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Research Article

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Inflation targeting in China based on a dynamic stochastic general equilibrium model

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ABSTRACT

Strict inflation or flexible inflation targeting, which is more suitable for China? By building, calibrating and estimating a new Keynesian DSGE model, we analyze and compare the effect of strict inflation and flexible inflation targeting. Through counterfactual simulation, analysis of impulse response and social welfare loss, we find, comparatively speaking, first, the strict inflation target will result to larger fluctuations of inflation and smaller fluctuations of output facing technology shocks; Second, the flexible inflation target will suppress the output expansion and inflation rising more largely in a relatively short period of time facing monetary policy shocks; final, the strict inflation targeting will result to fewer losses from the perspective of the central bank's loss function. Thus, flexible inflation targeting is appropriate for managing the economy in Interest rate liberalization, but would cause larger the welfare loss.

Key words: Interest rate Liberalization, DSGE Model, strict inflation targeting; flexible inflation targeting.

INTRODUCTION

The monetary policy still sticks to the flexible inflation targeting, but output still decline and inflation still gradually rise. whether flexible inflation targeting is a better choice? The strict inflation targeting or flexible inflation targeting, which is more suitable for China? To answer this question, this paper attempts to analyze the economic effects of different inflation targeting.

Sevesson divided the inflation targeting into two kinds. One is strict inflation targeting --- the central bank target function does not include stabilizing output. The other is flexible inflation targeting--- the central bank not only considers stabilizing inflation, but also stabilizing output. Sevesson[9]found that Inflation targeting can solve the problem of the dynamic inconsistency of monetary policy, and reduce the volatility of inflation. Adopting flexible inflation targeting regime can also stabilize output. Mishkin [7]also held the same view, he believed that inflation targeting significantly reduce inflation and inflation expectations. MSH[8]showed that the efficiency of monetary policy and economic performance in inflation targeting countries was inferior to those in the non-inflation targeting countries such as the United States and Germany. The literature is ambiguous about the effects of inflation targeting in emerging economies. While Goncalves and Salles [6]found a significant decline in inflation after the adoption of inflation targeting, Brito and Bystedt[3]do not. Stefan Gerlach, Peter Tillmann[10]concluded inflation targeting has performed well in Asia.

Dynamic stochastic general equilibrium model(DSGE), based on the dynamic optimization method to investigate

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the behavior main body (family, manufacturer, etc.) of decision making, namely maximize its in the family life under the assumption of utility, namely maximize its in the family life under the assumption of utility, manufacturer

to maximize profit for each main body behavior equation. General in DSGE models often including government departments (the central Banks, financial department) of behavioral decision. DSGE model considering the behavior of main body of economy interaction and mutual influence, thus judge behavior under the framework of general equilibrium

The researches of comparing the policy effect of different inflation targeting rules for China in the liberalization of deposits interest rates are rare. Based on a New Keynesian DSGE model, we construct a dynamic stochastic general equilibrium model to analyze the policy effect of these two kind of inflation targeting based on Impulse response function and loss function during the liberalization of interest rate—flexible inflation targeting and strict inflation targeting.

The paper is organized as follows. The second part builds the model. The third part Model Parameter calibration and estimation. In the fourth part we analyze the impulse response and calculate the loss functions. The last part is the conclusion.

MODEL CONSTRUCTION

Household optimization

Consider a version of the classical economy with consumption and labor in the utility function, the household chooses c_t, x_t, b_t, k_t to maximize its lifetime utility under the budget constraint for all $t = 0,1,2,...,$ household utility function

$$U = E_t \sum_{s=0}^{\infty} \beta^s (\ln c_{t+s} + \varphi \ln x_{t+s}) \tag{1}$$

The capital accumulation equation

$$k_t = i_t + (1-\delta)k_{t-1} \tag{2}$$

The budget constraint

$$c_t + i_t + b_t + \tau_t = \omega_t n_t + r_t^k k_{t-1} + \frac{R_t}{\pi_t} b_{t-1} + \Pi_t \tag{3}$$

where, $w_t n_t$, R_t , r_t^k , i_t , k_t respectively represent the real wage, the nominal deposit rate the real rental rate of capital, the investment, the actual capital stock. $\pi_t = P_t / P_{t-1}$, b_t , Π_t τ_t respectively represent the inflation rate, government bonds, monopoly profits that household obtain from the enterprise, the lump-sum taxes paid by consumers.

