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TREND INFLATION IN MODERATE AND LOW INFLATION PERIODS: THE IMPLICATION OF THAI MONETARY POLICY

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ABSTRACT

This paper examines the effects of trend inflation on managing of monetary policy during moderate and low inflation environments in Thailand. It extends the New Keynesian model by introducing a positive trend inflation. It finds that the response of inflation and output are lower during the moderate inflation period. A high level of trend inflation enlarges the welfare loss. When the target level for inflation is higher, lower weight on output fluctuation is the optimal policy. To adjust the inflation targeting rate, the central bank should consider the response of inflation and output gap to preserve the determinacy.

Keywords: Trend inflation; Monetary policy; Price dispersion; Welfare; Determinacy.
JEL Classifications: C32; E52.

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I. INTRODUCTION

This paper aims at investigating influences of trend inflation on policy implementations during moderate and low inflation environments in Thailand. It concentrates on analyzing two main issues. First, the paper evaluates the optimal stabilization policy under trend inflation. Particularly, it exploits how trend inflation gives rise to variations in impacts of the various type of disturbances in term of responses of welfare loss. This brings up the question whether or not a strategy to create the stabilization policy exists for Thailand. Second, it investigates trend inflation and the anchoring of expectation. It then evaluates the Thai monetary policy rule under the Rational Expectation Equilibrium (REE) determinacy. In this dimension, the question then arises whether or not a strategy that would insure determinacy for Thailand exists.

The hypothesis of this paper has roots in the literature that examines the effects of positive trend inflation. In this regard, Ascari (2004) and Ascari and Ropele (2007; 2009) assert that the notion of no inflation at steady state is simple but it is a misleading hypothesis. When conducting monetary policy analysis, it is therefore necessary to account for a positive trend inflation.

The main reason for examining the impact of trend inflation on policy implementations stems from the theoretical literature revealing that NAIRU theory does not hold in the long run under a positive trend inflation. For example, the notable study by Ascari (2004) indicates that the higher level of trend inflation generates a higher steady state output loss at an increasing rate regardless of pricing schemes. Amano et al. (2007) provides the same results. The positive trend inflation generates price dispersion across firms. In the steady state price dispersion results in the difference in output across firms leading to an aggregate long run output loss. The features of real rigidities enlarge the magnitude of the output loss for example a firm specific labor input as in Bakhshi et al. (2003) and a roundabout production structure as in Omari (2018).

Moreover, a positive trend inflation generates welfare loss. Amano et al. (2009), Coibion et al. (2012) and Ascari et al. (2018) document that the welfare loss rises with trend inflation. Sbordone (2007) shows that under welfare based loss function, inflation stabilization weight rises with the loss function. Amano et al. (2009) find that the representative household is willing to sacrifice their consumption to keep trend inflation constant at an optimal rate instead of increasing it. Coibion et al. (2012) derive the utility-based welfare loss function. They consider channels through which the positive trend inflation influences welfare. They show that the variance of output around its steady state and the variance of inflation from its trend inflation depend on the way of deriving the welfare loss function, not depending on the trend inflation. In contrast to Coiboin et al. (2012), Lago-Alves (2012) documents that trend inflation is negatively related to the relative weight of output gap. Lago-Alves (2012) suggests also that the divide coincidence does not hold because the policy trade-off exists when the economy has a positive trend inflation.

Furthermore, a positive trend inflation reduces the central bank’s ability to anchor inflation expectation under the rule based monetary policy. Hornstein and Wolman (2005) and Kiley (2007) present numerical results and indicate that a moderate trend inflation leads to possibility of instability and the indeterminacy.
Ascari and Ropele (2009) claim that the Taylor rule can ensure the determinacy of REE under zero trend inflation. Nevertheless, they provide evidence of shrinking determinacy region as trend inflation rises. Thus the Taylor principle fails when trend inflation is nonzero. Coiboin and Gorodnichenko (2011) and Arias et al. (2018) provide the empirical study to support the theoretical prediction using US data. They argue that the U.S economy in the pre-Volker era during 1970s, great inflation and highly volatile output period, was in the indeterminacy whether the standard Taylor principle is satisfied or not. After Volker disinflation during 1980s, U.S. economy moved into determinacy and a period of Great Moderation due to the aggressive monetary policy to reduce inflation and a fall in the trend inflation. Recently Khan et al. (2020) indicates that indeterminacy in new Keynesian models can occur even at low trend inflation levels. A policy rule reacting to output growth but not to output gap significantly increases the prospect of determinacy.

For Thailand, it has been over two decades since May 2000 that the Bank of Thailand has conducted monetary policy under the flexible inflation targeting framework to secure price stability and economic growth. Over time the target range has been adjusted to reflect the Thai economic situation. During May 2000 to August 2009, the Bank of Thailand set the target range for average core inflation from 0 to 3.5%. After that the target fr 0.5 to 3.0% was adopted. In 2015, the target was the headline inflation at 2.5±1.5%. Recently the inflation target was reduced to 1-3% in December 2019. Apparently, the idea of price stability in the Bank of Thailand practice is usually involved with a moderately positive rate of inflation. However, the Thai monetary policy investigation normally based on macroeconomic model is approximated around zero inflation steady state. This study examines influences of trend inflation on the Thai monetary policy during moderate and low inflation environments.

Given this background for Thailand, this paper uses the new Keynesian models augmenting a positive trend inflation to gives theoretical views on the consequence of the Thai monetary policy. In addition, it merges these results with evidence for Thailand during 2004Q1 to 2014Q4 and 2015Q1 to 2021Q1. Figure 1 illustrates the inflation rates in Thailand. This paper uses the Bayesian statistic method to calculate the parameters in the model, including the Bank of Thailand’s reaction function in both periods.
The model specification in this paper is built on the medium-sized new Keynesian (MNK) model based on Christiano et al. (2005) which embodies not only nominal rigidities but also some form of real rigidities including consumer habit formation, investment adjustment cost and roundabout production structure. In addition, this paper follows the important strands of the theoretical literature on the effect of a positive trend inflation which are:

1. Ascari and Sborone (2014) on how to derive the Phillips curve under trend inflation.
3. Woodford (2003) and Ascari and Ropele (2007) on how to derive the slope of the long run Phillips curve and to find the determinacy condition under trend inflation. The idea is to seek for the lowest response to inflation within the determinacy.

