**PLAYING HARD OR SOFT? : A SIMULATION OF INDONESIAN MONETARY POLICY IN TARGETING LOW INFLATION USING A DYNAMIC GENERAL EQUILIBRIUM MODEL**

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In the real world, the most "optimal" policy rule is not always the most "desirable" rule. There are always preferences, considerations and judgements involved during the process of monetary policy formulation. The hawks will always prefer a stronger stance and want to play as hard as possible in fighting the evil of inflation, while the doves prefer a softer, moderate stance. This paper attempts to simulate how such preferences affect the dynamics of the Indonesian economy using GEMBI, a stochastic non-linear dynamic GE model developed by Bank Indonesia. Preferences between playing *hard* by the hawks and playing *soft* by the doves in attaining the pre-announced 6%-7% targeted inflation are distinguished. The hawks will use a policy rule that achieves the target as soon as possible. The doves will use a policy rule which is more "accommodating" to the economy, and hence they are willing to live with a slightly higher inflation rate than the pre-announced target or to achieve the target over a longer time horizon.

## 1. Introduction

Over the past decade inflation targeting (IT) has become a fashionable framework for monetary policy in many countries. Inflation targeting is a framework of monetary policy marked by a pre-announced official inflation target at a certain period of time. The announcement is intended to assure the public that the long-term objective of monetary policy is to achieve stable and low inflation. Two important elements of inflation targeting are the target itself and the commitment of the government to the objective of monetary policy, which is low inflation. In preparing for the implementation of an inflation targeting (IT) framework, Bank Indonesia has been exploring the concept of inflation targeting itself and the operational framework on how to implement the central bank reaction function using a Taylor rule in achieving the targeted inflation in short medium and long term contexts. To this end, a number of macroeconomic models have been developed to support the implementation of the inflation targeting framework. One of the existing models is the General Equilibrium Model of Bank Indonesia (hereafter called GEMBI)[1].

General Equilibrium models are needed for medium and longer-term policy analysis and for evaluation of related policy issues. The policy evaluation issues include choosing an optimal policy rule in reaching a targeted inflation rate set by the central bank for a particular period of time, both in short-medium and longer term contexts. To this end, there are pitfalls, which can pose serious dangers to economic growth or longer-term stability. The proper design and policy implementation requires a careful analysis of the broader macroeconomic "environment" in which these policy options would be undertaken.

While the short-term impact of policy options is well captured by the short-term econometric oriented models such as MODBI (Annual Model of Bank Indonesia) and the quarterly model such as SOFIE (Short Term and Forecasting Model of the Indonesian Economy), GEMBI plays a role in complementing these models as a flight simulator in predicting the dynamics of interest rate policy options aimed at achieving the targeted inflation rate set by policy makers.

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[1] GEMBI is a stochastic non-linear dynamic general equilibrium (SNDGE) model. The construction of the model started in June 2000, developed by a team of Bank Indonesia economists at the Macroeconomic Studies Division of the Research and Monetary Policy Directorate (DKM/SEM) of Bank Indonesia. The model evolved from a theoretical concept to an operational policy instrument, for ongoing analysis and evaluation, with the assistance and advice of Prof. Paul D McNelis under the

This paper attempts to explore the interest rate policy options available to policy makers in reaching a targeted inflation rate within a certain period of time using the Taylor rule approach. In the real world the most “optimal” policy rule is not always the most “desirable” rule. There are always preferences, considerations and judgements involved during the process of monetary policy formulation. Inflation hawks will always prefer a stronger stance and want to play as hard as possible in fighting the evil of inflation, while doves prefer a softer, moderate stance. This paper tries to simulate how hawks or doves preferences affect the long-run dynamics of the Indonesian economy using GEMBI. Preferences between playing hard by the hawks and playing soft by the doves in attaining the pre-announced 6% - 7% inflation target are used in this simulation process. The hawks will adopt a policy rule to reach the target as soon as possible. The doves adopt a policy rule which is more “accommodating” to the economy, and hence they are willing to live with a slightly higher inflation rate than the pre-announced target or to attain the target rate over a longer time horizon.

The next sections include the structure of GEMBI, the result of the alternative policy simulations and the conclusion.

## 2. Structure of GEMBI

GEMBI has been developed for almost two years from a very simple model to a more complex one. At this phase, important sectors of the economy have been incorporated into the model. There are five sectors in the model: households, banks, firms produces traded and non-traded goods, the external sector, and the government. All agents except government have their own objective function and budget constraint. Optimization from each agent results in the formulation that will play its role in the model. The explanation of each agent is described as follows:

### 2.1. Households

The objective of households is to maximize the utility of household consumption.

Partnership for Economic Growth (PEG) project of the U.S. Agency for International Development (USAID).

$$\text{Max} \quad \sum b^{t+i} U(c_{t+i}) = \sum \left[ b^{t+i} \log c_{t+i} \right] \qquad b = \frac{1}{1+r}$$

where:

| | | |
|---|---|---|
| $c$ | = | consumption; |
| $r$ | = | social discount rate; |
| $h$ | = | coefficient of relative risk aversion. |

Households face the inter-temporal budget constraint that reflects their assets and liabilities. Both their assets and liabilities in the current period will have repercussions tin the future period.

$$x_{t+1} + d_{t+1} - l_{t+1} = \Pi_t^N + \Pi_t^T + x_t(1-p) + d_t(1+i_d - p) - l_t(1+i_l - p) - c_t - T(c_t) - \Gamma(c_t, x_t, d_t)$$

where:

| | | |
|---|---|---|
| $x$ | = | currency; |
| $d$ | = | deposits; |
| $l$ | = | domestic loans; |
| $T$ | = | taxes; |
| $p$ | = | inflation rate; |
| $G$ | = | transactions costs; |
| $P$ | = | profit from firms; |
| $i_d$ | = | deposit rate; |
| $i_l$ | = | loan rate. |

- The household assets consist of currency (*x*) and deposits (*d*), both are classified as liquid assets. Liquid means it is easy to use them in conducting daily transactions. Holding more of those two assets implies a reduction in transactions costs.
- The household liability is domestic loans (*l*). Households must pay taxes which are a function of consumption. In addition, they have to pay the transactions costs and bills for the goods they consume. They can only borrow from domestic banks directly. All foreign loans can only be extended to households through banks as domestic loans in terms of domestic currency.
- The transactions costs *(G)* have a negative relationship with liquid assets. The greater the households' holding of assets the cheaper the transactions costs will be.

$$\Gamma = q_x \frac{c_t}{x_t} + q_d \frac{c_t}{d_t}$$

- Households do not only represent labor employed by firms, but also are the owners. There is a transfer from firms to households in the form of wage payments and dividends (traded: $\Pi^T$ and non-traded firms: $\Pi^N$). Initially, all the receipts from firms to households will be used to pay households' debts. Additional income from firms will be held by households in the banks as deposits.