Using the Lagrange multiplier method, we can obtain from the optimization

$$\frac{\varphi c_{t+s}}{1-n_{t+s}} = \omega_{t+s} \tag{4}$$

$$\beta E_t \left(\frac{c_{t+s} R_{t+s+1}}{c_{t+s+1} \pi_{t+s+1}}\right) = 1 \tag{5}$$

$$\beta E_t \frac{c_{t+s}}{c_{t+s+1}} [(1-\delta) + r_{t+s+1}^k] = 1 \tag{6}$$

where β Lagrange multiplier, we also can regard equation (4) as a labor supply equation, which shows that: the higher real wages, the more quantity of labor supplied: the higher real wages, the more current consumption. Equation (5) reflects the family's choice between current consumption and future consumption, Equation (6) reflects increasing of the final return on capital will lead people to reduce current consumption and increase future consumption.

Firm Optimization

We introduce a basic model of monopolistic competition exists in the Intermediate Goods areas. Examples of such models can be found in Blanchar and Kiyotaki[2], Ball and Romer[1] and Walsh[11].

The representative final goods-producing firm

During each period $t = 0,1,2,...,$ the representative final goods-producing firm uses y_{it} units of each intermediate good $i \in [0,1]$, purchased at the nominal price P_{it}, to manufacture y_t units of the finished good according to the constant-returns-to-scale technology described by:

$$y_t = [\int_0^1 y_{it}^{\frac{\theta-1}{\theta}} di]^{\frac{\theta}{\theta-1}} \qquad (7)$$

where θ represents the elasticity of substitution between intermediate goods y_{it}

The final goods-producing firm chooses y_{it} for all $i \in [0,1]$ to maximize its profits, the first-order conditions for this problem are

$$y_t(i) = (\frac{P_t(i)}{P_t})^{-\theta} y_t \qquad (8)$$

The representative intermediate goods-producing firm

We assume a continuum of monopolistically competitive firms producing differentiated intermediate goods. The production function for producing good i is given by

$$y_{it} = z_t k_{i,t-1}^{\alpha} n_{it}^{1-\alpha} \qquad (9)$$

where $k_{i,t-1}$ and n_{it} represent the capital and labor services. z_t represents the technology.

The typical intermediate goods-producing firm's optimization problem, implies

$$r_t^k k_{it-1} = \alpha mc_t y_{it} \qquad (10)$$

$$\omega_t n_{it} = (1-\alpha) mc_t y_{it} \qquad (11)$$

we assume there are Calvo-style price setting frictions. An intermediate firm can set its price optimally with probability $1-\rho$, and with probability ρ it must keep its price unchanged relative to what it was in the previous period.

Gali and Gertler[5]allowed for a proportion $1\text{-}\zeta$ of the firms to set their expectations in a forward-looking direction and a proportion ζ of the firms to set their expectations on a backward- looking basis on Calvo[4], we obtain

$$\widehat{\pi}_t = \lambda_f E_t \widehat{\pi}_{t+1} + \lambda_b \widehat{\pi}_{t-1} + \lambda_{mc} \widehat{mc}_t \qquad (12)$$

where $\lambda_f = \beta\rho\psi^{-1}, \lambda_b = \zeta\psi^{-1}, \lambda_{mc} = (1\text{-}\zeta)(1\text{-}\rho)(1\text{-}\beta\rho)\psi^{-1}, \psi = \zeta + \rho + \zeta\rho(\beta\text{-}1)$, represent the deviation of the inflation rate for the steady-state, $E\widehat{\pi}_{t+1}, \widehat{\pi}_{t-1}, \widehat{mc}_t$, respectively represent the deviation from the steady-state of the expected inflation, the inflation inertia and the percentage of actual marginal cost. ζ, ρ, β, respectively represent the proportion of backward-looking pricing, a fraction keep prices unchanged and discount factor.

The central bank's behavior

The monetary authorities implement monetary policy based on a typical Taylor rules

$$\widehat{R}_t = \varphi_R \widehat{R}_{t-1} + \varphi_\pi E\widehat{\pi}_{t+1} + \varphi_y \widehat{y}_t + z_t^R \quad (13)$$

where $\widehat{R}_t, E\widehat{\pi}_{t+1}, \widehat{y}_t$ is the deviation of its steady state, z_t^R denotes monetary policy shocks.

External shocks
Technology shocks dynamic equation

$$\widehat{z}_t = \rho_z \widehat{z}_{t-1} + \varepsilon_t^z \qquad \varepsilon_t^z \sim N\ (0\sigma_z^2 \quad (14)$$

Economy's total resource constraints

$$y_t = c_t + i_t \quad (15)$$

PARAMETER CALIBRATION AND ESTIMATION

Model parameter calibration

We set the exogenous technology shocks steady state value as 1. With a sample period of nominal deposit rate deduction of the inflation rate and then averaged to obtain the steady state rate of 1%. Most estimates capital-output elasticity are between 0.6-0.7, we take 0.6. Annual value of physical capital depreciation rate is mostly set to 10% and the corresponding quarter value are set to 2.5%. Most literature to take mc as 0.91 φ is an substitute coefficient of leisure and consumption , we set to 1. Gal íand Gartner [5] allowed for a proportion ζ of the firms to set their expectations on a backward-looking direction. we set it to 0.25.