The above-mentioned approaches lead to the following main findings. First, during both moderate (2004Q1 to 2014Q4) and low inflation (2015Q1 to 2021Q1) periods in Thailand, the welfare losses are increasing while the relative weights on output gap are decreasing with trend inflation. The relative weights and the welfare losses are smaller for the low inflation period. A high level of trend inflation enlarges the welfare loss. When the target level for inflation is higher, lower weight on output fluctuation is the optimal policy. Second, as trend inflation increases, Thai monetary policy strategy is to increase large and positive response on inflation and small response on output gap. Thus, to ensure the determinacy,
the response on output gap should be low while the response of inflation should be high. Although Thai economy was in a determinate state in both periods, trend inflation rate threatens the determinacy equilibrium. The results are that during the low inflation period, the minimum responses of inflation to deviations of inflation target $\alpha_{\pi}$ for the determinacy is slightly lower comparing to those in the moderate inflation periods. It finds that given the coefficient on the output gap $\alpha_Y = 0.2$, Thai economy requires the minimum $\alpha_{\pi}$ which are consistent with determinacy is 1.337 during the moderate inflation environment.

This paper contributes to the literature that examines the impact of a positive trend inflation. Most theoretical studies have analyzed the performance of monetary policy under no trend inflation assumption. Although some study the effects of a positive trend inflation, they do not compare the impact of trend inflation in different inflation environments. Tanboon (2007) examines the Thai business cycle properties using a structural model. Phrommin (2018) indicates that the headline not the core inflation targeting regime produces a lower welfare loss. It focuses on the welfare loss due to monetary policy shocks, the analysis of other shocks especially a fiscal shock on the welfare loss is still paucity. Although previous empirical works have examined monetary policy rules such as Taguchi and Wanasilp (2018) and Tan and Mohamed (2020), the analysis of optimal stabilization policy for Thailand is still scarce. Furthermore, the impacts of trend inflation on the rational expectation equilibrium determinacy for Thai monetary policy have not been exploited. There has been a lack of evidence between trend inflation and monetary policy prescriptions associated with the determinacy in Thailand.

Finally, previous work has been examined the effects of positive trend inflation by employing Small-sized New Keynesian (SNK) model characterized by only exogenous nominal rigidities represented by Calvo (1983) and Taylor (1980) pricing schemes such as Ascari (2004) and Amano et al. (2009). Few studies employ the MNK model; see, for example, Coibion et al. (2012) and Ascari et al. (2018). Arias et al. (2018) argue that the threat of indeterminacy in the MNK model is more severe than that of the SNK model and probability of determinacy in the MNK model is lower than that of the SNK model in pre- and post-Volker period, although they are closely move together. To the best of my knowledge, there is no such study using the MNK model to consider how positive inflation generates variations in impacts of monetary and fiscal policy shocks in term of welfare costs and determinacy region, especially for Thailand. Therefore, the present article is an effort to fill these gaps in the literature.

The rest of this paper is organized as follows. Section II describes the MNK model. The Phillips curve with trend inflation will be derived and discussed in Section III. Section IV discusses the rational of the Bayesian estimation and the estimated parameters. Section V explains how to measure welfare costs and the optimal stabilization policy. Section VI presents the REE and some conclusions are provided in Section VII.
II. THE NEW KEYNESIAN MODEL

The MNK model is composed of a single final good and a continuum of intermediate goods. The monopolistic competition firms produce differentiated goods and have some market power to set the price of the goods they produce.

A. The Household

Households have choices to choose consumption good \( C_t \) and labor \( N_t \) optimally to maximize their expected utility with respect to their budget constraint. The preferences go along with an external habit formation utility function:

\[
U(C_t, L_t) = \left( (C_t - \chi C_{t-1}^{(1-q)}(1-N_t)^q)^{1-\sigma} - 1 \right) \frac{1}{1-\sigma}
\]  

(1)

\( \chi \) is a coefficient of habit persistence, \( q \) is share in consumption and labor share and \( \sigma \) stands for the coefficient of risk aversion coefficient while its inverse is the intertemporal elasticity of substitution. The proportions of time for leisure and work are \( L_t \) and \( N_t \) respectively. Thus, \( L_t + N_t = 1 \). The budget constraint is given by:

\[
B_t = R_{t-1}B_{t-1} + r_t^k K_{t-1} + W_t N_t - C_t - I_t - T_t
\]  

(2)

where \( B_t \) is the stock of financial assets at the end of period \( t \), \( R_t \) is the gross real interest rate paid on assets held at the beginning of period \( t \) to pay out interest in period \( t+1 \), \( r_t^k \) is the rental rate, \( W_t \) is the real wage rate and, \( I_t \) is investment and \( T_t \) are lump-sum taxes. Over time, the motion of capital is given by

\[
K_t = (1 - \delta)K_{t-1} + (1 - \phi(\frac{L_t}{L_{t-1}}))I_t
\]  

(3)

Capital formation includes capital adjustment costs expressed by the function \( \phi \)

B. The Final Goods Producing Firm

The firm that aggregates intermediate goods into a single composite good produces the final good by:

\[
Y_t = \left( \int_0^1 Y_i(t) \frac{\xi-1}{\xi} d(\iota) \right)^{\frac{1}{\xi-1}}
\]  

(4)

The firm takes as given the price of intermediate good \( P(i) \) and the price of the composite final good \( P_t \) and then maximizes profits given a production function as in equation (4). This results in the demand of intermediate good \( i \):
C. The intermediate goods producing firm

The intermediate goods are produced by a continuum of monopolistically competitive firms. Each intermediate good is produced by only one firm using labor and capital based on:

\[ Y_t(i) = A_t N_t^a(i) K_{t-1}^{1-a}(i) \]  

where \( A_t \) is the productivity process and \( K_t \) is end of period \( t \) capital stock. Each firm acknowledges the demand curve it faces or \( Y_t(i)=C_t(i) \). The feature of price stickiness follows the case of a staggered price setting established by Calvo (1983). In any period, the probability that each firm will not adjust its price is \( \omega \). All firms adjusting in period \( t \) face the same problem, so all adjusting firms will set the same price.\(^1\) Since all firms face the same marginal cost, the \( i \) index is dropped. The first order condition of profit maximization for optimal choice of \( P_t^* \) can be rearranged resulting in optimal pricing behavior of intermediate goods:

\[ \frac{P_t^*}{P_t} = \zeta (\zeta-1) \frac{E_t \sum_{k=0}^{\infty} \omega^k \Lambda_{t,t+k} Y_{t+k} \varphi_{t+k} \left( \frac{P_{t+k}}{P_t} \right)^{\zeta}}{E_t \sum_{k=0}^{\infty} \omega^k \Lambda_{t,t+k} Y_{t+k} \varphi_{t+k} \left( \frac{P_{t+k}}{P_t} \right)^{\zeta-1}} \]  

