Re-Evaluation of Japan's Monetary Policy in the late 1980s with the Interest Rate Gap[1]

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1 Introduction

It is readily apparent that a macroeconomic model that enables forecasting of an economy and analyses of a policy's impact has developed, although it has not reached a maximum point. Naturally, considering future policy action, it is important to obtain an evaluation of past policy through empirical works based upon historical data. However, now that it is possible to use a dynamic stochastic general equilibrium (DSGE) model describing a national economy, then using Bayesian techniques, the Bayesian-DSGE (B-DSGE) model, which is a point connecting theory with reality, is available for us. As

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described in this paper, a goal is to reevaluate monetary policy in the late 1980s using the latent variables from the B-DSGE model.

The conclusion reported by Jinushi, Kuroki, and Miyao (2000) is reconsidered: that the tightening monetary policy in 1987–88 was delayed. This paper presents examination of whether the delay of monetary policy included actual tightening by interpreting the natural rate of interest (NRI) measured from a B-DSGE model.

A Bayesian likelihood approach has been used to estimate a fully specified DSGE model since Smets and Wouter (2003). The DSGE model in this paper resembles that which excludes the investment-specific technological progress from the Hirose and Kurozumi (2012) model. Sugo and Ueda (2008) and Fujiwara et al. (2011) also estimate the large-scale DSGE model with Bayesian techniques and Japan's aggregate time series data.

This paper shows no evidence of the delay of monetary policy in the late 1980s, using the interest rate gap. Rather, because the BOJ did not specifically examine its own economy precisely, apparently no one has noticed that the stance of monetary policy has shown tightening since 1985.

2 Linearized DSGE Model

A DSGE model here mostly follows that of Hirose and Kurozumi (2012). I present the linearized DSGE model estimated in the next section. The dynamics of consumption, which follows from the consumption Euler equation with respect to consumption and bond-holding, is given as

$$\hat{c}_t = \frac{1}{\Omega_2\Omega_3}\frac{\theta}{z}\hat{c}_{t-1} + \frac{1}{\Omega_3}\left(\frac{\beta\theta}{z^\alpha}\frac{1}{\Omega_1\Omega_2} + \frac{1}{\Omega_2} + \frac{\beta\theta}{z^\alpha}\frac{1}{\Omega_1\Omega_2}\frac{\theta}{z}\right)E_t\hat{c}_{t+1} - \frac{\beta\theta}{z^\alpha}\frac{1}{\Omega_1\Omega_2\Omega_3}E_t\hat{c}_{t+2}$$
$$-\frac{1}{\sigma}(\hat{R}_t - E_t\hat{\pi}_{t+1} - r_t^N) \qquad (1)$$

where $\hat{c}_t$ denotes consumption, $\hat{R}_t$ is the nominal interest rate, and $\hat{\pi}_t$ stands for the inflation rate: $\Omega_1 \equiv 1-\theta/z$, $\Omega_2 \equiv 1-\beta\theta/z^\alpha$, $\Omega_3 \equiv 1/\Omega_2 + \beta\theta/z^\alpha(1/\Omega_1\Omega_2)(\theta/z) + 1/\Omega_2(\theta/z)$. Then the natural rate of interest $\hat{r}_t^N$ is defined as the following.

$$\hat{r}_t^N \equiv -\frac{\sigma}{\Omega_2\Omega_3}\frac{\theta}{z}z_t^z + \frac{\sigma}{\Omega_3}\left(\frac{\beta\theta}{z^\alpha} + \frac{1}{\Omega_2}\frac{\theta}{z} + 1\right)E_t z_{t+1}^z - \frac{\beta\theta}{z^\alpha}\frac{\sigma}{\Omega_1\Omega_2\Omega_3}E_t z_{t+2}^z$$
$$+\frac{1}{\Omega_2\Omega_3}z_t^b - \frac{1}{\Omega_2\Omega_3}\left(\frac{\beta\theta}{z^\alpha}+1\right)E_t z_{t+1}^b + \frac{\beta\theta}{z^\alpha}\frac{1}{\Omega_2\Omega_3}E_t z_{t+2}^b. \qquad (2)$$

Therein, z_t^b represents a preference shock.