Table 1. Parameters calibration values

π	R	δ	z	mc	
1	01%	.5%	1	0.91	0.6
φ		ζ	β	ρ_z	
1	1/3	0.25	0.99	0.8	

Model parameter estimation

Bayesian estimation method can combine with sample information and non-sample information, which makes the parameter values closer to the model's economic implications. When using the Bayesian method, take into account the parameters' general distribution and economic implications, we use the beta distribution for parameters that take sensible values between zero and one, the gamma distribution for coefficients restricted to be positive and the inverse gamma distribution for the shock variances. We choose two groups of data to estimate parameters, Interest rates and inflation, and the sample interval range is 1996 q1 to q3 2013.The results of parameters Bayesian estimation are shown in table 2. We can easily notice from the figure 1, all parameters changed significantly. In other words, the sequences of the three observations contain a lot of new information

According estimation and the definition of the two inflation targeting, we choose $\rho_\pi = 5.4$ $\rho_y = 0$ means Strict inflation targeting and $\rho_y = 0.65$ means flexible inflation targeting.

Table 2. Parameters bayesian estimation values

Parameters	Prior dist	Post. mean	95%confidence interval
ρ_R	Beta(0.5,0.1)	0.5980	[0.4952 0.6911]
ρ_π	gamma(2,1)	5.4318	[3.7528 7.0288]
ρ_y	gamma(2,1)	0.6519	[0.3315 0.9350]
σ_R	Inv-gamma(0.01, ∞)	0.0089	[0.0070 0.0107]

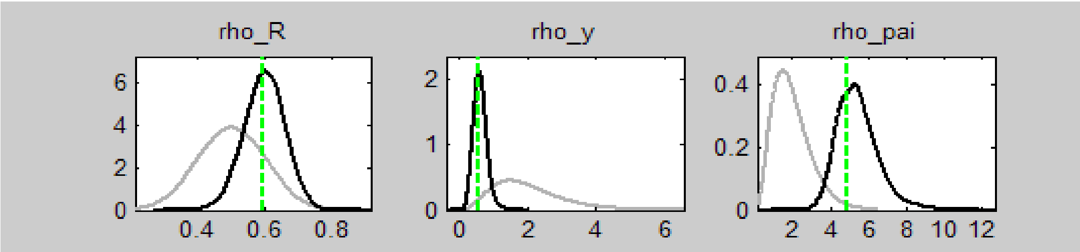

Figure 1 Prior distributions(in gray) and posterior distributions(in black)

SIMULATION AND ANALYSIS

The impulse response analysis

The next two figures show the simulation impulse response results for the strict and flexible inflation inflationary system.

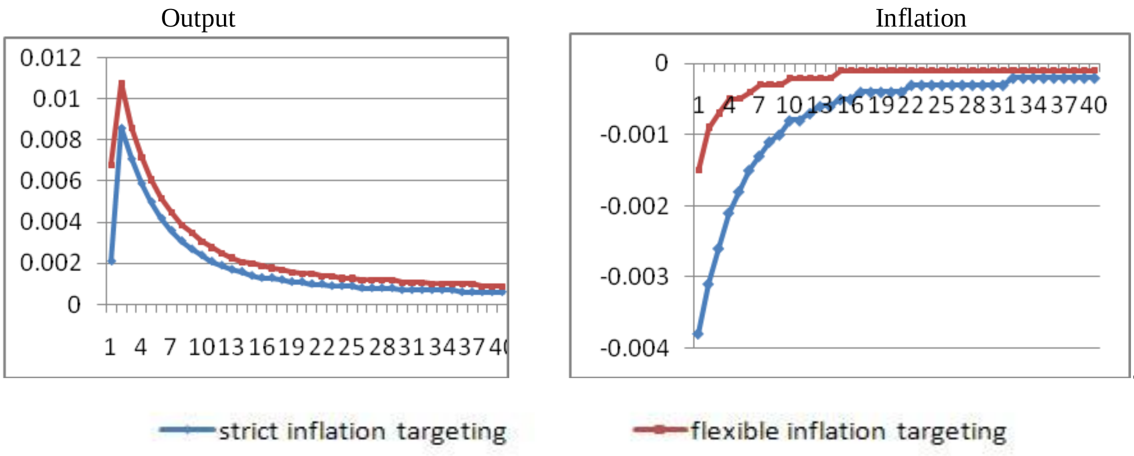

Figure 2 Impulse responses to a 1% technology shock

Faced with non-monetary policy shocks, the central bank will choose a monetary policy tool which will cause the smallest macroeconomic volatility, as the smaller fluctuations of the output and inflation means less social welfare loss. From figure 1, compared with the flexible inflation targeting, the strict inflation target will result to larger fluctuations of inflation and smaller fluctuations of output facing technology shocks