(7)

where \( \zeta (\zeta-1) \) represents the mark up, describing the difference between the price and the marginal cost. The expression (7) indicates that in the case of the sticky price model, firm will mark up the price over the weighted average of flow of future marginal costs. Let \( \Pi_{t,t+k} = \frac{P_{t+k}}{P_t} \) denotes the cumulative gross inflation rate over \( k \) periods. When \( k=0 \), \( \Pi_{t,t} = 1 \) and when \( k=1,2,\ldots,\Pi_{t,t+k} = \Pi_{t,t+1} + \Pi_{t,t+2} + \ldots + \Pi_{t,t+k} \). To help set up the model in linear form, the first order condition for pricing is transformed to recursive definitions. With \( x_t = \frac{P_t^*}{P_t} \) and \( \Lambda_{t,t+k} = \beta^k \frac{U_{c,t+k}}{U_{c,t}} \), price dynamics are:

\[ x_t = \frac{\zeta}{(\zeta-1) MM_t} M_t \]  

(8)

\[ M_t = Y_t U_{c,t} \varphi_t + \omega \beta E_t \left[ \Pi_{t+1}^\zeta M_{t+1} \right] \]  

(9)

\[ MM_t = Y_t U_{c,t} + \omega \beta E_t \left[ \Pi_{t+1}^{\zeta-1} MM_{t+1} \right] \]  

(10)

\(^1\) Let \( P_t^* \) be the optimal price selected by all firms changing at time \( t \). The aggregate of all prices in the economy would be: \( 1 = \omega \left( \frac{P_t^*}{P_t} \right)^{\zeta-1} + (1 - \omega) \left( \frac{P_t^*}{P_t} \right)^{1-\zeta} \) which implies \( \frac{P_t^*}{P_t} = \left[ \frac{1-\omega}{1-\omega (\zeta-1)} \right]^{1/(1-\zeta)} \).
D. The effects of monetary policy and the shocking process specification

Following the Taylor rule, a central bank should adjust its interest rate policy instrument for developments in inflation and output. The policy rule in log form can be written as:

\[
\log \left( \frac{R_{n,t}}{R_n} \right) = \rho_r \log \left( \frac{R_{n,t-1}}{R_n} \right) + (1 - \rho_r) \alpha_{\pi} \log \left( \frac{\pi_t}{\pi} \right) + (1 - \rho_r) \alpha_y \log \left( \frac{Y_t}{\bar{Y}} \right) + \epsilon_{M,t} \quad (11)
\]

where \(0 < \rho_r < 1\). It measures interest rate inertia. \(\alpha_\pi > 0\) and it captures how much the interest rate set by the central bank responds to the deviation of inflation from its target. Similarly, \(\alpha_y\) captures how much the interest rate set by the central bank responds to the output gap.

Furthermore, the model economy experiences an unanticipated variation in total productivity and government spending shocks. The exogenous shocks to technology and government spending are respectively shown below:

\[
\log \left( \frac{A_t}{A} \right) = \rho_A \log \left( \frac{A_{t-1}}{A} \right) + \epsilon_{A,t} \quad (12)
\]

\[
\log \left( \frac{G_t}{G} \right) = \rho_G \log \left( \frac{G_{t-1}}{G} \right) + \epsilon_{G,t} \quad (13)
\]

The parameter \(\rho\) measures how persistent each shock is. The variables \(\epsilon\) are innovations to each random shock.

III. THE PHILLIPS CURVE WITH TREND INFLATION

This section derives a log-linear approximations of the equilibrium conditions around a steady state with trend inflation. The trend inflation is positive and is set exogenously at \(\bar{\pi}\). Following Ascari and Sbordone (2014), it is simpler to log-linearize a recursive formulation. To do so, (9) and (10) are substituted in (8) and log linearize it. Then it is necessary to find \(\bar{M}_{t+1}\). To find it, firstly find \(\bar{M}_t\) by using two equations which are (8) and the expression of the relative price from footnote 1 and after that log-linearizing them. Then \(\bar{M}_t\) is updated one period to obtain \(\bar{M}_{t+1}\). This yields a Phillips curve with trend inflation. It comprises two equations describing respectively the dynamics of inflation and the evolution of the present discounted value of future marginal costs, \(M_t\).

\[
\hat{\pi}_t = \kappa(\bar{\pi}) \phi_t + \beta (1 - \bar{\pi})(1 - \omega \bar{\pi}^{\xi-1})(\bar{U}_{C,t} + \bar{Y}_t) + \beta (\bar{\pi} - 1)(1 - \omega \bar{\pi}^{\xi-1})E_t \bar{M}_{t+1} + \beta [(1 - \omega \bar{\pi}^{\xi-1})(\bar{\pi} - \xi + 1) - \omega \bar{\pi}^{\xi-1}]E_t \hat{\pi}_{t+1} \quad (14)
\]

\[
\bar{M}_t = (1 - \omega \beta \bar{\pi}^{\xi})(\bar{U}_{C,t} + \bar{Y}_t + \phi_t) + \omega \beta \bar{\pi}^{\xi} E_t [\bar{M}_{t+1} + \xi \hat{\pi}_{t+1}] \quad (15)
\]
where $\kappa(\bar{\pi}) = \frac{(1 - \omega \bar{\pi}^{\xi-1})(1 - \omega \beta \bar{\pi}^{\xi})}{\omega \bar{\pi}^{\xi-1}}$. The slope of the Phillips curve $\kappa(\bar{\pi})$ clearly depends on the degree of price stickiness, the discount factor and the inflation targeting rate. Price dispersion is important because it governs the costs of inflation. Yun (1996) asserts that finding the relation between the aggregate output and aggregate factor input characterizes the price dispersion. Given the model presented in this paper, the equilibrium relation between aggregate demand and aggregate factor inputs can be derived as:

$$\begin{align*}
C_t + I_t + G_t &= \left(\frac{P_t^*}{P_t}\right)^{\xi} \tilde{Y}_t = \left(\frac{P_t^*}{P_t}\right)^{\xi} (A_t N_t)^{a} K_{t-1}^{1-a}
\end{align*}$$

where $\tilde{Y}_t$ is the integral of gross output across intermediate good firms and $P_t^* = \left[\int_0^1 P_t(i)^{-\xi} di\right]^{-1/\xi}$ and $\left(\frac{P_t^*}{P_t}\right)^{-\xi}$ measures output loss due to price dispersion as in Yun (1996). Figure 2 displays the relationship between the price dispersion at the steady state, output loss and the trend inflation. After log-linearize expression of the price dispersion at the steady state around the trend inflation, it can be written as:

$$\Delta_t = \left[\frac{\xi \omega \bar{\pi}^{\xi-1} (\bar{\pi} - 1)}{1 - \omega \bar{\pi}^{\xi-1}}\right] \hat{\pi}_t + \omega \bar{\pi}^{\xi} \Delta_{t-1}$$

