한국은행

THE BANK OF KOREA

BOKDSGE: A DSGE Model for the Korean Economy

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Outline

1. Background
2. Model structure & parameter values
3. Model experiment
4. Current status

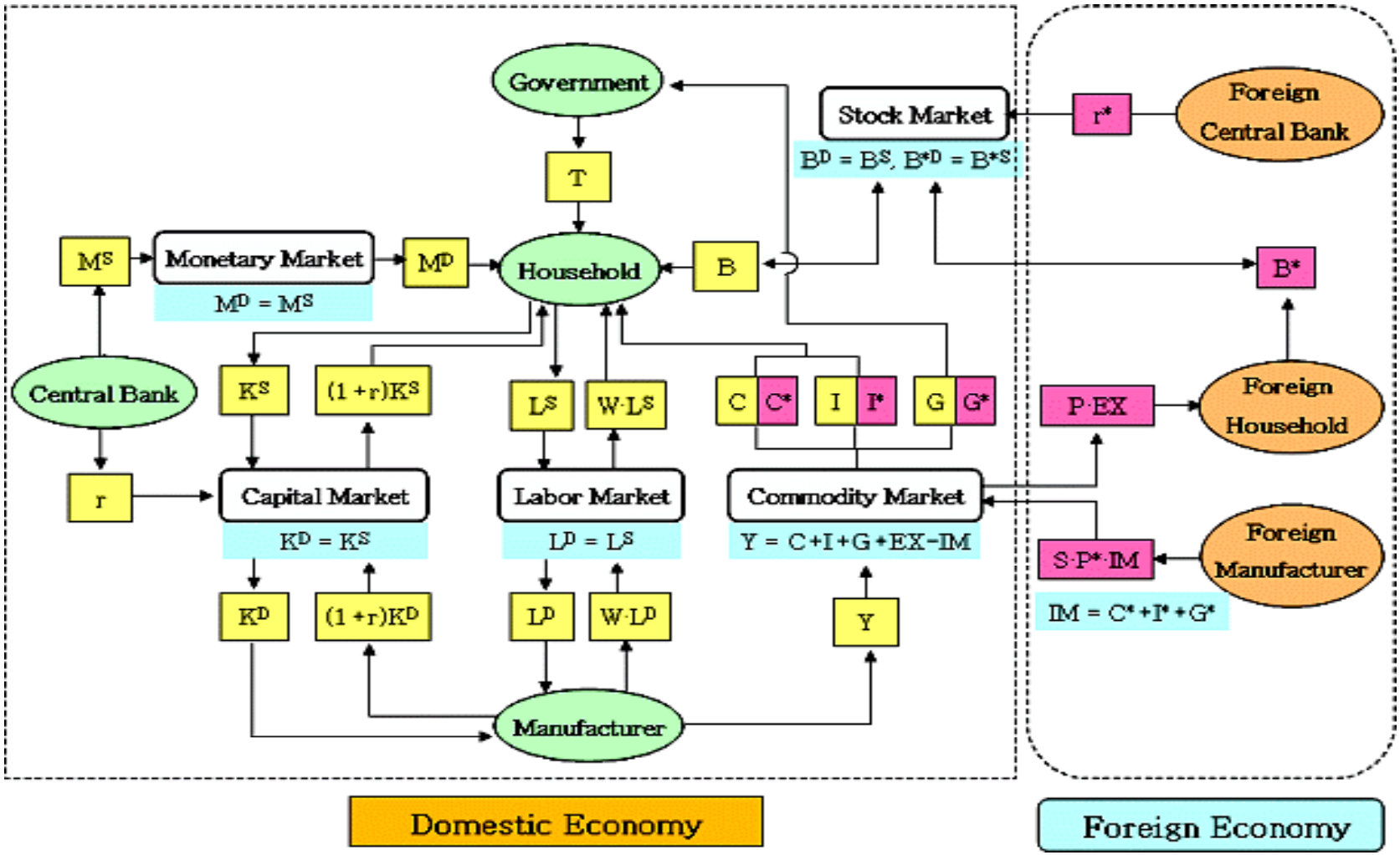
1. Background

- main macro forecasting model : BOK04
  - Keynesian type simultaneous equation model
    (81 endogenous variables; 26 exogenous variables)

