement of import prices means that the change in the exchange rate and foreign price will not immediately reflect on import prices, so the correction will take place gradually. Here it is assumed that the importers for some time have in stock a good imported into the past at the old prices.

$$\pi_t^m = \rho^{\pi m} \cdot \pi_{t-1}^m + (1 - \rho^{\pi m}) \cdot (\pi_t^* + \Delta s_t) \tag{5}$$

Uncovered interest rate parity equation is the basis for determining the nominal exchange rate s_t. Interest rates i_t and i_t^* represent yields of domestic and foreign currency, respectively. As the local currency is usually riskier, therefore it is seeking additional yield, which represents the risk premium ($prem_t$). Therefore, when comparing these yields, the difference must be corrected for the risk premium. In the end, the final difference ($-i_t + i_t^* + prem_t$) is the uncovered interest parity, and if it shows that the yields on local currency is higher (the difference is negative), the domestic currency will become more attractive. This will increase the demand for domestic currency, and will come to an appreciation of the exchange rate in the current period. At the same time, the appreciation of the exchange rate in the current period to the next period after the initial appreciation of the expected depreciation of the exchange rate that would equalize returns (Es_{t+1} depreciate). In addition to domestic and foreign interest rates, the exchange rate is influenced by other factors not included in the model (political uncertainty, international environment) and they would be covered by the exchange rate shock (ε_t^s). Thus defined, theoretically uncovered interest parity, in this model, is adjusted for central bank intervention in the foreign exchange market directed to preventing the cycle of the exchange rate. If there are pressures to the depreciation of the exchange rate, the central bank sells foreign currency, which reduces foreign exchange reserves and thereby neutralizes the exchange rate changes.

$$s_t = Es_{t+1} + (-i_t + i_t^* + prem_t)/4 - \omega \cdot FX\,\mathrm{int}_t + \varepsilon_t^s \tag{6}$$

Expected changes in the exchange rate (Es_{t+1}) in equation (6) represent the expectations of market participants on the basis of which they make decisions about the profitability of investments. Assumption of the model is that rational expec-

tations are formed at a level between the previous level of the exchange rate and a model designed for the future.

$$Es_{t+1} = \rho^{es} \cdot s_{t-1} + (1 - \rho^{es}) \cdot s_{t+1} \tag{7}$$

The reaction of monetary policy is represented by a modified version of the Taylor rule, and it is determined by the height of the reference interest rate (i_t) in order to achieve the inflation target. According to the original Taylor rule, the central bank should respond to the interest rate on the current deviation of inflation from target and deviations of GDP from potential (output gap).

$$i_t = \rho^i \cdot i_{t-1} + (1 - \rho^i) \cdot (\bar{r}_t + \pi_{t+1} + \varphi_1 \cdot (\pi 4_{t+k} - \pi^T) + \varphi_2 \cdot \hat{y}_t) \tag{8}$$

The main difference between the modified and the original Taylor's rule is that the height of the reference interest rate in the current period is determined in relation to the projected (expected) inflation in the future ($\pi 4_{t+k}$). Mark k is the number of periods in advance to which the benchmark interest rate reacts, and it is usually one year (k = 4) since monetary policy acts with a certain time lag. Thus, if the projected inflation of *k* periods targets the period ahead (π^T), the key policy rate should be increased, and vice versa, if the projected inflation is below target, monetary policy should relax.

The original Taylor rule, the central bank reacts to the output gap ($\hat{y}_t$). If the economy is booming, the output gap is positive and the interest rate should be increased, thereby tightening monetary policy. However, if the central bank keeps inflation stable, this would create a favorable macroeconomic conditions, which would consequently stabilize fluctuations in the output gap. In this case, the central bank would have the interest rate to respond to the output gap, so that in equation (8) the value of the parameter φ_2 was 0.

Another modification from the original Taylor rule is the existence of inertia in the interest rate. This means that the interest rate in the current period is largely dependent on the previous value (i_{t-1}), since the central bank is usually not prone to rapid changes in interest rates.