(17)

The Phillips curve then could be written in a normal expression as an inflation-output relation. The expression (14) and (15) become:

$$\begin{align*}
\hat{\pi}_t &= \kappa(\bar{\pi}) (-\bar{U}_{C,t} - \bar{U}_{N,t} - \bar{Y}_t - \bar{N}_t) + \beta (1 - \bar{\pi})(1 - \omega \bar{\pi}^{\xi-1})(\bar{U}_{C,t} + \bar{Y}_t) + \\
&+ \beta (\bar{\pi} - 1)(1 - \omega \bar{\pi}^{\xi-1})E_t \hat{\pi}_{t+1} + \beta (1 - \omega \bar{\pi}^{\xi-1})(\bar{\pi} - \xi + 1) - \omega \bar{\pi}^{\xi-1}E_t \hat{\pi}_{t+1} \\
\hat{\pi}_t &= (1 - \omega \beta \bar{\pi}^{\xi})(-\bar{U}_{N,t} + \bar{N}_t) + \omega \beta \bar{\pi}^{\xi} E_t [\hat{\pi}_{t+1} + \xi \hat{\pi}_{t+1}]
\end{align*}$$

(18)

(19)

The Phillips curve under trend inflation composes of three dynamic equations which are the expressions (18), (19) and (17). If $\bar{\pi}$=1, these three equations become the standard new Keynesian Phillips curve. Trend inflation results in a smaller feedback on current output gap and a larger feedback on future expected inflation. In other words, the short run Phillips curve flattens. The relation between inflation and output gap weakens. The inflation rate becomes more forward looking but less sensitive to fluctuation in the output gap.

\[2\] Let $\Delta_t = 1/(P_t^*/P_t)^{\xi}$. The dynamic relationship between the price dispersion and inflation can be written as:

$$\begin{align*}
\Delta_t &= \omega \bar{\pi}^{\xi} \Delta_{t-1} + (1 - \omega) \left(\frac{M_{MVt}}{M_{MVt}}\right)^{-\xi}.
\end{align*}$$

We can show that the price dispersion is: $\Delta = \frac{1 - \omega}{(1 - \omega) (1 - \omega \bar{\pi}^{\xi-1} + \bar{\pi}^{\xi-1})}$ at the steady state. This expression explains that the price dispersion at the steady state also depends on the trend inflation.
Figure 2.
Trend Inflation, Price Dispersion and Output at Steady State

This figure displays the relationship between the price dispersion at the steady state and trend inflation on the left panel. It also depicts the relationship between output at the steady state and the trend inflation on the right panel. Trend inflation rate (percent per quarter) is on the horizontal axis. Using fairly standard values in the numerical computations setting as in Ascari and Sbordone (2014), the discount factor = 0.99, the elasticity of substitution = 11 and the degree of price stickiness = 0.75. Without trend inflation, the price dispersion equals one and given output at steady state is one.

(A). Price Dispersion at Steady State

(B). Output at Steady State
IV. THE BAYESIAN ESTIMATION

The model is fitted to Thai data and discuss the resulting parameter estimates. Then the estimated parameters of the moderate and low inflation periods in Thailand are compared. The system consists of three observable variables, including annualized CPI inflation rates, annualized the Bank of Thailand policy rate and real GDP growth. The data are in quarterly basis and they are all seasonally adjusted. This study uses quarterly Thai data collected from 2004Q1 to 2014Q4 characterized moderate inflation period and from 2015Q1 to 2021Q1 characterized low inflation period. The data is from CEIC that is a database system using data aggregated from the IMF and the Bank of Thailand. In the empirical analysis, the vector of observables is:

\[ Y_t = [4R_t, 4\pi_t, \Delta y_t + z_t] \]  (20)

To estimate the parameters in the developed model, this study uses the Bayesian statistics.\(^3\) A few structural parameters are fixed and consistent with standard values reported in the literature. The discount factor \( \beta \) is 0.99. The substitution of elasticity of goods \( \zeta \) is set at 11 according to Ascari and Sbordone (2014). The degree of price rigidity \( \omega \) is set at 0.75, implying an average price duration approximately 3 quarters as in Gali and Monacelli (2005), and Sbordone (2002). The priors for the parameters of the habit factor, the invest adjustment costs and labor share are the values commonly found in the literatures. There are two panels in this table, A and B. Panel A uses the data from 2004Q1 to 2014Q1. Panel B uses the data from 2015Q1 to 2021Q1.

### Table 1. Prior and Posterior Parameter Estimation Results in Moderate and Low Inflation

This table summarizes the Bayesian estimates of the parameters for Thailand. The discount factor \( \beta \) is 0.99. The substitution of elasticity of goods \( \zeta \) is set at 11 according to Ascari and Sbordone (2014). The degree of price rigidity \( \omega \) is set at 0.75 as in Gali and Monacelli (2005) and Sbordone (2002). The priors for the parameters of the habit factor, the invest adjustment costs and labor share are the values commonly found in the literatures. There are two panels in this table, A and B. Panel A uses the data from 2004Q1 to 2014Q1. Panel B uses the data from 2015Q1 to 2021Q1.

<table>
<thead>
<tr>
<th>Prior Post. Density Mean</th>
<th>Mean 90% HPD Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Moderate Inflation Period</strong></td>
<td></td>
</tr>
<tr>
<td>Structural Parameters</td>
<td></td>
</tr>
<tr>
<td>Habit ( \chi )</td>
<td>beta</td>
</tr>
<tr>
<td>Investment adj. cost ( \phi_X )</td>
<td>normal</td>
</tr>
<tr>
<td>Labor share ( \alpha )</td>
<td>beta</td>
</tr>
<tr>
<td>Inflation at steady state</td>
<td>normal</td>
</tr>
<tr>
<td>Trend growth rate</td>
<td>normal</td>
</tr>
<tr>
<td>Nominal interest rate</td>
<td>normal</td>
</tr>
</tbody>
</table>