- develop a DSGE model, suitable for
  - forecasts/projections and policy analysis
  - risk and uncertainty assessment
  - communication

2. Model structure …

- typical SOE structure



2. Model structure …

A. Household

$$\max \quad U = E_0 \left\{ \sum_{t=0}^{\infty} \beta^t \left[\ln\left(\tilde{C}(h)_t - b \cdot \tilde{C}(h)_{t-1} \right) - \chi_1 \frac{N(h)_t^{1+\nu}}{1+\nu} + \chi_2 \ln\left(\frac{M(h)_{t+1}}{\tilde{P}_t} \right) \right] \right\}$$

$$\text{s.t.} \quad \tilde{C}(h)_t + \tilde{I}(h)_t + \frac{b(h)_{t+1}}{R_t} + \frac{s_t b(h)^*_{t+1}}{R^*_t \phi_B(t)} + m(h)_{t+1}$$

$$= w(h)_t \left[1 - \frac{\phi_w}{2} \left\{ \frac{w(h)_t / w(h)_{t-1}}{w(h)_{t-1} / w(h)_{t-2}} \left(\frac{\tilde{\pi}_t}{\tilde{\pi}_{t-1}} \right) - 1 \right\}^2 \right] N(h)_t$$

$$+ R_t^K K(h)_t + \frac{b(h)_t}{(1+g_y)\tilde{\pi}_t} + \frac{s_t b(h)^*_t}{(1+g_y)\tilde{\pi}_t} + \frac{m(h)_t}{(1+g_y)\tilde{\pi}_t} - T(h)_t + \Pi(h)_t$$

- featuring habit formation; money-in-utility function; and CES type of composite goods and price index

B. Firms (monopolistic competition)

production technology

$$Y_t(j) = \exp(z_t) \cdot \left[N_t(j)(1+g_y)^t \right]^{\alpha} \cdot K_t(j)^{1-\alpha}$$

profit maximization :

$$\max_{\{P_t(j)\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \left(\frac{D_{0,t}}{\tilde{P}_t} \right) \left[P_t(j) \left(\left[\frac{P_t(j)}{P_t} \right]^{-\psi_p} Y_t \right) \left\{ 1 - \frac{\phi_P}{2} \left(\frac{P_t(j)/P_{t-1}(j)}{P_{t-1}/P_{t-2}} - 1 \right)^2 \right\} - \tilde{P}_t mc_t(j) \left(\left[\frac{P_t(j)}{P_t} \right]^{-\psi_p} \right) Y_t \right]$$

where $$mc_t(j) = \left(\frac{1}{e^{z_t}} \right) \left(\frac{w_t}{\alpha} \right)^{\alpha} \left(\frac{r_t^K}{1-\alpha} \right)^{1-\alpha}$$

2. Model structure …

law of motion on capital :

$$(1+g_Y)K(h)_{t+1} = (1-\delta)K(h)_t + e^{zi_t}\left[1-\frac{\phi_I}{2}\left(\frac{(1+g_Y)\tilde{I}(h)_t}{\tilde{I}(h)_{t-1}}-1\right)^2\right]\tilde{I}(h)_t$$

where $$\tilde{I}(h)_t = \left[\theta I_t(h)^{\frac{\gamma-1}{\gamma}} + (1-\theta)I_t^*(h)^{\frac{\gamma-1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}}$$

- featuring labor augmenting technological progress; rigidities on wage and prices (Rotemberg, 1982); and quadratic adjustment costs on capital accumulation

C. Central Bank : monetary reaction function

$$\frac{R_t}{\overline{R}} = \left(\frac{R_{t-1}}{\overline{R}}\right)^{\rho_{\hat{R}}} \left(\frac{\tilde{\pi}_t}{\overline{\pi}}\right)^{\rho_{\pi}} \left(\frac{Y_t}{\overline{Y}}\right)^{\rho_Y} \exp\left(\hat{R}_t\right)$$