The sum of the trend of real interest rates and expected inflation ($\bar{r}_t + \pi_{t+1}$) is neutral expected return of the market participants, ie. yield at which market participants are indifferent. Therefore, if the projected inflation is above target, it is necessary to set the interest rate so as to be above neutral, ie. Monetary policy should be restrictive. Likewise, if the projected inflation below the target, it is necessary to expansionary monetary policy, and the key policy rate should be set below the neutral.

In addition to the above-described basic equations in the model, there are auxiliary equations such as the identity and autoregression processes. Thus, the real exchange rate (z_t) is defined as the difference between the level of foreign prices expressed in domestic currency ($p_t^* + s_t$) and domestic prices (p_t). If the nominal exchange rate depreciates, it is expected that domestic prices due to the inertia of the movement, a reaction completely immediately, and therefore will the real exchange rate depreciate.

$$z_t = p_t^* + s_t - p_t \tag{9}$$

The deviation of the real exchange rate from the long-term trend is a gap in the real exchange rate ($\hat{z}_t$). Developing countries, due to many years of conducting social policy, tend to have a lower price (especially non-tradable goods). Therefore, during the transition period in those countries, a rapid growth of domestic prices compared to foreign prices expressed in the domestic currency is expectedAccordingly, in the long term, appreciation trend of the real exchange rate is expected ($\Delta\bar{z}_t$ which indicates a trend change $\bar{z}_t$, less than zero). Also, this is the reason why countries in transition target set at a higher level than in developed countries. Trend appreciation of the real exchange rate is presented with autoregression equation (10), a level trend in the real exchange rate is determined by using the identity (11).

$$\Delta\bar{z}_t = \rho^{\Delta\bar{z}} \cdot \Delta\bar{z}_{t-1} + (1-\rho^{\Delta\bar{z}}) \cdot \Delta\bar{z}^{ss} + \varepsilon_t^{\Delta z} \tag{10}$$

$$\bar{z}_t = \bar{z}_{t-1} + \Delta\bar{z}_t / 4 \tag{11}$$

$$z_t = \bar{z}_t + \hat{z}_t \tag{12}$$

Equation (12) is the identity under which the real exchange rate can be separated into two components - trend ($\bar{z}_t$) and gap ($\hat{z}_t$). Since the real exchange rate and trend in the model defined above equations, equation (11) determines the gap of the real exchange rate, which then enters the equation (2) and (3) as an approximation of the cost of imports.

The real interest rate (r_t) is the yield on the domestic currency (i_t) adjusted for inflation base ($E\pi_{t+1}$).

$$r_t = i_t - E\pi_{t+1} \tag{13}$$

The interest rate defined in this manner, analogous to the real exchange rate, fluctuates around a long-run trend ($\bar{r}_t$), which is determined by the equation of real

uncovered interest parity. This equation represents the economic fundamentals resulting from uncovered interest parity and purchasing power parity.

$$\bar{r}_t = \bar{r}_t^* + prem_t + \Delta\bar{z}_t \tag{14}$$

The expression on the right side of equation (14) shows how investors determine the real return they expect to receive in local currency. It is a real yield that could achieve the secure foreign market ($\bar{r}_t^*$), which added to the risk premium demanded by the country's yield ($prem_t$), then the yield adjusted for the expected real depreciation/appreciation of the exchange rate ($\Delta\bar{z}_t$). This implies that, if participants in the foreign exchange market expect a real depreciation of the exchange rate or perceive the country as riskier, they will demand higher real yields.

The point is that the real interest rate is around long-term trend. Deviation from trend is a gap in the real interest rate and indicates whether the real yield is higher or lower than expected.

$$r_t = \bar{r}_t + \hat{r}_t \tag{15}$$

If the gap ($\hat{r}_t$) is a positive real interest rates, the central bank on that basis implements a restrictive monetary policy. Then the real return on domestic currency is higher, making it more attractive for investment.

Country risk premium ($prem_t$) shows how financial markets evaluate the country in terms of investment. For riskier countries, a higher yield and a higher risk premium are required. Since the risk premium depends on many external factors that cannot be captured by the model (political situation, regional environment, cooperation with international institutions), a simple autoregression equation is introduced.

$$prem_t = \rho^{prem} \cdot prem_{t-1} + (1-\rho^{prem}) \cdot prem^{ss} + \varepsilon_t^{prem} \tag{16}$$

In equation (16) shock is included (ε_t^{prem}), which can compensate for the model effects on the risk premium. After the initial shock, the assumption is that the risk premium uniformly returns to a neutral level.