\(^3\) Using the Bayesian approach, the posterior distribution can be computed as: \( p(\theta|Y, M) = \frac{p(Y|\theta, M)p(\theta|M)}{p(Y|M)} \) where \( p(.) \) stands for a probability density function and \( M \) stands for the model. The information set of an observed macro-time series until period \( T \) is \( Y_T = [y_1, y_2, y_3, \ldots, y_T] \). The term \( p(Y_1|\theta, M) \) is the likelihood density of the model parameters. The prior is described by a density function of the form \( p(\theta|M) \). The probability of data is \( p(Y_1|M) \).
According to the Thai data during the moderate inflation periods, the prior means of the inflation in quarter basis at steady state was 0.75%. The trend growth rate was 0.956% and the nominal interest rates were 0.641% quarterly. The government spending-output ratio was 0.1519. However, in the low inflation periods, the prior means of inflation at steady state was 0.03% in quarter basis. The trend growth rate was 0.415% and the nominal interest rates were 0.330% quarterly. The government spending-output ratio was 0.1674. The data reflects the fact that Thailand’s economy grew at an average annual rate of 4% in the moderate inflation years of 2004Q1 to 2014Q4 and only 1.6% in the low inflation years of 2015Q1 to 2021Q1. In 2020, the COVID-19 pandemic struck Thailand and the economic impact has been severe, leading to a decline in output growth. Thailand’s policy response to the COVID-19 pandemic was to support economic activity leading to a higher government spending-output ratio during the low inflation period.
In both periods, the priors for the parameters of the policy rule are centered at the values commonly associated with the Taylor rule. Taylor pointed out that the feedback of inflation should be larger than one. This study allows for interest rate smoothing with a prior mean of 0.75. The priors for the shock parameters of the model follow Smets and Wouters (2007). The degree of persistence of each shock is set at a moderate value in both periods.

The Bayesian estimates of the parameters for Thailand during the moderate and low inflation periods can be found in Table 1 Panel A and B respectively. The posterior means are reported as point estimates along with the 90% posterior probability intervals. The estimates of the structural parameters fall within plausible range in both observation periods. The posterior means do not differ markedly from their priors. The investment adjustment cost $\phi_X$ is estimated to be higher than the prior mean. Regarding to the policy parameters, this study finds that the Bank of Thailand during the moderate inflation period pursues a moderately anti-inflationary policy $\alpha_{\pi} = 1.875$ and demonstrates concern for output $\alpha_Y = 0.119$. There is also a reasonably high degree of interest-smoothing with an estimate of $\rho_r = 0.963$. Nonetheless, during the low inflation period, $\alpha_{\pi} = 2.325$ and $\alpha_Y = 0.131$. For the reaction function depending on the inflation deviating from its target and the output gap, the aggressive policy to combat the inflation leads to a large coefficient on the inflation deviating from its target and in turn a larger increase in the central bank policy rate. As a result, inflation is low. Therefore, during a low inflation period, the feedback of inflation is clearly higher. However, during both periods the coefficient on output gap is not significantly different with only slightly higher for the low inflation period. This is because the Bank of Thailand has the same level of concern of output during moderate and low inflation environments. The higher $\alpha_{\pi}$ and $\alpha_Y$, the more the Bank of Thailand will increase the interest rate in response to inflation and output. The degree of interest-smoothing is also high in the low inflation period at $\rho_r = 0.983$.

The estimates of the government spending shock processes reflect the high degree of persistence found in the data, capturing by the high degree of autocorrelation in government spending $\rho_G = 0.744$ and $\rho_G = 0.748$ during the moderate and low inflation periods respectively. However, in both periods the degrees of persistence of the technology shock are low.

V. TREND INFLATION AND OPTIMAL STABILIZATION POLICY

To assess the performance of policy rules, much of the literature has adopted a welfare-based criterion, relying on a second-order approximation to the utility loss. In this analysis, the paper investigates the effects of trend inflation on welfare loss of policy shocks during moderate and low inflation environment in Thailand. These policy shocks include monetary and fiscal policy that may distort the economic welfare to produce welfare costs. This paper follows Woodford (2003), Ascari and Ropele (2007) and Lago-Alves (2012) and assumes a quadratic loss function of the form:
where $\vartheta$ is the relative weight between output and inflation stabilization around the target. The relative weight on output in the welfare function can be written as:

$$W = \frac{1}{2} E_t \sum_{j=0}^{\infty} \beta^j (\pi^2_{t+j} + \vartheta Y^2_{t+j})$$ (21)

where $\vartheta(\bar{\pi}) = \lambda(\bar{\pi}) = \frac{\kappa(\bar{\pi})}{\sigma + \varphi}$ and $\kappa(\bar{\pi}) = \frac{(1-\omega \bar{\pi}^{\xi-1})(1-\beta \bar{\pi}^{\xi})}{\omega \bar{\pi}^{\xi-1}}$. The welfare losses are expressed in terms of the equivalent permanent consumption decline, measured as a fraction of steady state consumption. The relative weight of output fluctuations in the loss function depends on the trend inflation. Using the standard values of consumption elasticity and consumption and labor share, $\sigma = 1$ and $\varphi = 0.9$, this study can determine the implied variance of inflation and output and the corresponding welfare losses associated in each observation periods.

This section firstly quantifies welfare loss of the overall shocks in Thailand. The variance of inflation is 3.7606 during the period of moderate inflation and is 3.192 during the period of low inflation. The variances of output are 3.192 and 3.368 for moderate and low inflation periods respectively. The relative weights on output and welfare loss with values of trend inflations are reported in Table 2 Panel A. For the observation periods, the relative weights on output are decreasing with trend inflation. However, the welfare losses are increasing with trend inflation. The relative weights and welfare losses are smaller in the period of low inflation.

To measure the importance of the individual shocks to the welfare loss, the variance decompositions of each shock are calculated. Next, this section investigates the welfare loss of monetary policy shock in Thailand and reports the results in Table 2 Panel B. The contribution of interest rate to the variance of inflation during the moderate inflation period is 0.594 and it is 0.553 during the low inflation period. The variances of output are 0.018 and 0.034 for moderate and low inflation periods respectively. In the low inflation period, inflation and output variations are smaller. The relative weights and welfare losses are smaller in the low inflation environment. For both periods, the welfare losses are increasing with trend inflation whereas the relative weights are decreasing with trend inflation.
This table shows the relationship between welfare loss and trend inflation during moderate and low inflation in Thailand. The welfare losses are expressed in terms of the equivalent permanent consumption decline, measured as a fraction of steady state consumption. Using the standard values of consumption elasticity and consumption and labor share, \(\sigma=1\) and \(\varrho=0.9\). There are four panels in this table (a to d) with each panel having its own shocks.