From the Euler equation, one obtains the following demand function for deposits and currency as a function of the lending rate, the deposits rate, total consumption and a transactions technology parameter.

$$d_{t+1} = \sqrt{\frac{q_d c_{t+1}}{i_l - i_d}}$$

$$x_{t+1} = \sqrt{\frac{q_d c_{t+1}}{i_l}}$$

The demand for deposits depends positively on consumption but negatively on the spread between the lending and deposit rates. The demand for currency depends positively on consumption and negatively on the lending rate. It may be surprising that the lending rate affects the demand for currency, but not the demand for deposits. The reason is straightforward: the lower the lending rate, the higher demand for consumption through lower borrowing cost, and in turn the higher demand for currency.

The solution for current consumption demand comes from the forward-looking expectation,

$$c_t = \left[ b\, l_{t+1}(1 + i_l - p)(1 + T + \frac{q_x}{x_t} + \frac{q_d}{d_t}) \right]^{-1}$$

The level of consumption in the current period depends on the level of currency and deposits positively and the *marginal cost of consumption* in the future period ( $l_{t+1}$ ).

## 2.2. B a n ks

The objective of the banks is to maximize profit:

$$\text{Max} \quad \sum b^i \Pi^B_{t+i}$$

Subject to the inter-temporal budget constraint :

$$\Pi_t^B + b_{t+1} + l_{t+1} - d_{t+1} - l_{t+1}^* = b_t(1+i-p) + l_t(1+i_l - p)(1-r^L) - d_t(1+i_d - p)$$
$$- \Omega_l l_t - i a_R d_t - l_t^*(1+i^* + q^* + E\Delta e - p)$$

where

| | | |
|---|---|---|
| $b$ | = | traded bonds |
| $l*$ | = | foreign loan |
| $r^L$ | = | default risk |
| $i$ | = | interest rate |
| $q$ | = | risk premium |
| *EDe* | = | expected exchange rate |
| $a_R$ | = | reserve requirement |
| $W_L$ | = | coefficient of banking cost in managing loans |

- A bank's income consists of the profit it makes, the bonds it holds and the loans it makes. Bonds in this model are traded bonds, which have the lowest risk level represented by government bonds. Bonds are traded in Open Market Operations conducted by the central bank. In the case of Indonesia, the proxy for this bond is *Sertifikat Bank Indonesia (SBI)* issued by the central bank as a policy instrument to absorb and expand base money.
- A bank's liabilities consist of deposits and foreign loans. Sources of loanable funds are deposits and foreign loans. Banks are allowed to borrow abroad while households and firms can only borrow from the domestic banks in terms of domestic currency. The supply of loans is unlimited in the sense that it always fulfill the demand for loans, and therefore banks only determine the lending and deposit rates they offer in order to maximize their profit.
- Banks face default risk when they lend their funds. This is represented by the cost of managing loans and deposits. This is similar to the opportunity cost of holding required reserves.

Solving the inter-temporal optimization problem for the bank, one obtains the following relationship between the interest rate on bonds *(i)*, the deposit and lending rates ( $i_d$ and $i_{l)}$, the foreign interest rate *i**, a risk premium *(q)*, and expected depreciation *E(De)*.

$$i_l = \frac{i + \Omega_l + r^L(1-p)}{1 - r^L}$$

$$i_d = i(1 - a_R)$$

while the nominal spread between lending and deposit rates is expressed as follows:

$$i_l - i_d = i\left[\frac{r^L}{1 - r^L} - a_R\right] + \left[\frac{\Omega_l + r^L - r^L p}{1 - r^L}\right]$$

To rule out arbitrage opportunities for financial institutions, in which banks borrow from abroad and lend at a profit to the government, the following interest parity condition holds

$$i = i^* + q + E\Delta e$$

This interest parity equation will be used to solve for the logarithmic value of the exchange rate at time *(t)*, which in turn depends on the interest differential and the adjusted risk premium, as well as the expected exchange rate at time *(t+1)*

$$e_t = i^* - i + q + Ee_{t+1}$$

### 2.3. Firms Producing Traded and Non-Traded Goods

The firms producing traded and non-traded goods are maximizing their profit:

$$\text{Max} \quad \sum b^i \Pi^T_{t+i}$$

subject to a budget constraint :

$$\Pi_t - l_{t+1} + k_{t+1} = e_t A(k_t)^a + (1-d)k_t - l_t(1 + i_l - p)$$

where

| | | |
|---|---|---|
| $k$ | = | productive capital stock |
| $d$ | = | depreciation rate of capital stock |

All outputs from firms producing traded goods are exported, hence, they will not affect domestic inflation. On the other hand excess demand in the non-traded sector will affect inflation since the non traded output is fully consumed domestically.

However, imported goods affect inflation through their prices which are related to the depreciation of the exchange rate. Some points need to be noted as follows:

- Output of the firms will be converted in the form of wage payments and will be used in investment spending and loan payments. If there is additional surplus, it will be transferred to households as dividends and will be deposited in the banking system.
- The production technology is Cobb-Douglass with capital as the factor of production. $y = e_t^T A^T (k_t^T)^a$ . For simplification, labor is not a constraint and is always in equilibrium.
- Firms' assets are in the form of capital and their production output while their liabilities are in the form of domestic loans. The firm cannot borrow from the foreign market directly, but is allowed to borrow from domestic banks in terms of domestic currency.
- Following Kydland and Prescott, it is also possible to introduce "time to build" dynamics, in which new investment comes "on line" as productive capital, only with a lag of one to several quarters. In this case, the actual productive capital stock in each period is a function of lagged investment gradually coming "on line", less depreciation:

$$\hat{k}_t^j = \sum_{i=0}^{T*} x_i I_{t-1}^{K_j} + (1 - d_j) k_{t-1}^j$$
$$0 \le x_i \le 1, \sum x_i = 1$$

  where *x* is the proportion of the desired capital stock which comes on line at period *i = 0* and T* represents the time horizon for the total investment plan to be realized.
- Other than depreciation of capital, firms also face adjustment costs that make it costly to convert capital already included in the production process ('putty-clay"). Production itself is influenced by two types of shocks, i.e., terms of trade shocks and non-traded production shocks.

Each firm solves these equations to determine the desired stock of capital at time t, given by $\hat{k}_t^T$ *and* $\hat{k}_t^N$

$$\hat{k}_{t+1}^{T} = \left[ \frac{i_l - p + d}{a e_t^T A^T} \right]^{\frac{1}{a-1}}$$

$$\hat{k}_{t+1}^{N} = \left[ \frac{i_l - p + d}{a e_t^N A^N} \right]^{\frac{1}{a-1}}$$

## 2.4. Government

The government issues bonds to finance budget deficits. It spends money on non-traded goods, $g^N$; pays back its previous debts and collects seigniorage revenue on holdings of base money, $m_0$:

$$b_{t+1} - b_t = g^T + (g^N / z) + (i - p)b_t - pm_{0,t} - T(c_t)$$

where

| | | |
|---|---|---|
| $b$ | = | stock of domestic bonds held by government; |
| $g^N$ | = | government expenditure on non-traded goods; |
| $pm$ | = | inflation tax/seigniorage. |

It is assumed that the government bonds are held by banks. If government borrowing relative to GDP is above a critical threshold, the government will raise taxes in order to balance the budget and to freeze the expansion of government debt. Similarly, if the government is running a surplus, it will reduce its debt until the debt is retired. Then the government will reduce taxes levied on the households in a lump-sum fashion.