Central bank interventions in the foreign exchange market aimed at preventing exchange rate cycles (Equation 6) imply that the central bank intervenes in the foreign exchange market in response to any change in the exchange rate

$$FX\,\mathrm{int}_t = \omega^1 \cdot \Delta s_t / 4 \tag{17}$$

Since they are not without costs, central bank interventions in the foreign exchange market affect the change in the level of foreign exchange reserves:

$$FXrezerve_t = FXrezerve_{t-1} - FX\,\mathrm{int}_t \tag{18}$$

The remaining equations are simple identities for the conversion of different growth rates.

$$p_t = p_{t-1} + \pi_t / 4 \tag{19}$$

$$\pi 4_t = p_t - p_{t-4} \tag{20}$$

$$s_t = s_{t-1} + \Delta s_t / 4 \tag{21}$$

4. Empirical Data and Results

4.1. The function of the impulse response

The model parameters can be determined in several ways, and the most commonly used is the combination of approaches. When data is available for a very long period of time, it is possible to use econometric estimation to determine various economic ties. However, developing countries are the most commonly encountered in the course of history with major structural changes, which is why the time series data often contain fractures which, combined with the lack of some statistical data, drastically reduces the possibility of obtaining reliable estimates. For these reasons, the most commonly used is calibration where the parameters are adjusted in accordance with the economic logic of the theory so that they better reflect macroeconomic developments in specific countries. Calibration can help various studies and the experiences of other countries.

Since it is not the intention that the model represents a specific country, the parameters of the model are calibrated and have values approximate to those often encountered in the literature. Instead of calibration, the model's response functions to various shocks will be presented. This analysis is most often used during calibration to determine whether the model behaves in accordance with our expectations.

The initial assumption is that the economy is in a state of balance (equilibrium) and that at time $t = 1$ affects one shock, e.g., price growth of 1%. We then create a simulation with these assumptions and, based on the results, analyze individual shocks affecting the economy.

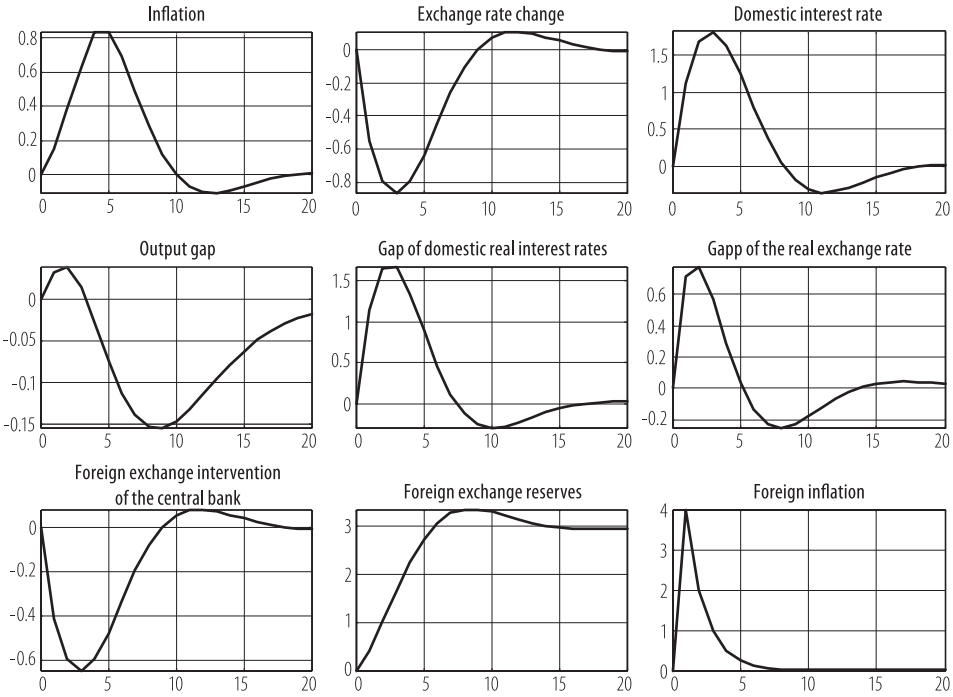
The model's response functions to individual shocks are described below. The main characteristic of this analysis is the assumption that, at some point, the economy affects only one shock, which facilitates tracking of the shock through all the channels of monetary transmission. The figures represent deviations of variables from steady state, which means that the stationary variables must at some point return to the starting value. This assumption is not valid for non-stationary variables, such as price level, the level of the nominal exchange rate and the level of foreign exchange reserves.