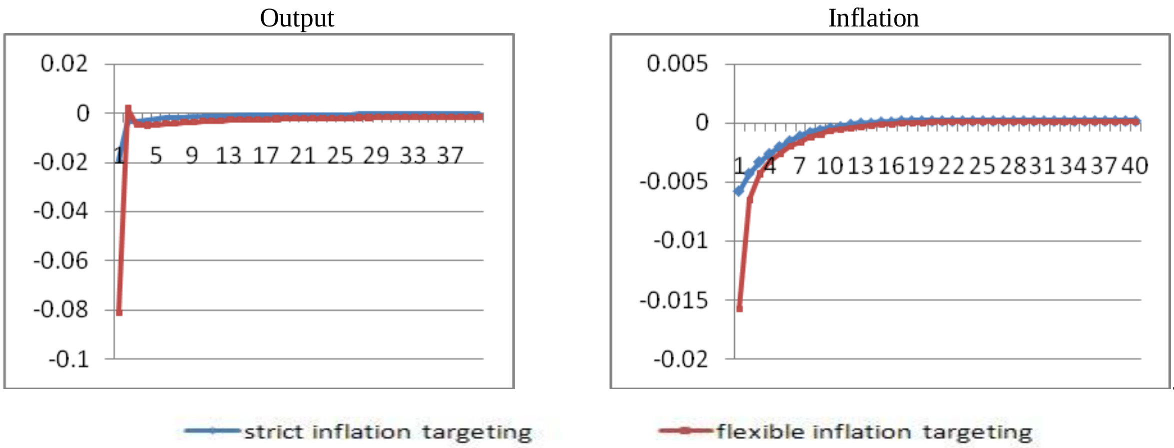

Figure 3 Impulse responses to a 1% nominal interest rate shock

From the impact effects of the monetary policy adjustments, desirable monetary policy instruments can play the largest policy effects in the shortest time. From Figure 3, compared with the strict inflation target, flexible inflation target will suppress the output expansion and inflation rising largely in a relatively short period of time. Therefore, from the perspective of the monetary policy shock effect, flexible inflation target is superior to strict inflation targeting.

The central bank's loss function
Assume that the central bank's loss function is as follows.

$$L = E_t \sum_{i=1}^{n} \vartheta^i [\pi_{t+i}^2 + \lambda y_{t+i}^2] \tag{16}$$

In the equation above, ϑ is the discount factor. λ ($\lambda > 0,$) characterizes the concern degree on the putout from the central bank. n represents the time range. We set 40 as n, which means that banks consider 10-year policy effects at most. Consistent with the previous time frame, the Central Bank and the family is assumed to have the same time preference, namely, $\vartheta = \beta = 0.99$. we set $\lambda = 0.5, \lambda = 1, \lambda = 2$ respectively. we calculate the two loss function under the two kinds of inflation targeting. Table 4 shows us that faced with the impact of non-monetary policy, compared with the flexible inflation targeting, the welfare losses under the strict inflation targeting regulation is smaller, which means that from the point of welfare, the strict inflation targeting regulation is superior to flexible inflation targeting regulation.

Table 4. the loss functions under different target systems

	strict inflation targeting			flexible inflation targeting		
λ	0.5	1	2	0.5	1	2
technology shock	0.000169	0.000293	0.000540	0.000218	0.000432	0.000860

CONCLUSION

Strict inflation or flexible inflation targeting, which is more suitable for China? Until now, there are still few researches about that. In this paper, base on a new Keynesian model with the price stickiness, under the dynamic stochastic general equilibrium framework, we analyze and compare the applicability of the strict inflation targeting and the flexible inflation target in the interest rate liberalization.

Based on the rigorous theoretical analysis, calibration and simulation, we find first, the strict inflation target will result to larger fluctuations of inflation and smaller fluctuations of output facing technology shocks; Second, flexible inflation target will suppress the output expansion and inflation rising largely in a relatively short period of time facing monetary policy shocks; final, the strict inflation targeting will result to fewer losses from the perspective of the central bank's loss function.

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