## 2.5. Parameterized Expectations

The above model is constructed for simulation and policy evaluation through numerical approximation algorithms. One could simulate the model to obtain the dynamics of the endogenous variables, given the exogenous policy rules, the shocks and the specification of the underlying parameters and initial conditions. The main issue for simulating this model is that there are forward looking variables for consumption and the exchange rate:

$$c_t = \left[ b\, l_{t+1} (1 + i_l - p)(1 + T + \frac{q_x}{x_t} + \frac{q_d}{d_t}) \right]^{-1}$$

$$e_t = i^* - i + q + Ee_{t+1}$$

How to find values at time *t* as a function of variables expected at time *t+1* is the central issue for “solving” such “a forward looking” stochastic non-linear dynamic general equilibrium model.

Following Marcet (1988, 1993), Den Haan and Marcet (1990, 1994), and Duffy and McNelis (2000), the approach of this study is to “parameterize” the forward looking expectations in this model, with non-linear functional forms $y^E$, $y^C$:

$$E_t\{l_{t+1}R\} \cdot \{[1+g'(c_t)] + \Gamma_{ct}\} = y^c(x_{t-1};\Omega_l)$$

$$E_t e_{t+1} = y^E(x_{t-1};\Omega_E)$$

where $R=(1+i_L-p)$ and $x_t$ represents a vector of observable variables at time *t*, of traded and non-traded production, the marginal utility of consumption, the real interest rate, and the real exchange rate:

$$x_t = \{y^T, y^N, l, r, z\}$$

The functional form for $y^E$, $y^C$ is usually a second order polynomial expansion (see, for example, Den Haan and Marcet (1994)). However, Duffy and McNelis (2001) have shown that the neural networks have produced results with greater accuracy for the same number of parameters, or equal accuracy with few parameters, than the second order polynomial approximation. Judd (1996) classifies this approach as a “projection” or a “weighted residual” method for solving functional equations, and notes that the approach was originally developed by Williams and Wright (1982, 1984, 1991). These authors pointed out that the conditional expectation of the future gain price as a “smooth function” of the current state of the market, and that this conditional expectation can be used to characterize equilibrium.

The specification of the functional forms $y^E(x_t;\Omega_E)$ and $y^C(x_t;\Omega_C)$ according to the neural network approximation is done in the following way:

$$n_{k,t} = \sum_{j=1}^{J*} b_j x_{j,t}$$

$$N_{k,t} = \frac{1}{1+e^{-n_{i,t}}}$$

$$y_t = \sum_{k=1}^{K^*} k_k N_{k,t}$$

where $J^*$ is the number of exogenous or input variables, $K^*$ is the number of neurons, $n_t$ is a linear combination of the input variables, $N_t$ is a logsigmoid or logistic transformation of $n_t$, and $y_t$ is the neural network prediction at time t of either $(e_{t+1})$ or $\{l_{t+1}R\} \cdot \{[1+g'(c_t)] + \Gamma_{ct}\}$.

As seen in this equation, the only difference from ordinary non-linear estimation relating "regressors" to a "regressand" is the use of the hidden nodes or neurons, *N*. One forms a neuron by taking a linear combination of the regressors and then transforming this variable by the logistic or logsigmoid function. One then proceeds to thus one or more of these neurons in a linear way to forecast the dependent variable $y_t$.

Judd (1996) notes that the neural networks provide us with an "inherently non linear functional form" for approximation, in contrast with methods based on linear combinations of polynomial and trigonometric functions. Both Judd (1996) and Sargent (1997) have drawn attention to the work of Barron (1993), who found that neural networks do a better job of "approximating" any non linear function than polynomials, in the sense that a neural network achieves the same degree of in sample predictive accuracy with fewer parameters, or achieves greater accuracy, using the same number of parameters. For this reason, Judd (1996) concedes that neural networks may be particularly efficient at "multidimensional approximation".

The main choices that one has to make for a neural network is $J^*$, the number of regression variables, and $K^*$, the number of hidden neurons, for predicting a given variable $y_t$. Generally, a neural network with only one hidden neuron closely approximates a simple linear model, whereas larger numbers of neurons approximate more complex non linear relationships. Obviously, with a large number of "regressors" *x* and with a large number of neurons N, one approximates progressively more complex non-linear phenomena, with an increasingly larger parameter set.

The "solution" for the parameters $\Omega_E = \{b_E, k_E\}$ and $\Omega_l = \{b_l, k_l\}$ of the neural network functional specification for $y^E$ and $y^l$ is through recursive estimation.

Initially, the parameter sets $\Omega_E$ and $\Omega_\lambda$ are specified at random initial values. The full model is then simulated for a long interval. Then the squared forecast errors for $ln(E_{t+1})$ and $ln(l_{t+1}R_t)$ are computed, based on the sum of the squared difference realized values of $ln(E_{t+1})$, $l_{t+1}$ and the predictions given by $y^E$, $y^l$ based on the initial values $W_E$ and $W_l$. These parameter sets are then updated in a recursive estimation process, as the models are simulated repeatedly, until convergence is achieved, when the sum of squared differences between the approximated and the model generated values $y^E$, $y^l$ is minimized.

Judd (1998) calls this method a "fixed point iteration" with simulation and non linear optimisation to compute the critical conditional expectation, in this case for $E_{t+1}$ and $\lambda_{t+1}$. Judd (1998 : p 601) calls this use of simulation "intuitively natural" and related to rational expectation "learning ideas".

The idea behind this numerical approximation for solving for the "forward expectation" for $ln(E_{t+1})$ and $(l_{t+1})$ is that agents do not know perfectly the underlying model, but have to "learn it" from observations and minimizing forecast errors through time. While this approach to the formulation of expectations seems to contradict pure rationality of economic agents, Hansen and Sargent (2000) recently noted that economists readily concede that all models are approximations, in order to be tractable, i.e. both feasible to solve and to simulate. But they also note that with tractability comes a form of misspecification, which is unavoidable in applied economic research.

## 3. Inflation Targeting Using Soft or Hard Policy Rules

GEMBI is constructed with a Taylor rule reaction function where the central bank controls the short-term interest rate as it responds to price conditions and the output gap. Under this monetary framework, the central bank tries to achieve a targeted inflation rate by adjusting the short-term interest rate through open market operations. The appropriate interest rate is the rate which is consistent with a Taylor Rule. In this model, the Taylor rule is a function of last period's interest rate, the deviation between expected inflation and targeted inflation, and the output gap.