D. External Sector

interest rate parity condition :

$$\frac{R_t}{R_t^*} = E_t\left[\left\{\frac{s_{t+1}}{s_t}\right\}\left\{\frac{\phi_B(t)}{1+\phi_B'(t)}\right\}\right]$$

where $\phi_B(t) = \exp\left[-\phi_B\left(\frac{s_t B_{t+1}^*}{p_t Y_t}\right)\right]$

2. Model structure …

E. Equilibrium

- market clearing: goods market, labor market, capital market, money market, bond market, and external (stock-flow) balance
- balanced growth equilibrium path
- symmetric equilibrium, consisting of Korea and its Trading Partners

2. … and parameter values

- pragmatic approach in setting parameter values
  - goal: mimic Korean macro dynamics
  - strategy: incorporate various evidence including "Great ratios", VAR impulse responses, and inflation target
  - tools: historical data, IV estimation, method of moments, MLE with Kalman Filter
    - MATLAB with DYNARE (v3.0)

2. … and parameter values

- classify parameters into 5 groups: $\{\Omega_1, \Omega_2, \Omega_3, \Omega_4, \Omega_5\}$

group	coverage (examples)	tools	metric
Ω_1 (8)	▪ data driven · depreciation rate · discount rate · inflation target · potential growth rate	historical date (SNA)	-
Ω_2 (3)	▪ monetary policy reaction function parameters	IV estimation	-

2. … and parameter values

group	coverage (examples)	tools	metric
Ω_3 (8)	▪ long-run steady state · great ratios · adjustment costs · preferences	calibration (method of moments)	$\lvert\triangle(\Omega_3)\rvert$ of 8 relevant variables
Ω_4 (8)	▪ short-run dynamics · habit formation · elasticities	pseudo-calibration (MM)	$[\triangle(\Omega_4)\ I\ \triangle(\Omega_4)']$ of 10 horizon GDP & Cons. dynamics
Ω_5 (14)	▪ exogenous shock parameters	MLE with Kalman filter	likelihood of 7 time series

1. $\triangle(\Omega)$ = data driven statistics – Model(Ω)
2. □ : sequential iteration of $\Omega_5 \rightarrow \Omega_4 \rightarrow \Omega_3$
   (convergence critical values: $|\Omega_3| < d_1$ and $|\Omega_4| < d_2$)