### Table 2. Trend Inflation and Welfare Loss During Moderate and Low Inflation

<table>
<thead>
<tr>
<th>Panel A: Overall Shocks</th>
<th>0%</th>
<th>1%</th>
<th>2%</th>
<th>4%</th>
<th>6%</th>
<th>8%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moderate inflation period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative weight on output</td>
<td>0.260</td>
<td>0.257</td>
<td>0.255</td>
<td>0.249</td>
<td>0.024</td>
<td>0.237</td>
</tr>
<tr>
<td>Welfare loss</td>
<td>2.296</td>
<td>2.312</td>
<td>2.327</td>
<td>2.359</td>
<td>2.391</td>
<td>2.424</td>
</tr>
<tr>
<td><strong>Low inflation period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative weight on output</td>
<td>0.112</td>
<td>0.110</td>
<td>0.107</td>
<td>0.103</td>
<td>0.098</td>
<td>0.093</td>
</tr>
<tr>
<td>Welfare loss</td>
<td>1.785</td>
<td>1.814</td>
<td>1.843</td>
<td>1.903</td>
<td>1.964</td>
<td>2.026</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Monetary Policy Shock</th>
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</thead>
<tbody>
<tr>
<td><strong>Moderate inflation period</strong></td>
</tr>
<tr>
<td>Relative weight on output</td>
</tr>
<tr>
<td>Welfare loss</td>
</tr>
<tr>
<td><strong>Low inflation period</strong></td>
</tr>
<tr>
<td>Relative weight on output</td>
</tr>
<tr>
<td>Welfare loss</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel C: Fiscal Policy Shock</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moderate inflation period</strong></td>
</tr>
<tr>
<td>Relative weight on output</td>
</tr>
<tr>
<td>Welfare loss</td>
</tr>
<tr>
<td><strong>Low inflation period</strong></td>
</tr>
<tr>
<td>Relative weight on output</td>
</tr>
<tr>
<td>Welfare loss</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel D: Technology Shock</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moderate inflation period</strong></td>
</tr>
<tr>
<td>Relative weight on output</td>
</tr>
<tr>
<td>Welfare loss</td>
</tr>
<tr>
<td><strong>Low inflation period</strong></td>
</tr>
<tr>
<td>Relative weight on output</td>
</tr>
<tr>
<td>Welfare loss</td>
</tr>
</tbody>
</table>

Table 2 Panel C demonstrates the effects of trend inflation on welfare loss of fiscal policy shock. The contribution of government spending to the variance of inflation during the moderate inflation period is 0.392 and it is 0.900 during the low inflation period. The variances of output are 1.299 and 3.088 for moderate and low inflation periods respectively. Interestingly, the inflation and output variations are larger in the low inflation periods based on the fiscal policy shock. A possible explanation could be the higher government spending-output ratio during the low inflation period. In addition, the relative weights are smaller, but the welfare losses are larger for the low inflation period. However, for both periods, the relative weights are decreasing with trend inflation, but the welfare losses are increasing with trend inflation.
The effects of trend inflation on welfare loss of technology shock are displayed in Table 2 Panel D. The contribution of technology shock to the variance of inflation during the moderate inflation period is 2.773 and it is 1.744 during the low inflation period. The variances of output are 0.3565 and 0.2451 for moderate and low inflation periods respectively. The inflation and output variations are smaller in the low inflation period. For both periods, the relative weights are decreasing with trend inflation, but the welfare losses are increasing with trend inflation.

In summary, when considering both high and low inflation periods, the government spending shock contributes the most to output volatility. The technology shock causes the highest inflation volatility. The monetary policy shock contributes about 16% of inflation variation but it contributes about 1% of output variation. For the moderate inflation environment, a high level of trend inflation enlarges the welfare loss. Regardless of the shocks, the relative weight is decreasing, and the welfare loss is increasing with trend inflation. Among the shocks, the technology shock generates the highest welfare loss. The monetary policy shock generates the lowest welfare loss. An increase in trend inflation level generates higher welfare loss.

The average welfare loss is given by the combination of the variances of the inflation and output gap. It expresses in terms of the equivalent permanent consumption decline, measured as a fraction of steady state consumption. When trend inflation is higher, the inflation fluctuations are costlier due to a larger and more time impact on price dispersion. The increase in inflation fluctuation leads to an increase in the welfare loss. In other words, with a high trend inflation, output loss increases and consumption declines. In addition, as trend inflation rises, the shock is passed more into inflation and less into output because higher trend inflation generates higher sacrifice ratio. To achieve the optimal stabilization policy, the Bank of Thailand should increase the weight on inflation fluctuation and decrease the weight on output volatility in its policy loss function. A higher level of trend inflation increases the welfare costs and produces more severe results. The policy prescriptions therefore change under positive trend inflation. This study finds that the optimal policy for Thailand has a smaller weight on output volatility when inflation target is higher.

VI. TREND INFLATION AND THE ANCHORING EXPECTATION
Taylor (1999) and Clarida et al. (2000) use a theoretical model with no trend inflation and argue that the increase in U.S. inflation in the 1970s was due to the fact that the Fed increased the nominal interest rate less than one-for-one with inflation. The results, they argue, was that the inflation got out of control and the U.S. economy was characterized by self-fulfilling expectation driven fluctuations. However, Ascari and Ropele (2007) show instead that the determinacy region significantly changes with trend inflation. Therefore, it cannot be neglected to account for trend inflation to find that the equilibrium determinates or indeterminate.
This section explores how trend inflation affects the rational expectation equilibrium determinacy properties for Thailand. Taylor principle requires $\alpha > 1$ or the short run nominal interest rate should rise by more than the increase of inflation in the long run. However, Ascari and Ropele (2007) show that Taylor principle is merely a necessary condition for rational expectation equilibrium determinacy. For the developed model in this paper, the slope of the long run Phillips curve can be derived as:

$$\frac{\partial \phi}{\partial \pi} \bigg|_{LR} = \frac{-1}{\kappa(\pi)Y + \eta(\pi)Y_H} \left[ (\kappa(\pi) + \eta(\pi))\nu I \Omega(\pi)(\pi - 1) - \right]$$

$$\eta(\pi) \left[ \frac{\zeta \omega \pi^\xi}{1 - \omega \pi^\xi} + \beta \left( (1 - \omega \pi^\xi)(\zeta \pi - \zeta + 1) - \omega \pi^\xi \right) \right]$$

where,

$$\Omega(\pi) = \frac{\zeta \omega \pi^\xi}{(1 - \omega \pi^\xi)(1 - \omega \pi^\xi)}$$

(24)

$$\eta(\pi) = \beta (1 - \pi)(1 - \omega \pi^\xi)$$

(25)

$$\nu I = \frac{N}{N-1} [2q(\sigma - 1) + 1] + 1$$

(26)

$$Y_I = (1 - 2q(1 - \sigma)) \left[ \frac{N}{N-1} \alpha + \frac{1}{\alpha} + 2\sigma(1 - q) + 2q - 2 \right]$$