– The Taylor rule as a reaction function will produce the path of the interest rate as an intermediate target variable. Open market operations (Cut off Rate) are directed to reach that path.
– The change in the stock of bonds will change the money supply in the economy. The money supply is assumed to be equal to the demand for money since both are affected by the interest rate generated by the Taylor rule.

The Taylor rule's base interest rate is mathematically formulated in GEMBI as follows:

$$i_t = a_1 + a_2 i_{t-1} + a_3 (p_{t+6} - p*) + a_4 (y_t - y^{pot})$$

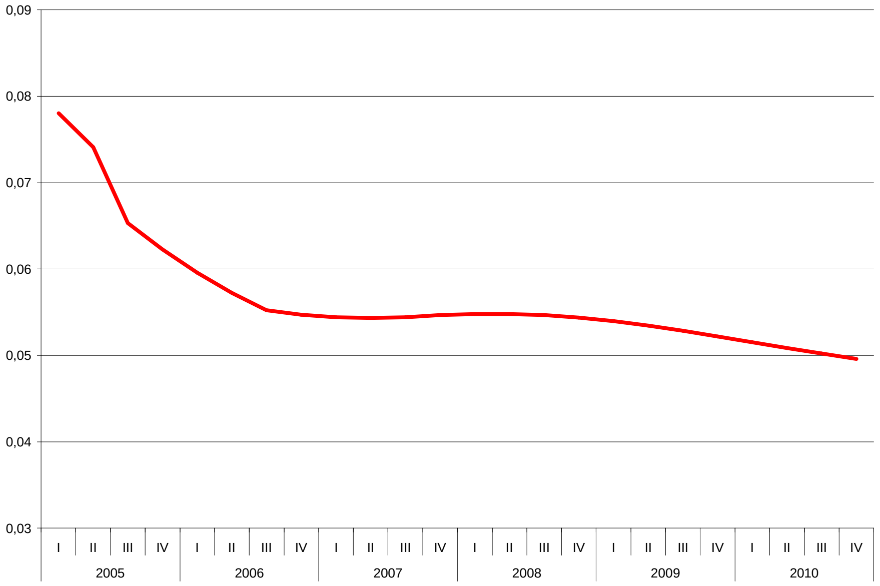
where,

| | |
|---|---|
| i | = interest rate |
| $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ | = weighted coefficients (under this simulation, $\alpha_1$ is set to zero) |
| $\pi$ | = Inflation rate ( $\pi *$ represents the target value) |
| $y_t$ | = excess demand |
| $y^{pot}$ | = potential output |
| t | = time operator |

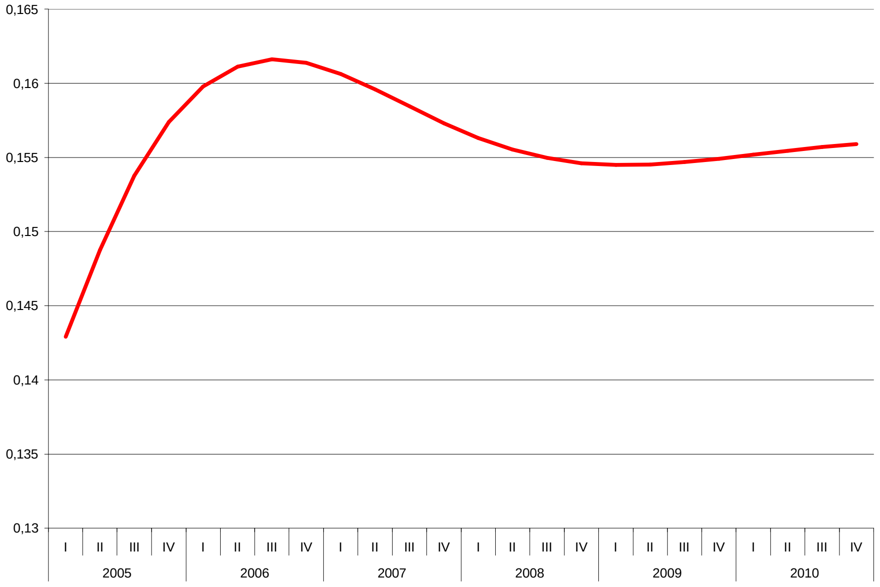
## 3.1. Simulation Results

The dynamic paths produced by GEMBI simulations include the interest rate, inflation rate, exchange rate and GDP growth rate for the period 2005-2010. These simulations are undertaken based on a baseline scenario without any shocks. GEMBI is constructed as a medium to long-term model, however, the short-term dynamics for 2002-2004 are well captured by macro-econometric models such as MODBI and SOFIE.