2. … and parameter values

- dynamic properties compared with the data counterpart

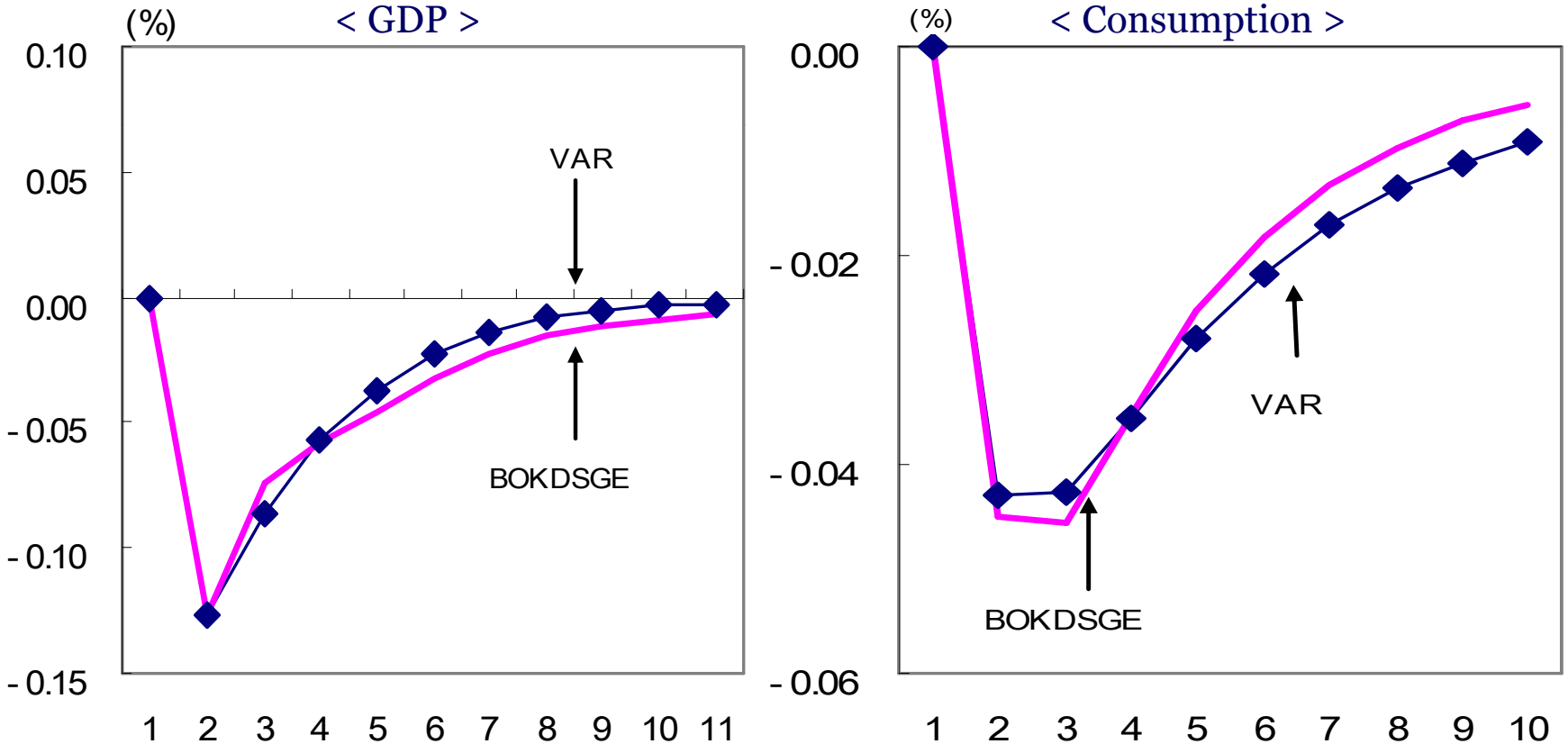
(in percent)	Consumption to GDP	Government Expenditure to GDP	Fixed Capital Formation to GDP	Export to GDP
Data	52.2	12.2	29.4	47.4
Model	56.5	12.4	28.9	40.9
	Net Export to GDP	Inflation Rate	Nominal Interest Rate	Money/GDP
Data	6.3	2.75	4.28	7.76
Model	2.2	2.56	4.00	7.62

		GDP	C	I	Exp.	Imp.	Inflation	Ex. Rate	Int. Rate
Correlation Coefficient with GDP	Data	…	0.64	0.61	0.36	0.61	-0.14	-0.11	0.13
	Model	…	0.53	0.65	0.95	0.65	0.24	-0.03	0.13
First-order Autocorrelation Coefficient	Data	0.59	0.89	0.10	0.79	0.67	0.10	0.78	0.77
	Model	0.55	0.89	0.88	0.69	0.88	0.21	0.70	0.80

2. … and parameter values

- impulse responses: comparison with VAR counterpart

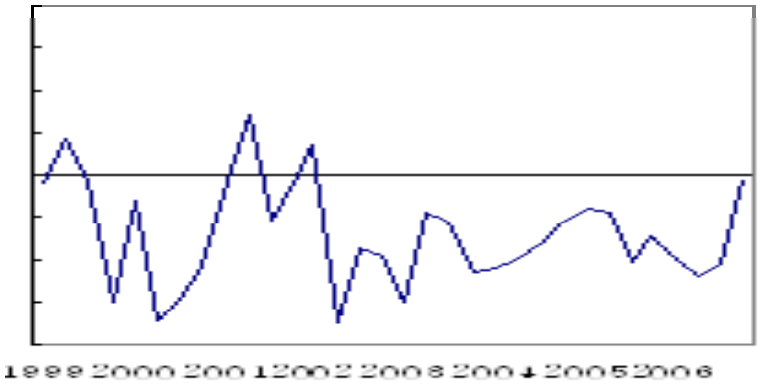
impulse responses to monetary policy shock