4.2. Foreign prices shock

If there is a one-time growth of foreign prices, it will be imported inflation affecting the growth of domestic prices. The reaction of central banks is to increase interest rates in order to tighten monetary policy, which would make the local currency more attractive for investment, and to prevent the appreciation of the exchange rate. Opening a positive real interest rate gap indicates that the central bank, on that basis, is a restrictive monetary policy (higher real rate of return). On the other hand, this opens a positive real exchange rate gap, which indicates that, due to their rigidity, domestic prices grow more slowly than foreign prices. Lower domestic prices affect the increased demand for domestic goods for which a positive output gap initial opened. Appreciation of the exchange rate, due to the reaction of central banks increasing interest rates, absorbs shock and affects the equalization of imported and domestic prices expressed in a common currency, i.e., closes the gap of the real exchange rate. With the closing of the gap appreciation, positive effects on the gaps of output are exhaustive and overrides a restrictive monetary policy (a positive real interest rate gap), and therefore aggregate demand in the coming period falls (opens a negative output gap).

Due to high interest rates in response to higher inflation, exchange rate appreciates and central bank intervenes in the foreign exchange market to prevent the appreciation of the purchase of foreign currency, which results in an increase in foreign exchange reserves. After the absorption effects of the rise in prices, inflation returns to the target, and the central bank reduces interest rates. The exchange rate is stabilized, and so is the use of central bank interventions. The economy returns to a steady state and, as a result of the reaction of monetary policy to increase foreign prices, foreign exchange reserves are at a higher level.

Figure 1: One-time increase in the foreign price of 1% (4% per year)