## Dynamic Inflation Path

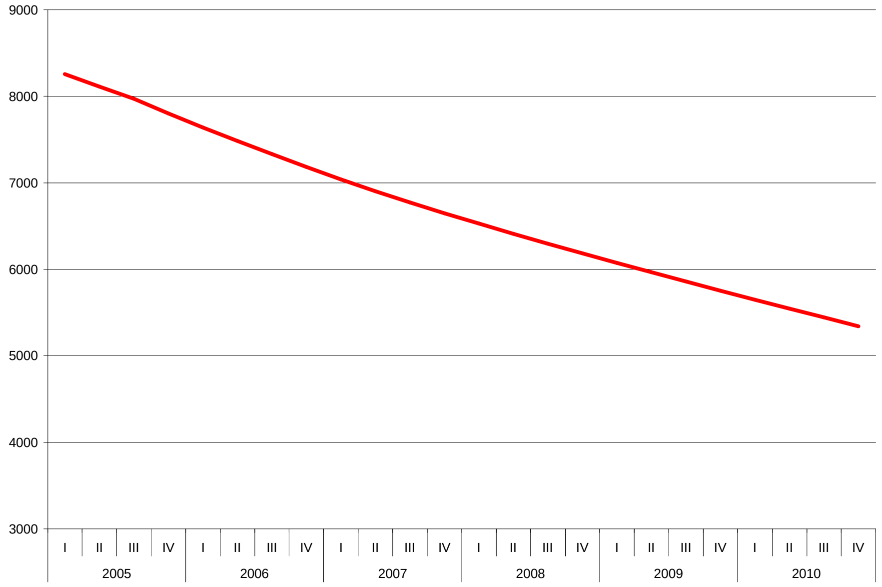



## Dynamic Interest Path

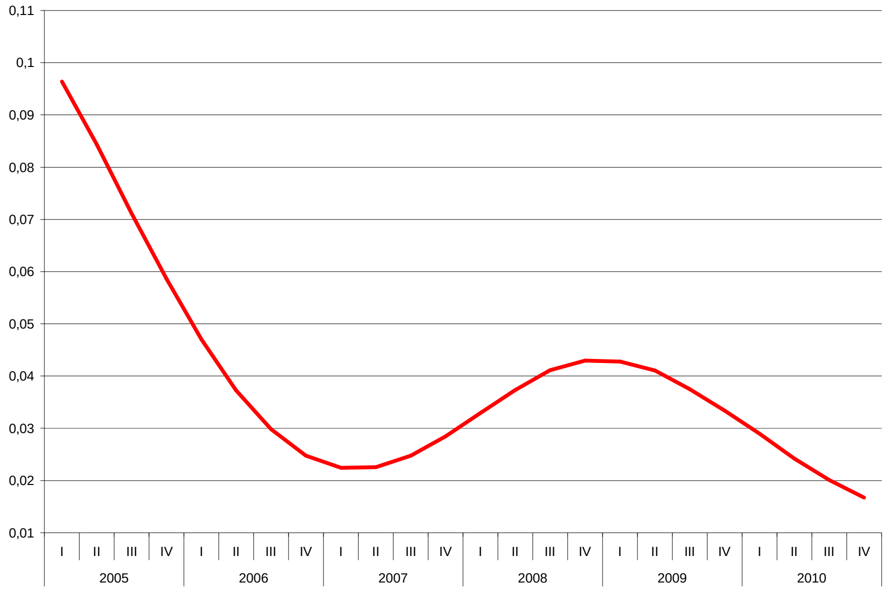



The average interest rate reaction path towards inflation and growth is recorded at 11.7% throughout 2005. In the following years, interest rate increases to 14.1% in 2006 and 15.4% in 2007.

## Dynamic Path of the Exchange Rate




## Dynamic Path of GDP Growth




## Table 1: Dynamic Path for 2005 - 2010

| | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| **Inflation** | S2:62S3:684S4:52 | 0,070 | 0,057 | 0,054 | 0,055 | 0,053 | 0,051 |
| **Sbirate** | S2:62S3:684S4:52 | 0,151 | 0,161 | 0,159 | 0,155 | 0,155 | 0,156 |
| **Erate** | S2:62S3:684S4:52 | 8036 | 7410 | 6842 | 6355 | 5914 | 5496 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Gdpgrowth** | S2:62S3:684S4:52 | 0,074 | 0,032 | 0,019 | 0,027 | 0,033 | 0,031 |

### 3.2 Interest Rate Simulation using Soft and Hard Preferences

Since the interest rate is endogenously determined by the Taylor Reaction Function, different interest rate simulation paths then can be attained through the following steps:

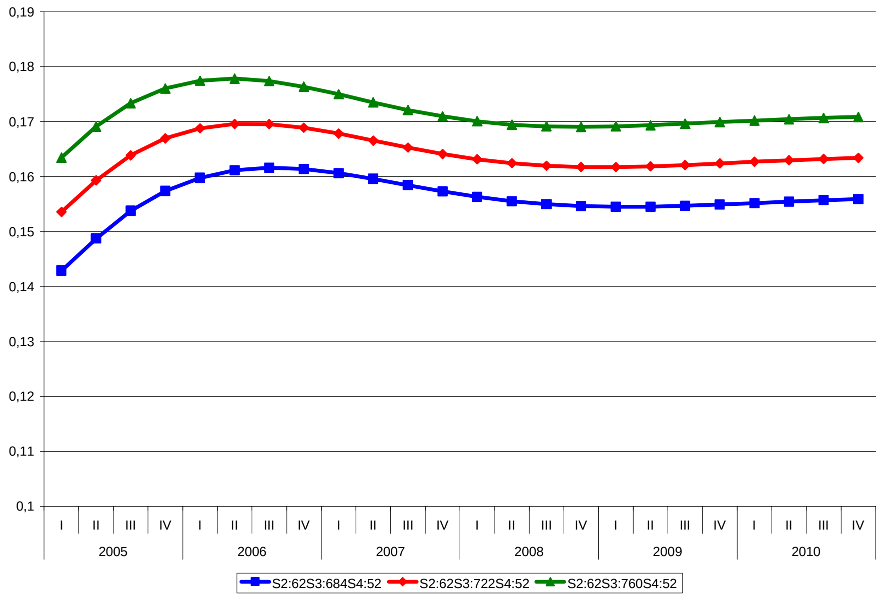
1. Changing the weights of coefficients of the Taylor Reaction Function; or
2. Altering the time horizon in which the desired inflation target is to be achieved.

The weighted coefficients will determine monetary policy responses to the inflation gap, between the actual and target rates while a change in the time horizon reflects aggressiveness of the disinflation program undertaken by the central bank.

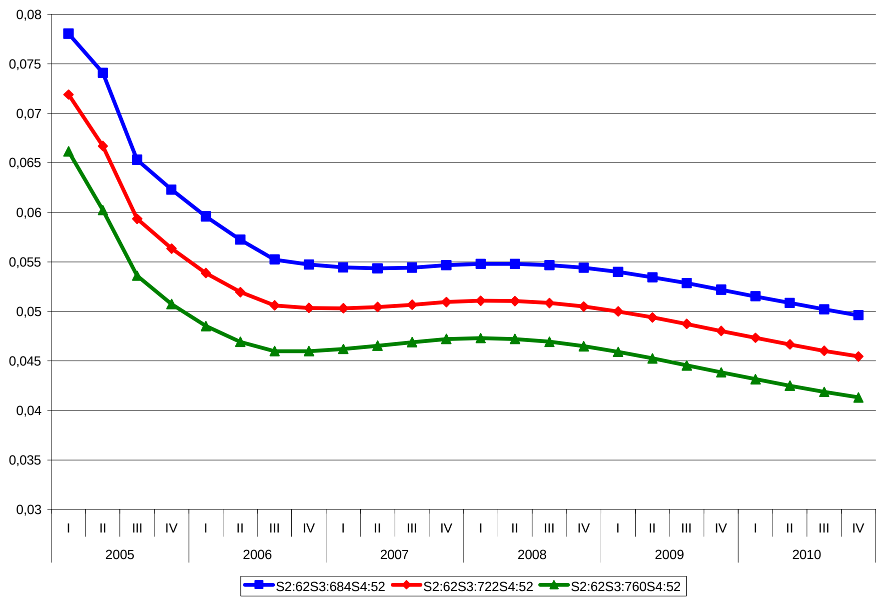
## 1. *Simulations Using Different Weights for Coefficients in the Taylor Reaction Function*

The simulation uses three alternative weigh for the coefficients, on the inflation gap ($a_3$) represented by S3 value on graphs (0.684, 0.722, and 0.760). The larger weights for the inflation gap coefficient reflects a "hard" policy reaction and therefore results in higher interest rate along the dynamic path.