(27)

$$Y_{II} = [2q(1 - \sigma) - 1] \left[ \frac{N}{N-1} \alpha + (1 - q)(-2\sigma + 1) - q \right] \frac{1}{\alpha} + 1$$

(28)

The slope of the long run Phillips curve for different values of trend inflation is demonstrated in Figure 3 during the moderate inflation period. As trend inflation rises, the derivative $\frac{\partial \phi}{\partial \pi} \bigg|_{LR}$ will be negative. Figure 3 also displays the relationship between the degree of price stickiness $\omega$ and the slope of the long run Phillips curve. The slope of the long run Phillips curve is highly sensitive to the value of $\omega$. At the lower value $\omega = 0.5$, the slope of the long run Phillips curve turns negative very quickly as trend inflation rises. Furthermore, with the developed model, the paper finds that at $\omega = 0.75$ the labor supply at the steady state makes no differences in the slope of the long run Phillips curve. The labor supply at the steady state however can influence the slope of the long run Phillips curve when the degree of price stickiness is lower.

Woodford (2003) indicates that the rational expectation equilibrium can be derived from the Taylor principle as follow: $\alpha_s + \frac{1 - \beta}{\lambda} \alpha_y > 1$ and $\frac{\partial \xi}{\partial \pi} \bigg|_{LR} = \alpha_s + \alpha_y \frac{\partial \xi}{\partial \pi} \bigg|_{LR} > 1$. 

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Figure 3.
Trend Inflation and the Slope of the Long Run Phillips Curve During the Moderate Inflation in Thailand

This figure demonstrates the relationship between the slope of the long run Phillips curve and trend inflation. Trend inflation rate (percent per quarter) is on the horizontal axis. The long-run slop of the Phillips curve is on the vertical axis. The left panel uses the degree of price stickiness 0.75. The right panel uses the degree of price stickiness 0.5. The model and calibration of parameters are described in the text.

(A). The Degree of Price Stickiness 0.75

(B). The Degree of Price Stickiness 0.5
Considering the NK literature with no trend inflation, the derivative \( \frac{\partial y}{\partial R|_{LR}} \) is slightly positive and very near zero. The tradeoff between \( \alpha_\pi \) and \( \alpha_y \) exists but it is weak as in equation (23). The \( \alpha_y \) has plays less important role to preserve the REE determinacy. The central bank must respond aggressively to output deviations when the value of \( \alpha_\pi \) is small to guarantee the REE determinacy. However, when the derivative \( \frac{\partial y}{\partial R|_{LR}} \) is negative, the trade off between \( \alpha_\pi \) and \( \alpha_y \) vanishes. If the central bank prefers to reduce the value of \( \alpha_\pi \), it could respond less aggressive to output deviations to ensure the determinacy. In addition, the coefficient of output gap \( \alpha_y \) is important. For Thailand, given the value of \( \omega = 0.75 \), if the trend inflation is 2% annually, \( \frac{\partial y}{\partial R|_{LR}} \) is -0.548 and if the trend inflation is 4% annually, \( \frac{\partial y}{\partial R|_{LR}} \) is -1.674. Therefore, the larger the trend inflation rate, the lower the steady state output. On other words, the model with trend inflation exhibits a negative relationship between long run output and inflation. The steady state output losses result from positive trend inflation.

Figure 4 plots the minimum value of \( \alpha_\pi \) to preserve the determinacy with several trend inflation rates during the moderate and low inflation in Thailand. It compares the standard values of the Taylor rules in literatures where \( \alpha_y = 0.25 \) and Thai monetary policy rule based on the developed model in this study from Table 1 Panel A and B, indicating that \( \alpha_y = 0.12 \) for the moderate inflation period and \( \alpha_y = 0.13 \) for the low inflation period in Thailand. As expected, for both periods in Thailand without trend inflation, the standard Taylor rule or any value of \( \alpha_\pi > 1 \) provide the REE determinacy. However, an increase in trend inflation rate threatens the determinacy equilibrium. In both periods for the standard Taylor rule, \( \alpha_\pi \) must above 1.2 for the 2% annually trend inflation and above 1.5 for the 4% annually trend inflation to avoid the indeterminacy.

This study finds that the smallest \( \alpha_\pi \) values consistent with determinacy differ from the standard Taylor principle. During the moderate inflation in Thailand, attaining determinacy needs a minimum \( \alpha_\pi \) of 1.137, 1.421, 2.131 and 2.952 for an annual trend inflation rate of 2, 4, 6 and 8% respectively. During the low inflation in Thailand, attaining determinacy needs a minimum \( \alpha_\pi \) of 1.137, 1.419, 2.125 and 2.940 for an annual trend inflation rate of 2, 4, 6 and 8% respectively. The minimum value of \( \alpha_\pi \) is slightly lower for the lower inflation environment. These results indicate that the chance to preserve the determinacy is slightly higher for the lower inflation environment.

Since the year 2000, the Bank of Thailand has set the upper ranges of the inflation targeting rates above 3% slightly. During the moderate inflation years of 2004Q1 to 2014Q, the value of \( \alpha_\pi = 1.875 \) is ensure determinacy. The value of \( \alpha_\pi = 2.325 \) during the low inflation period of 2015Q1 to 2021Q1 is guarantee determinacy for Thailand.
Figure 4.
Trend Inflation Rates and the Minimum Values of $\alpha_n$ Which are Consistent with Determinacy for Thailand

This figure shows the minimum values of $\alpha_n$ which are consistent with determinacy for Thailand. Trend inflation rate (percent per quarter) is on the horizontal axis. The minimum long-run response to inflation needed for determinacy is on the vertical axis. The left panel uses the Thai data during the high inflation period. The right panel uses the Thai data during the low inflation period. The standard Taylor rule is an asterisk and the Thai monetary policy rule estimated is a circle.

(A). The Moderate Inflation Period

(B). The Low Inflation Period
The Bank of Thailand sets nominal interest rates in reaction to inflation to deviations of inflation target and output gap. Adopting this monetary policy rule has an impact on the prospect of determinacy. One of the main purposes of this paper is to provide the Thai monetary policy strategy under the REE determinacy. The important question then arises what factor really influences the determinacy. This study discovers that the degree of price stickiness is a crucial factor for determining the determinacy. Finding the conditions leading to determinacy for Thailand is illustrated in Table 3. Given different values of the coefficient on the output gap $\alpha_Y$ and for the moderate inflation period, it reports the Bank of Thailand minimum responses of inflation to deviations of inflation target $\alpha_\pi$ which are consistent with determinacy for an annual inflation trend of 2%, 4% and 8% under degrees of price stickiness $\omega$ of 0.75 and 0.50.