Source: Author

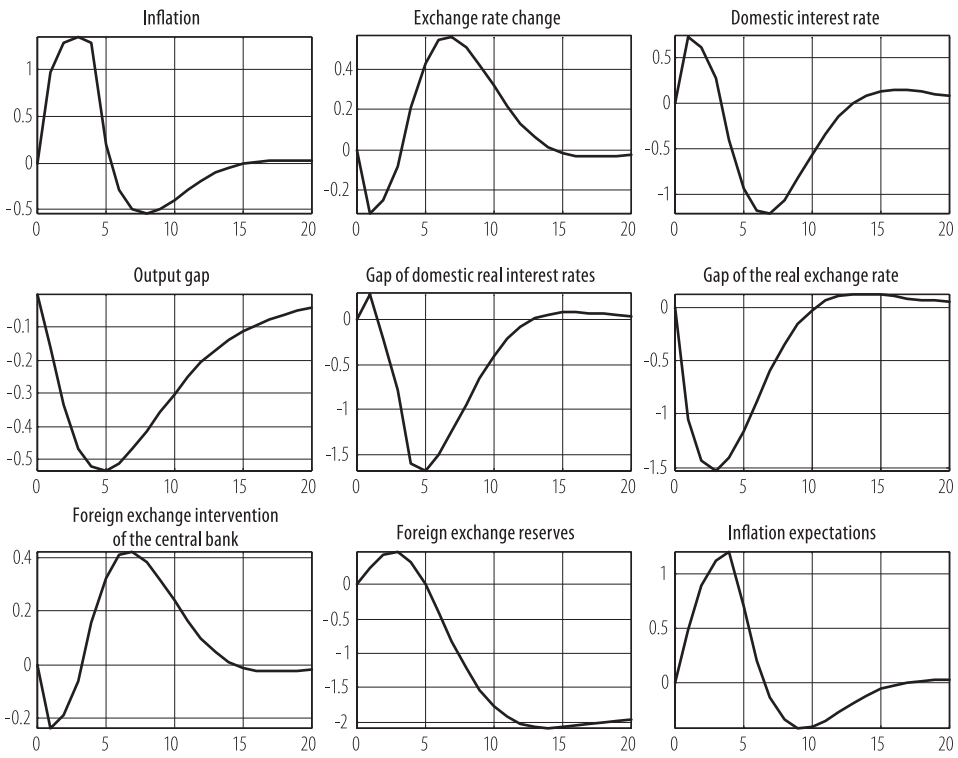
4.3. Domestic prices shock

In contrast to the shock of foreign prices, domestic price shock overflows directly and fully to inflation. As this shock is local, domestic prices become relatively higher than foreign prices, so the real exchange rate appreciates, thus creating disinflation pressures in the future. Since it is a one-time shock, this means that the price growth keeps inflation in calculating year-on-year, after which its sudden fall is projected. The full effect of monetary policy reaction is achieved with a one-year lag, to which the central bank responds with the projected deviation of inflation from the target a year in advance. Consequently, due to the projected decline in inflation, which followed after an initial growth, the central bank lowers interest rates, causing a depreciation of the exchange rate.

To prevent price correction over depreciation exchange rate, which could then cause the instability of the financial system, the central bank intervenes in the

foreign exchange market in order to mitigate the exchange rate cycle. Due to such conduct of monetary policy, the central bank neutralizes local shocks through the interest rate, thereby preventing the exchange rate from acting as an absorber.

Figure 2: One-time increase in domestic prices of 1% (4% per year)



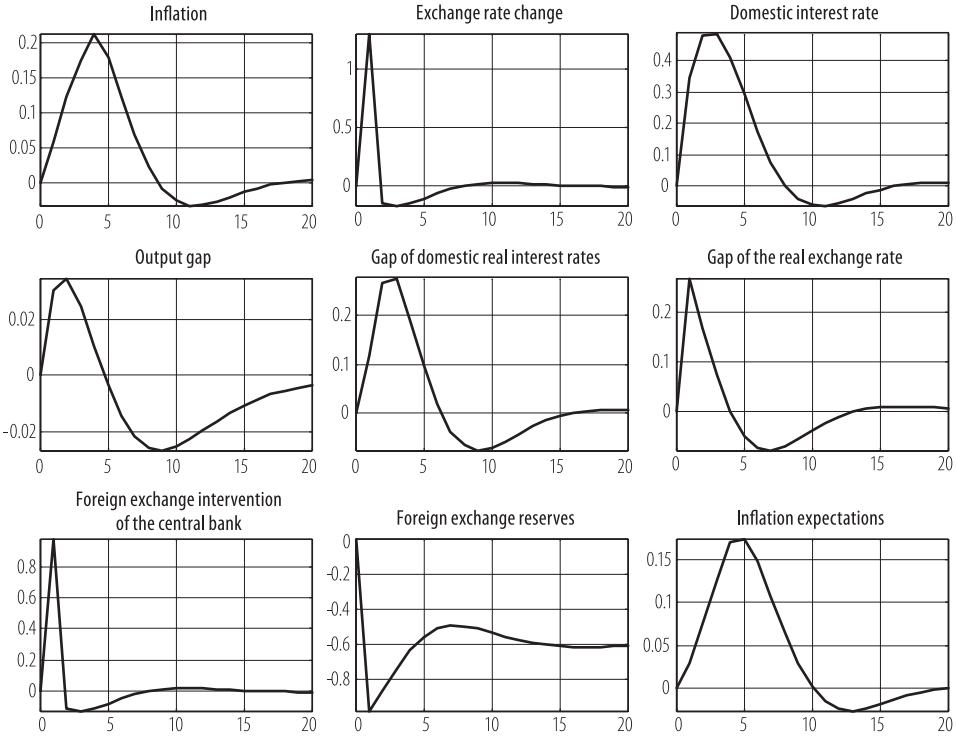
Source: Author

4.4. Exchange rate shock

Shock exchange rate acts on inflation through two channels. The first channel is direct, via import prices (imported inflation), while the second channel is indirect, through the gap in the real exchange rate. Exchange rate depreciation causes a direct increase in import prices denominated in the domestic currency, which in turn leads to an increase in domestic inflation. Since this transmission effect is not complete, due to the inertia in the movement of prices, there is a gap opening depreciation of the real exchange rate. A positive gap of the real exchange

rate affects the growth of domestic demand, which leads to a positive opening of output gap. The real marginal cost (demand and import) growth and to generate inflationary pressures in the future.