Labor supplied by households is differentiated by a union, so that some monopoly power over wages exists. Such backgrounds result in an explicit wage equation and allow for the introduction of Calvo-style sticky nominal wages. Because of nominal wage stickiness and partial indexation of wages to inflation[3], real wages adjust only gradually to

[3] See Hirose and Kurozumi (2012).

the desired wage as

$$\hat{w}_t - \hat{w}_{t-1} + \hat{\pi}_t - \gamma_w \hat{\pi}_{t-1} + z_t^z = \beta z^{1-\sigma}(E_t \hat{w}_{t+1} - \hat{w}_t + E_t \hat{\pi}_{t+1} - \gamma_w \hat{\pi}_t + E_t z_{t+1}^z)$$

$$+ \frac{1-\xi_w}{\xi_w} \frac{(1-\beta \xi_w z^{1-\sigma})\lambda^w}{\lambda^w + \chi(1+\lambda^w)} (\chi \hat{l}_t - \hat{\lambda}_t - \hat{w}_t + z_t^b) + z_t^w, \tag{3}$$

where $\hat{w}_t$ represents the real wage, $\hat{l}_t$ denotes labor, $\hat{\lambda}_t$ stands for the marginal utility of consumption, and z_t^w is a labor shock.

Aggregating the Cobb–Douglas production functions over intermediate good firms generates

$$\hat{y}_t = (1+\phi)\{(1-\alpha)\hat{l}_t + \alpha(\hat{u}_t + \hat{k}_{t-1} - z_t^z)\}, \tag{4}$$

where $\hat{k}_t$ represents capital, $\hat{u}_t$ is the utilization rate of capital, and z_t^z is a technology shock.

Each intermediate good firm produces a differentiated good of one kind by choosing a pair of capital and labor to minimize production cost. Because of Calvo-type price stickiness and partial indexation to lagged inflation of those prices that can not be reoptimized, as described in Smets and Wouters (2003), prices adjust sluggishly to their desired price. Profit maximization by price-setting firms gives rise to the following New Keynesian Phillips curve as

$$\hat{\pi}_t - \gamma_p \hat{\pi}_{t-1} = \beta z^{1-\sigma} (E_t \hat{\pi}_{t+1} - \gamma_p \hat{\pi}_t) + \frac{(1-\xi_p)(1-\beta \xi_p z^{1-\sigma})}{\xi_p} \hat{mc}_t + z_t^p, \tag{5}$$

where $\hat{mc}_t$ denotes the real marginal cost and z_t^p represents a cost-push shock.

As in Hirose and Kurozumi (2012), the capital service firm owns the entire stock of capital at the beginning of each period. It rents utilization-adjusted capital to intermediate goods firms. The optimality condition for profit maximization with respect to investment $\hat{i}_t$ yields

$$\frac{1}{\zeta}\{\hat{i}_t - \hat{i}_{t-1} + z_t^z + z_t^i\} = q_t + \frac{\beta z^{1-\sigma}}{\zeta}\{E_t \hat{i}_{t+1} - \hat{i}_t + E_t z_{t+1}^z + E_t z_{t+1}^i\}, \tag{6}$$

where z_t^i is an investment shock.

The monetary authorities follow a generalized Taylor rule by gradually adjusting the policy-controlled interest rate.

$$\hat{R}_t = \phi_r \hat{R}_{t-1} + (1-\phi_r)\left\{\frac{\phi_\pi}{4}\sum_{j=1}^{3}\hat{\pi}_{t-j} + \phi_y (\hat{y}_t - \hat{y}_t^*)\right\} + z_t^r \tag{7}$$

In that equation, $\hat{y}_t^*$ is the potential output and z_t^r is a monetary policy shock.

Equations (1)–(7) and just six equations—the capital accumulation, utilization rate, Tobin's q, real marginal cost, cost-minimizing condition, production function, and potential output—determine 13 endogenous variables. All seven persistent shocks $z_t^z, z_t^b, z_t^w, z_t^g, z_t^i, z_t^p,$

and z_t^r follow the stationary first-order autoregressive processes[4].

3 Bayesian estimation

Our estimation methodology resembles that of Smets and Wouters (2003). We use Dynare, which is a useful tool for conducting Bayesian estimation[5]. The Dynare toolbox derives the reduced-form representation of the DSGE model and automatically provides stability and eigenvalue analysis. Moreover, it enables us to conduct Bayesian estimation[6].