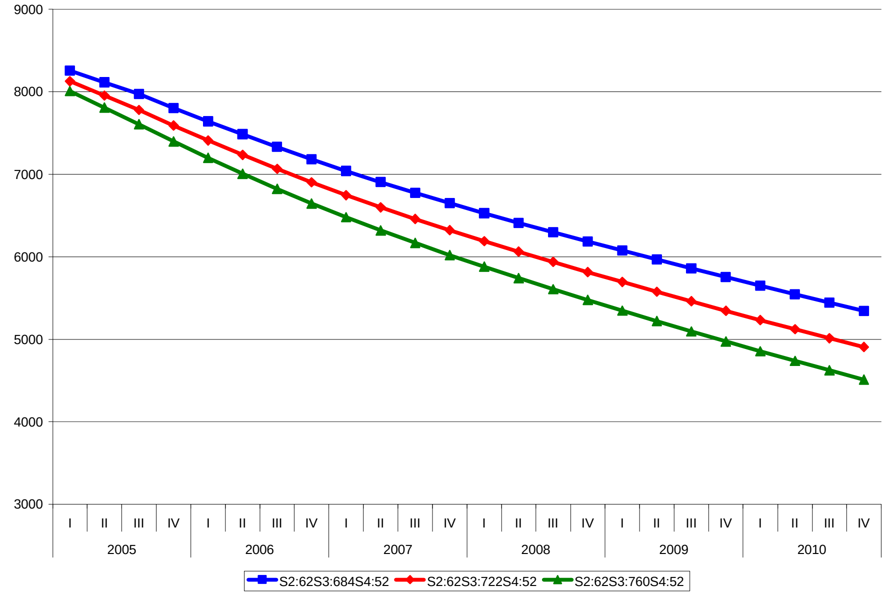
## Dynamics of the Interest Rate



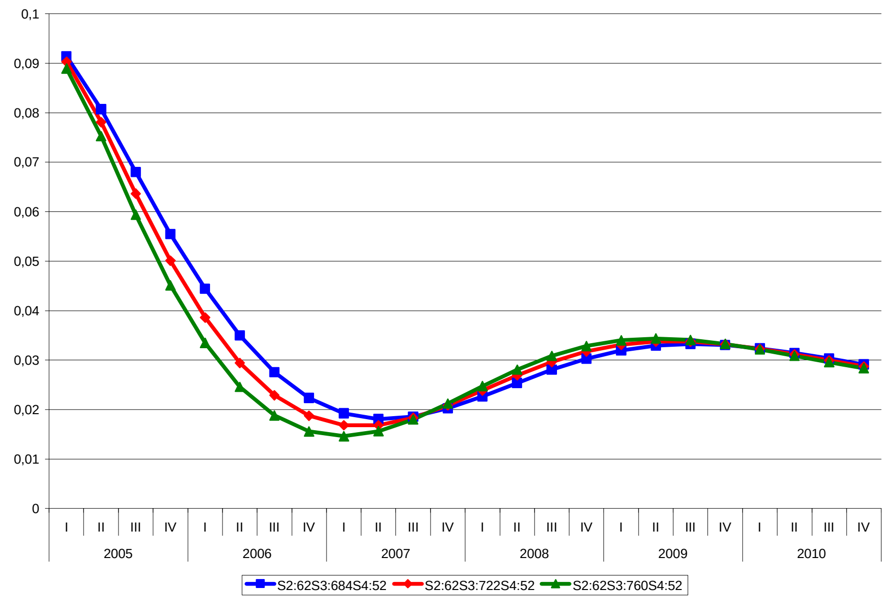

## Dynamics of the Inflation Rate



## Dynamics of the Exchange Rate




## Dynamics of GDP Growth




In response to a higher interest rate path, the dynamics of inflation under a hard policy would result in a lower inflation dynamic path. In turn, the exchange rate strengthen more quickly under a hard disinflation program, while GDP growth is on a lower dynamic path than under a moderate or soft inflation.

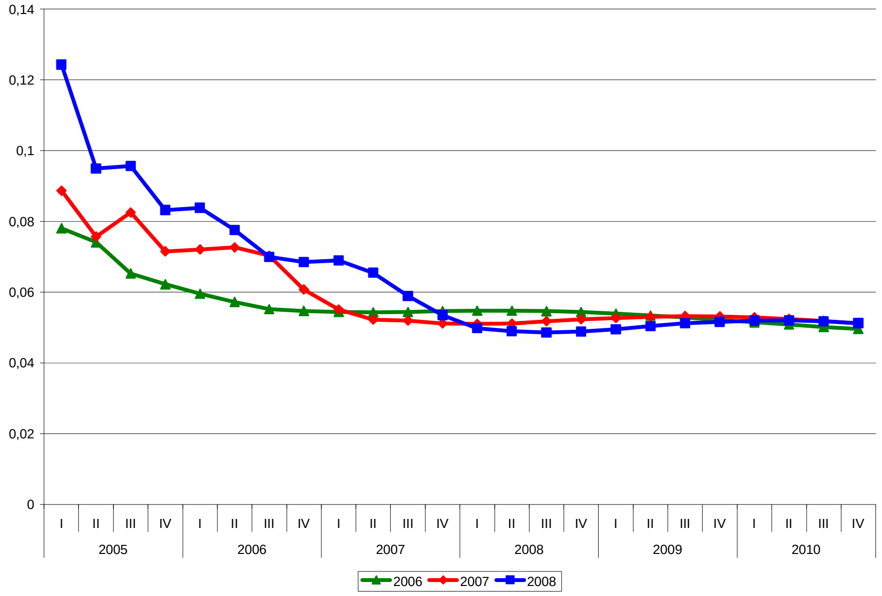
**Table 2: Dynamics of Alternative Horizons in Reaching Targeted Inflation**

| | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| **Inflation** | S2:62S3:684S4:52 | 0,070 | 0,057 | 0,054 | 0,055 | 0,053 | 0,051 |
| | S2:62S3:722S4:52 | 0,064 | 0,052 | 0,051 | 0,051 | 0,049 | 0,046 |
| | S2:62S3:760S4:52 | 0,058 | 0,047 | 0,047 | 0,047 | 0,045 | 0,042 |
| **Sbirate** | S2:62S3:684S4:52 | 0,151 | 0,161 | 0,159 | 0,155 | 0,155 | 0,156 |
| | S2:62S3:722S4:52 | 0,161 | 0,169 | 0,166 | 0,162 | 0,162 | 0,163 |
| | S2:62S3:760S4:52 | 0,170 | 0,177 | 0,173 | 0,169 | 0,170 | 0,171 |
| **Erate** | S2:62S3:684S4:52 | 8036 | 7410 | 6842 | 6355 | 5914 | 5496 |
| | S2:62S3:722S4:52 | 7863 | 7153 | 6531 | 6001 | 5519 | 5068 |
| | S2:62S3:760S4:52 | 7705 | 6918 | 6247 | 5676 | 5159 | 4682 |
| **Gdpgrowth** | S2:62S3:684S4:52 | 0,074 | 0,032 | 0,019 | 0,027 | 0,033 | 0,031 |
| | S2:62S3:722S4:52 | 0,071 | 0,027 | 0,018 | 0,028 | 0,033 | 0,031 |
| | S2:62S3:760S4:52 | 0,067 | 0,023 | 0,017 | 0,029 | 0,034 | 0,030 |