Figure 3: Depreciation shock exchange rate of 1% (4% per year)



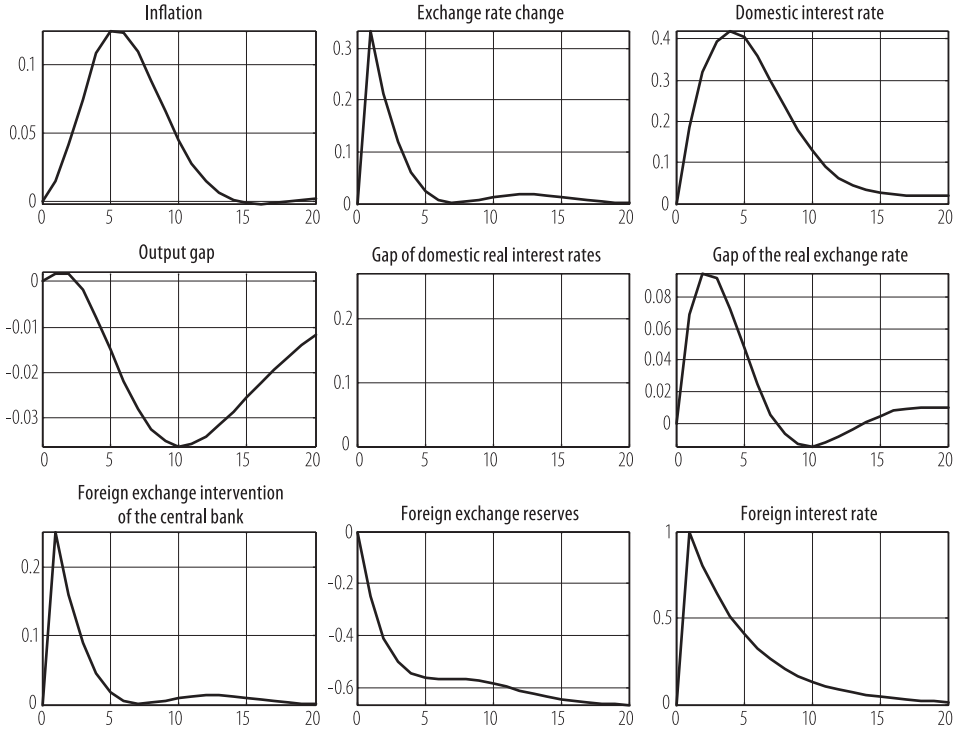
Source: Author

The central bank responds by increasing interest rates to local currency more attractive and thus stopped depreciation pressures, and thus stabilized inflation. In addition to the reaction rate, the central bank on exchange rate shock depreciation reacts and selling of foreign exchange reserves, in order to neutralize the shock and mitigate exchange rate cycle.

4.5. Shock foreign interest rates

Growth in foreign interest rates means higher yield on the foreign currency, the domestic currency makes it less attractive. Lower yields in the domestic market will influence the outflow of capital, and therefore depreciation of the nominal exchange rate. Depreciation, similar to the shock of the exchange rate, causing a rise in inflation, which the central bank responds by increasing interest rates, while at the same time and interventions in the foreign exchange market to prevent a depreciation of the exchange rate. A depreciation of the exchange rate will lead to an increase in import prices, which will then exceed domestic prices, thereby opening a depreciation gap in the real exchange rate. This difference in prices must be encouraged to demand for domestic goods, which will affect the growth of output. However, at the same time, the wider gap of output will act in the opposite direction of tight monetary policy since the real interest rate gap is positive.

Figure 4: Growth in foreign interest rates of 1%



Source: Author

As the central bank`s stops correcting imbalances over the exchange rate with foreign exchange interventions, this means that the effect of the restrictive monetary policy on aggregate demand is going to be dominant, which leads to a negative opening of output gap, which further affects the stabilization of prices. Once the economy stabilizes and foreign interest rates return to normal levels, the effects on the domestic market are exhausted (absorbed) as well.