Table 3 provides the Thai monetary policy prescription associated with a determinate state. The analysis is to search for the lowest $\alpha_\pi$ value consistent with determinacy while keeping other parameters at their estimated values. It shows that with the degree of price stickiness 0.75 and $\alpha_Y = 0.2$, the Bank of Thailand minimum responses of inflation to deviations of inflation target $\alpha_\pi$ which are consistent with determinacy are 1.11, 1.34, and 1.91 for an annual inflation trend of 2%, 4% and 8% respectively. Nonetheless, when the degree of price stickiness is reduced to 0.5, the lowest $\alpha_\pi$ value consistent with determinacy must be equal to 1.01 with a 2% trend inflation. It increases to 1.03 with a 4% trend inflation. With a 6% trend inflation it increases to 1.05. Therefore, a higher level of degree of price stickiness poses more threat to the determinacy.

### Table 3. The REE Determinacy Conditions Under Trend Inflation of Thailand

This table shows the Bank of Thailand’s minimum responses of inflation to deviations of inflation from target $\alpha_\pi$ which are consistent with determinacy of an inflation trend of 2%, 4% and 6% annually. It uses Thai data during moderate inflation period. For the low inflation period, the lowest $\alpha_\pi$ values are slightly lower those of the moderate inflation period.

<table>
<thead>
<tr>
<th>Trend Inflation</th>
<th>Response of Consistent $\alpha_\pi$ with Determinacy</th>
<th>Degree of Price Stickiness = 0.75</th>
<th>Degree of Price Stickiness = 0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_Y = 0.2$</td>
<td>2%</td>
<td>&gt;1.110</td>
<td>&gt;1.011</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td>&gt;1.337</td>
<td>&gt;1.027</td>
</tr>
<tr>
<td></td>
<td>6%</td>
<td>&gt;1.905</td>
<td>&gt;1.048</td>
</tr>
<tr>
<td>$\alpha_Y = 0.4$</td>
<td>2%</td>
<td>&gt;1.220</td>
<td>&gt;1.026</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td>&gt;1.674</td>
<td>&gt;1.057</td>
</tr>
<tr>
<td></td>
<td>6%</td>
<td>&gt;2.811</td>
<td>&gt;1.097</td>
</tr>
<tr>
<td>$\alpha_Y = 0.6$</td>
<td>2%</td>
<td>&gt;1.287</td>
<td>&gt;1.039</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td>&gt;1.915</td>
<td>&gt;1.086</td>
</tr>
<tr>
<td></td>
<td>6%</td>
<td>&gt;3.716</td>
<td>&gt;1.146</td>
</tr>
<tr>
<td>$\alpha_Y = 0.8$</td>
<td>2%</td>
<td>&gt;1.287</td>
<td>&gt;1.052</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td>&gt;1.915</td>
<td>&gt;1.115</td>
</tr>
<tr>
<td></td>
<td>6%</td>
<td>&gt;3.716</td>
<td>&gt;1.195</td>
</tr>
</tbody>
</table>
The coefficient of output gap $\alpha_y$ becomes important and cannot be ignored under trend inflation. With the degree of price stickiness 0.75 and an increase of $\alpha_y$ from 0.20 to 0.40, the lowest $\alpha_y$ value consistent with determinacy increases to 1.22 with a 2% trend inflation. It increases to 1.67 with a 4% trend inflation. With a 6% trend inflation it increases to 2.81. Accordingly, when the $\alpha_y$ value rises, the minimum requirements on $\alpha_y$ to ensure determinacy are even higher. Consequently, the central bank has a more difficult task in controlling the inflation expectation with a higher inflation target. Moderate levels of trend inflation alter the determinacy region. To be guaranteed in a determinate state, the response of output $\alpha_y$ should be low and the response of inflation $\alpha_\pi$ should be high. For Thai economy, if $\alpha_y = 0.20$, the lowest $\alpha_\pi$ must be 1.34 to preserve the determinacy for the inflation targeting rates at 4%. This finding suggests that the Bank of Thailand should be aware of the coefficient of inflation $\alpha_\pi$ and the coefficient of output gap $\alpha_y$ when adjusting its inflation targeting rate.

VII. CONCLUSION

The inflation target rates set by the Bank of Thailand have changed over time and the average inflation in Thailand was moderately different from zero. It therefore matters to assume a positive trend inflation in macroeconomic model for monetary policy analysis. This paper extends the Medium-sized New Keynesian (MNK) model by taking log-linear approximation around a general level of trend inflation. The paper shows that in the model with trend inflation, price dispersion determines the cost of inflation, and it depends on trend inflation. The inflation targeting rate influences the slope of the Phillips curve. The slope flattens with trend inflation.

The model is calibrated using Thai data by the Bayesian statistic method. The results are that the policy rule parameters, namely the coefficient on the inflation deviating from its target and coefficient on the output gap are lower during the moderate inflation period in Thailand. It finds that welfare loss is large with a high level of trend inflation. The relative weight on output gap falls with trend inflation. When the target level for inflation is higher, the optimal policy for Thailand is to lower weight on output volatility.

Furthermore, the analysis suggests that as trend inflation increases, in the long run the slope of the Phillips curve is negative. This result implies that the larger the trend inflation rate, the lower the steady state output. Furthermore, the slope of the long run Phillips curve is sensitive to the degree of price stickiness. Although the Thai economy was in the determinacy during the observation periods, the Bank of Thailand had a difficulty in managing the inflation expectation with a higher inflation target. The results of this study mostly are parallel to the international literature. However, the feedback on inflation in Thailand is slightly higher than that of the advanced economies during the moderate inflation environment. The feedback on output gaps is roughly the same. At 4 percent annual inflation rate, the welfare losses in Thailand have increased to represent around 2.35 percent of consumption while for the advanced economy the figure is around 1.9 percent as in Amano et al. (2009). Given 4 percent annual inflation rate and the feedback on output gaps is $\alpha_y = 0.2$, the response of consistent $\alpha_\pi$ with determinacy for Thailand
Trend Inflation in Moderate and Low Inflation Periods: The Implication of Thai Monetary Policy

is 1.33 while for the advanced economy the figure is around 1.7 as in Coibion et al. (2012). The paper made the further contribution by providing the Thai monetary policy prescription to ensure the determinacy. To change the inflation targeting rate, the coefficient of inflation and output gap must be considered to avoid indeterminacy.

REFERENCE