## *2. Simulations Using Alternative Time Horizons in Reaching the Targeted Inflation Rate*

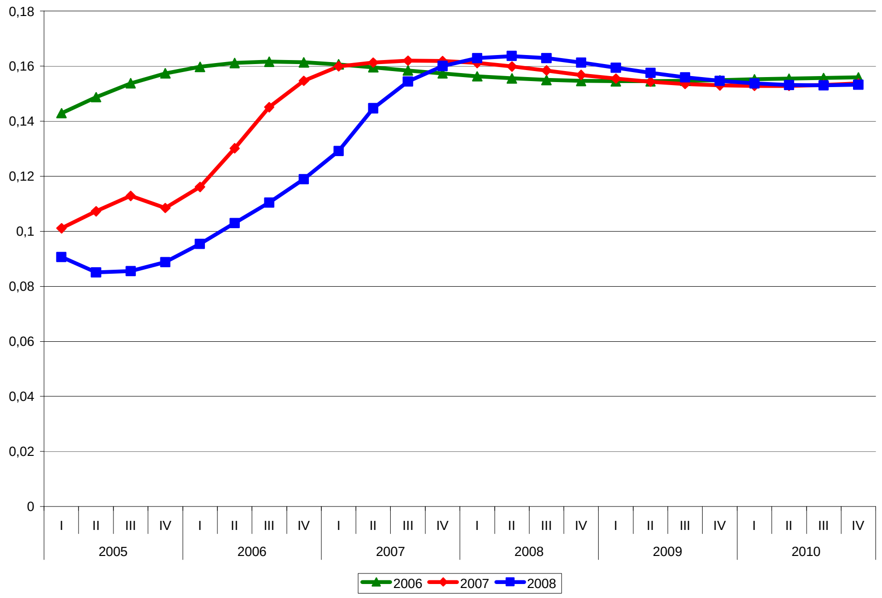
Under this simulation, three alternative time horizons in reaching the 6%-7% inflation target are set for 2006, 2007 and 2008. The longer time horizon represents a soft disinflation program in which its policy impact on other macro variables is quite moderate.

## Dynamics of Inflation




The soft policy preference of reaching a 6% inflation rate, is set to be achieved in 2008 represented by the **blue line**, while the quasi hard policy preference set, is to be achieved in 2007 represented by the **red line**. The hardest policy preference set, is to be achieved in 2006, represented by the **black line.** The dynamics of these alternative horizons for attaining the inflation target in term of macro variables can be seen below:

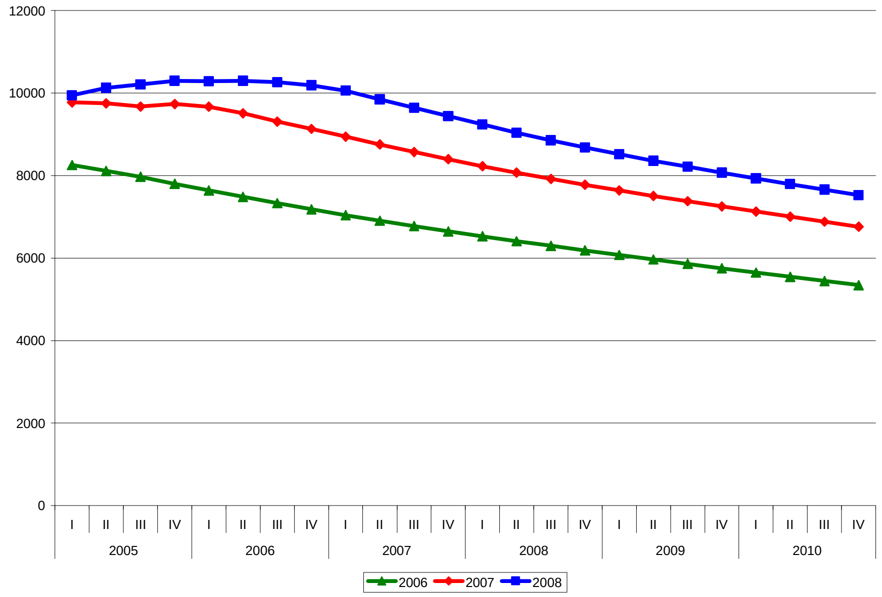
## Dynamics of the Interest Rate



The soft disinflation program allows a longer time horizon in reaching the targeted inflation rate, and, as a result, it requires lower interest rate dynamics (blue line). The average interest rate level moves around 8.8% in 2005, 10.7% in 2006 and 14.7% in 2007 and eventually ends up in a narrowing range of between 14%-16%..

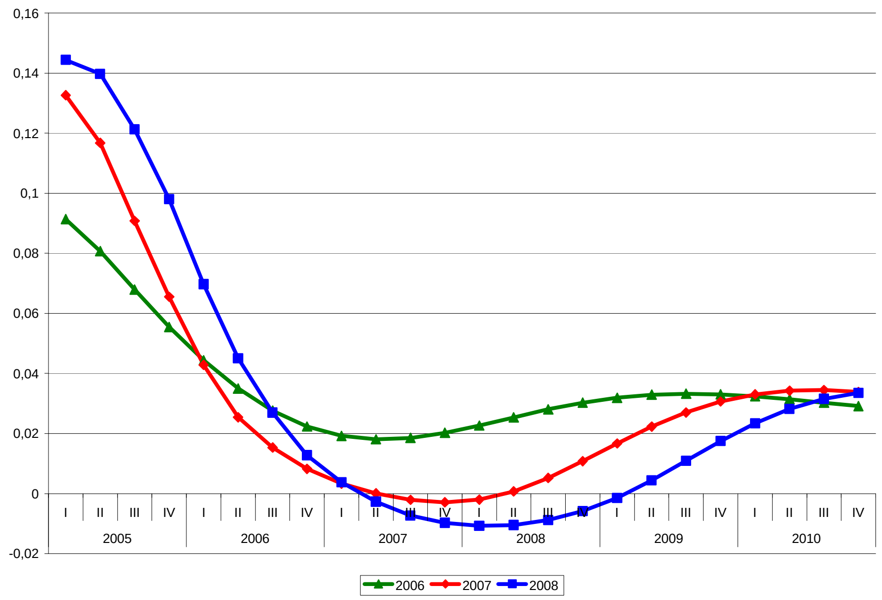
The responses in monetary policy required by the quasi hard disinflation program create higher interest rate dynamic path. The average SBI rate moves from around 15.1% in 2005 to 16.1% in 2006, and to 15.9% in 2007 and ends up in narrowing range as well (red line). Similarly, the hardest disinflation program leads to a much higher interest rate dynamic path as is reflected in the black line.