The details of prior distributions used in the paper are presented in Table 1. Choosing the prior distributions, we mostly follow the previous literature on the Japan's Bayesian estimation: Hirose and Kurozumi (2012). The last two columns in Table 1 report the posterior for the structural parameters.

The data used for estimation are the real output growth rate, the real consumption growth rate, real investment growth rate, real wage growth rate, hours worked, inflation rate, and nominal interest rate in Japan's economy[7]. Similar to Hirose and Kurozumi (2012)

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[4] z_t^g is an expenditure shock.

[5] The Dynare file is available from the author upon request.

[6] See An and Schorfheide (2007) for a detailed explanation of Bayesian estimation.

[7] See Hirose and Kurozumi (2012). However, different Hirose and Kurozumi, the estimated potential output was not used herein.

and previous studies, all data were obtained at quarterly frequencies of 1980Q2 to 1991Q4. The end of the sample is determined to exclude the period of the zero nominal interest rate policy because this paper specifically examines monetary policy before the bubble burst.

4 Implications

Jinushi, Kuroki, and Miyao (2000) presumed that the average economy during 1975–85 was ideal and that the benchmark nominal policy rate arose from an ad-hoc policy rule. Furthermore, they examined the difference between the actual policy rate and the rule-based one. As described herein, unlike Jinushi, Kuroki, and Miyao (2000), who considered a desired economy existing every period by the B-DSGE model, this paper presents a specific examination of the gap separating the natural rate of interest and the actual policy rate.

Figure 1 depicts the interest rate gap defined as the difference in between the *nominal* Call rate and the *nominal* based NRI[8]. The shaded areas indicating recessions are dated by the Cabinet Office.

8 From the Fisher equation, the nominal based natural rate of interest here is equal to the posterior mean of the two-sided smoothed estimate of the natural rate of interest adding the model-based expected inflation $E_t \pi_{t+1}$.

The monetary policy in 1987–88, broadly speaking, was in a position where the economy was unexpectedly tightened. After the Plaza Accord of 1985, the rapid appreciation of the yen brought about recessionary effects, and affecting the decline of the potential output, the natural rate of interest fell. Therefore, the positive gap has remained. Moreover, as in Table 1, whereas the policy response to the output gap was quite low ($\phi_y = 0.069$), the authority preferred the stable inflation ($\phi_\pi = 1.697$) and the indexation to the past policy rate ($\phi_r = 0.458$). The salient implication is that the BOJ had not misunderstood the potential economy and that neither economic agent noticed it. Consequently, no delay of monetary policy tightening is evident[9]. Instead, it seems clear that the monetary policy stance was potentially tightening.

Because the BOJ would not raise the controlled policy rate, the discount rate, in 1987 immediately and dynamically, by tightening monetary policy gradually, promoting the accumulation of bubble can not be ruled out. However, it is interpreted that the tightening policy had maintained upward growth since the big tightening in 1988Q1.

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[9] Figure 1 also shows that the easy monetary policy in the early 1980s used to ride out the recession caused by the second oil crisis in 1979 indicates negative gaps.

5 Conclusion

As described in this paper, the aim is to evaluate monetary policy of the late 1980s. As a consequence, the latent interest rate gap that Jinushi, Kuroki, and Miyao (2000) did not address showed that no monetary policy at that time was delayed. Rather, the authority could not ascertain the potential condition of the economy. Monetary policy was unexpectedly on the tightening side from 1985.

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Table 1: Prior and posterior distributions of parameters

Parameters	Descriptions	Prior distribution		Posterior distribution	
		Distribution	Mean	Mean	90% interval
σ	risk aversion	Gamma	1.000	2.676	[2.017, 3.293]
θ	habit consumption	Beta	0.700	0.146	[0.070, 0.218]
χ	elasticity of labor supply	Gamma	2.000	3.848	[2.347, 5.320]
$1/\zeta$	elasticity of invst. adj. cost	Gamma	4.000	4.276	[1.638, 6.800]
ϕ	s.s. fixed cost	Gamma	0.075	0.072	[0.053, 0.091]
γ_w	wage indexation	Gamma	0.500	0.385	[0.014, 0.732]
ξ_w	a fraction of wage	Gamma	0.375	0.109	[0.038, 0.176]
γ_p	price indexation	Gamma	0.500	0.211	[0.001, 0.432]
ξ_p	a fraction of price	Gamma	0.375	0.697	[0.616, 0.773]
λ_p	s.s. price markup	Gamma	0.150	0.219	[0.109, 0.331]
ϕ_r	interest rate smoothing	Gamma	0.800	0.458	[0.282, 0.645]
ϕ_π	policy response of inflation	Gamma	1.700	1.697	[1.540, 1.854]
ϕ_y	policy response of output	Gamma	0.125	0.069	[0.024, 0.113]
ρ_z	persistence of	Beat	0.500	0.074	[0.015, 0.128]