5. Results and Implications

Many central banks have introduced inflation targeting under the pressure from the IMF. Adoption of inflation targeting happened on pretty favorable macroeconomic terms whose distinctive features were absence of supply shock, low budget deficit and foreign currency access. In the 1990s, macroeconomic environment was generally stable. It was a "conduciveto price stability" with inflation on a downward trajectory in many countries, especially in developed ones, even before inflation targeting adoption. That could have contributed to efficiency of inflation targeting monetary considering other strategies. Moreover, the question is whether systemic risks, corresponding volatility and inflation are really decreased with the introduction of inflation targeting or due to "favourable exogenous" factors. Essentially, inflation targeting is not superior concerning other monetary strategies and it is also vulnerable to shocks as well as exchange rate targeting in the presence of fiscal imbalance and domination. Numerous empirical results on success of inflation targeting appear when inflation is relatively overcome in the whole world. The question is how will inflation targeting progress if the world inflation increases considerably and what about negative demand shocks? Central banks which do not target inflation have been also successful in achieving and maintaining low inflation. Inflation is reduced through inflation targeting but it is accompanied with great costs of unemployment and highway. That result imperils "long term money neutrality" which is an important part of theoretical framework of inflation targeting. Present focus on inflation targeting can cause "atrophy of real outcomes", especially in a supply shocks environment.

When discussing inflation, it is essential to emphasize three key elements:

1. identification of the primary cause of inflation, i.e. the initial shock that triggered the inflation process.
2. diagnosing the type of inflation
3. defining macroeconomic policy measures for the disinflation process.

Disinflation (the process of reducing inflation) does not mean a reduction in prices nor a return to a previous level, but a reduction in the rate of price growth. Diagnosing the type of inflation is of primary importance for taking the right macroeconomic policy measures, because different types of inflation require different macroeconomic policy measures for the disinflation process. In order for the supply-side disinflation process to be successful, it is necessary to direct the "beam" of macroeconomic policy to the "infinitesimal" cause of inflation, in order to dampen the price growth that is the initial trigger for the uncontrolled acceleration of inflation and inflationary expectations by increasing aggregate supply, thereby preventing market turbulence and absorbing inflationary shocks. Therefore, it is necessary to create a "frictional force" for inflation, which the interest rate certainly cannot do in the event of negative supply shocks.

A wrong macroeconomic policy (inflation targeting in the presence of negative supply shocks) would mean “putting out fires” where there is “smoke” rather than where there is “fire”. Such a policy would “ignite” inflation. Therefore, an increase in the interest rate with the aim of suppressing supply inflation would cause a long period of “arrhythmic” states in which the world economy would find itself (stagnation, stagflation, incession and slumpflation). This is the so-called inflation paradox, which implies an increase in inflation even due to an increase in the interest rate that should reduce inflation. This leads to an inflation-interest spiral, which increases the gap between aggregate supply and aggregate demand, which further leads to an acceleration of the inflation spiral, thereby paving the way to slumpflation, hyperinflation and depression.

The world economy has entered a series of negative supply shocks (the 2008 financial crisis, the pandemic, the energy crisis, oil shocks, sanctions, tariffs) that have “lit the fuse” of inflationary inertia which, in the event of the buildup of new negative shocks (a new pandemic, a world war, deglobalization, shortages, bursting price bubbles, the financial crisis, the foreign exchange crisis, etc.), would lead aggregate supply to a precipitous decline. This would cause shortages and trigger the explosion of an “inflationary nuclear bomb”.

Macroeconomics recognizes, but does not reward, ex post wisdom. Even prior to the 2008 financial crisis, I warned of what at the time appeared unimaginable, namely a tragic trajectory for the global economy. I argued then, a claim later confirmed by events, that a rise in global inflation was inevitable and that the global economy would face severe economic pathologies, including: stagnation (real GDP growth of u to 2%), stagflation (inflation under conditions of stagnation), incression (inflation under conditions of recession), and the most severe economic pathology - slumpflation (simultltaneously high inflation and high

unemployment), all ultimately leading to global economic depression (a recession lasting at least twenty-four months and characterized by a decline in GDP of at least ten percent and an increase in unemployment of at least twenty-five percent). Taken together, these developments indicate that the regime of inflation targeting has long since reached its end.

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