## Dynamics of the Exchange Rate




As a consequence of higher interest rates responses under the Taylor Rule, resulting from monetary policy the hard disinflation program will produce a higher interest rate differential. As a result, the exchange rate appreciates much faster and moves from Rp8,036 in 2005, Rp7,410 in 2006 and Rp5,496 in 2010.

## Dynamics of GDP Growth




The hard disinflation program also results in a lower dynamic path of GDP growth compared with the soft and quasi hard programs. However, under the hard program the average growth rate for one decade is slightly higher (3.6%) than for the other two policy options (3.5% and 3.3%). In addition, as a result of a hard disinflation program, the dynamic path of GDP growth rate is more stable as compared with the soft and semi-hard programs.

## Table 3: Dynamics of Alternative Horizons for Reaching the Targeted Inflation Rate

| | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Average |
|---|---|---|---|---|---|---|---|---|
| **Inflation** | target=2006 | 0,070 | 0,057 | 0,054 | 0,055 | 0,053 | 0,051 | 0,057 |
| | target=2007 | 0,080 | 0,069 | 0,053 | 0,052 | 0,053 | 0,052 | 0,052 |
| | target=2008 | 0,100 | 0,075 | 0,062 | 0,049 | 0,051 | 0,052 | 0,048 |
| **Sbirate** | target=2006 | 0,151 | 0,161 | 0,159 | 0,155 | 0,155 | 0,156 | 0,156 |
| | target=2007 | 0,107 | 0,137 | 0,161 | 0,159 | 0,154 | 0,153 | 0,164 |
| | target=2008 | 0,088 | 0,107 | 0,147 | 0,163 | 0,157 | 0,153 | 0,172 |
| **Erate** | target=2006 | 8036 | 7410 | 6842 | 6355 | 5914 | 5496 | 6675 |
| | target=2007 | 9735 | 9405 | 8667 | 8000 | 7444 | 6944 | 6356 |
| | target=2008 | 10143 | 10258 | 9747 | 8954 | 8290 | 7728 | 6064 |
| **Gdpgrowth** | target=2006 | 0,074 | 0,032 | 0,019 | 0,027 | 0,033 | 0,031 | 0,036 |
| | target=2007 | 0,101 | 0,023 | 0,000 | 0,004 | 0,024 | 0,034 | 0,035 |
| | target=2008 | 0,126 | 0,039 | -0,004 | -0,009 | 0,008 | 0,029 | 0,033 |

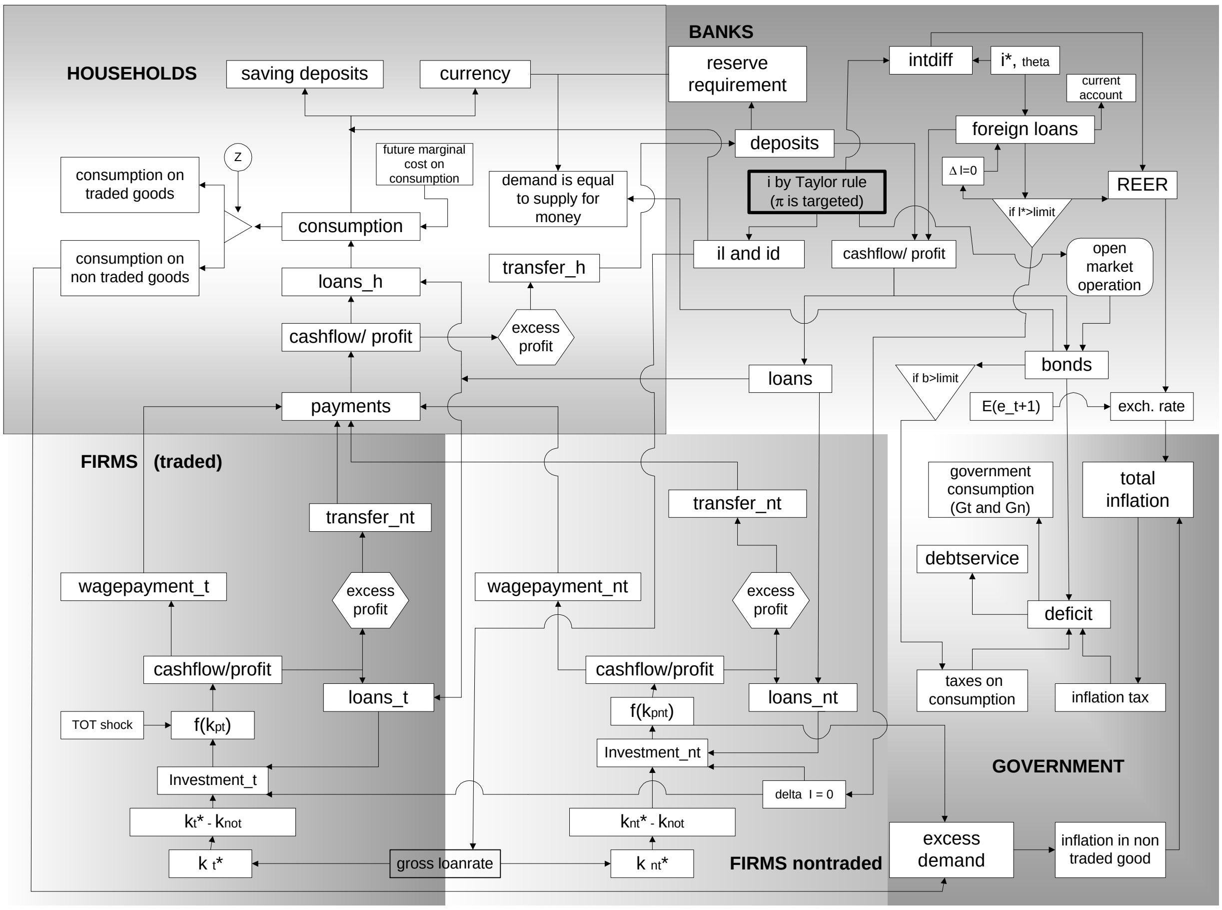
## 4. Conclusion

- Alternative simulations using GEMBI provide the dynamic impacts of different disinflation programs on other macroeconomic variables. Under different central bank preferences (play soft or play hard) one would be able to see different desired paths of interest rates responses to achieve the medium-term inflation target and its impact on the exchange rate and GDP growth rate.

- The “soft” disinflation program (both in the form of a longer achievement horizon and in lower coefficient weight in the Taylor Rule reaction function) turn out to have moderate positive impacts on interest rate dynamics and GDP growth.

- The “hard” disinflation program, as reflected in the shorter achievement horizon or in the bigger weight in Taylor Rule reaction function, did exactly reflect a lowering of the GDP growth path in the first two years but gradually achieves a higher growth rate of GDP in the following years as compared to the other disinflation programs.

# APPENDIX
# INFLATION TARGETING FRAMEWORK
# USING INTEREST RATE AS OPERATING TARGET



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