	technology				
ρ_b	persistence of preference	Beat	0.500	0.845	[0.757, 0.929]
ρ_i	persistence of investment	Beat	0.500	0.606	[0.395, 0.869]
ρ_g	persistence of extended demand	Beat	0.500	0.936	[0.902, 0.971]
ρ_w	persistence of wage markup	Beat	0.500	0.350	[0.081, 0.603]
ρ_p	persistence of price markup	Beat	0.500	0.835	[0.719, 0.958]
ρ_r	persistence of monetary policy	Beat	0.500	0.822	[0.715, 0.926]
σ_z	st. dev. of technology	Inverse gamma	0.500	1.815	[1.455, 2.165]
σ_b	st. dev. of preference	Inverse gamma	0.500	0.221	[0.128, 0.310]
σ_i	st. dev. of investment	Inverse gamma	0.500	5.401	[2.738, 8.438]
σ_g	st. dev. of extended demand	Inverse gamma	0.500	2.227	[1.807, 2.637]
σ_w	st. dev. of wage markup	Inverse gamma	0.500	1.377	[0.967, 1.782]
σ_p	st. dev. of price markup	Inverse gamma	0.500	0.277	[0.155, 0.392]
σ_r	st. dev. of monetary policy	Inverse gamma	0.500	0.178	[0.144, 0.212]

Note: The paper follows the setting of prior distributions by Hirose and Kurozumi (2012).

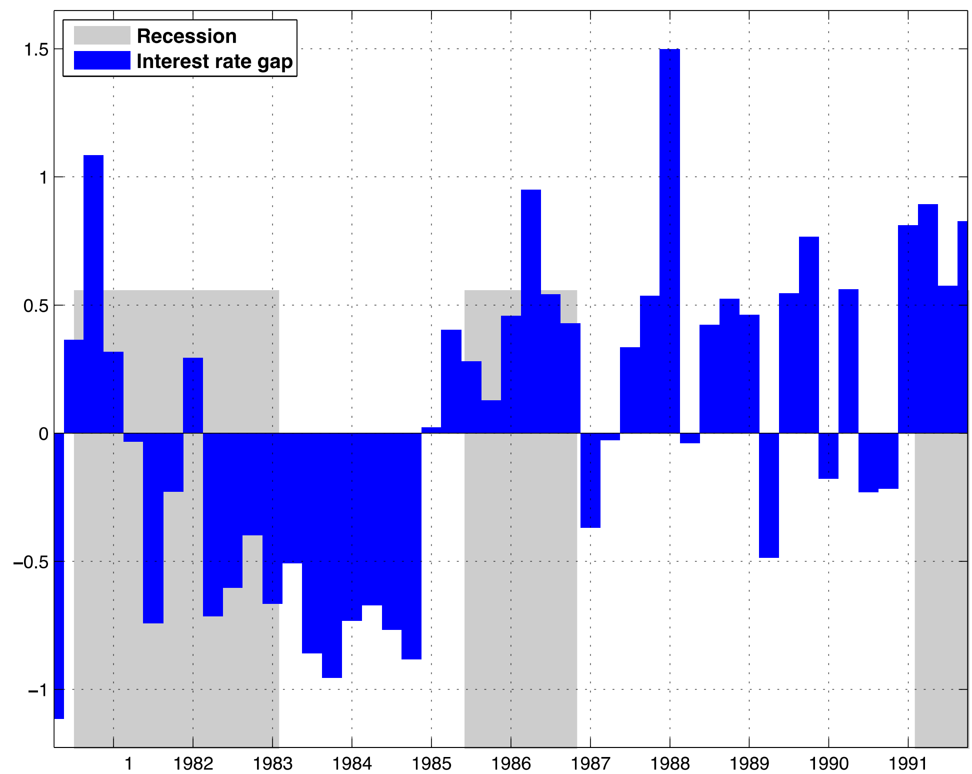

Figure 1: Interest rate gap.