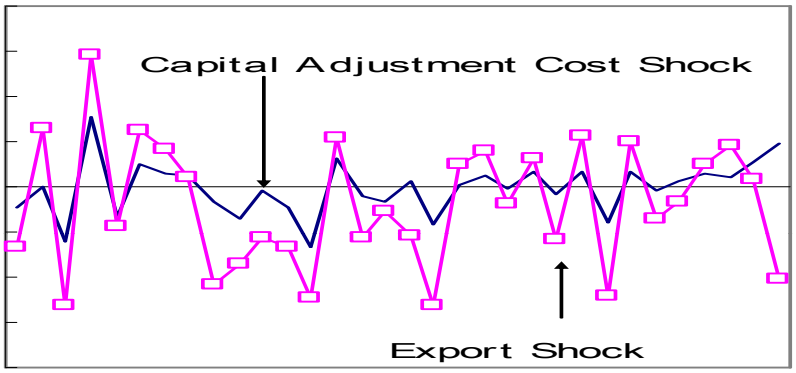
3. Model experiment

- "back-out" realizations of the economic shocks …

< Productivity Shock >

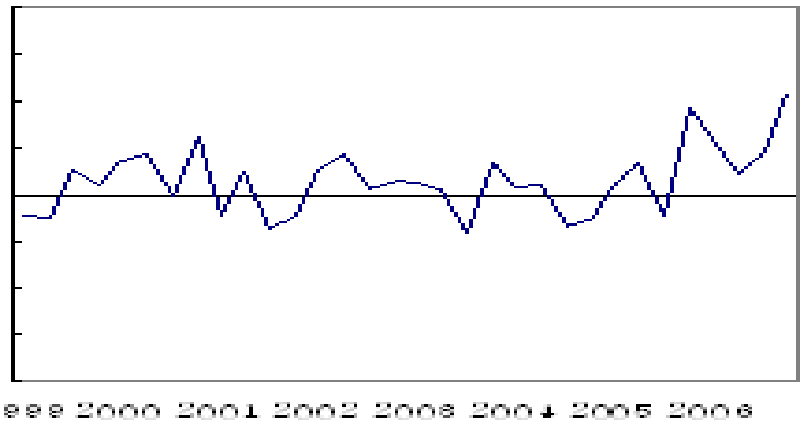


< Export and Capital Adjustment Cost Shocks >



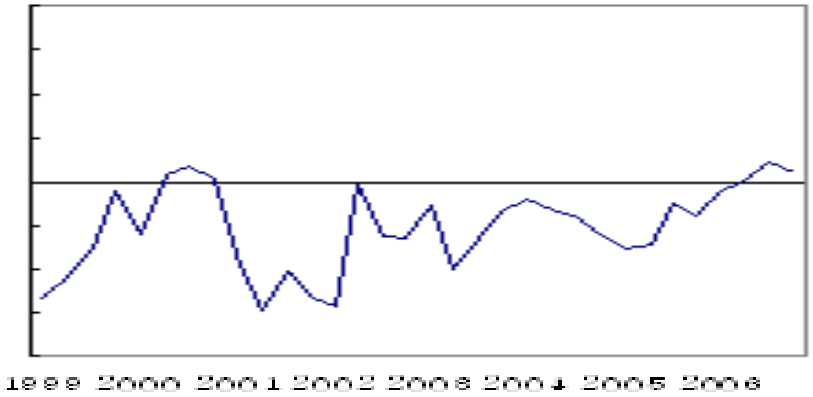
< Fiscal Policy Shock >

< Monetary Policy Shock >

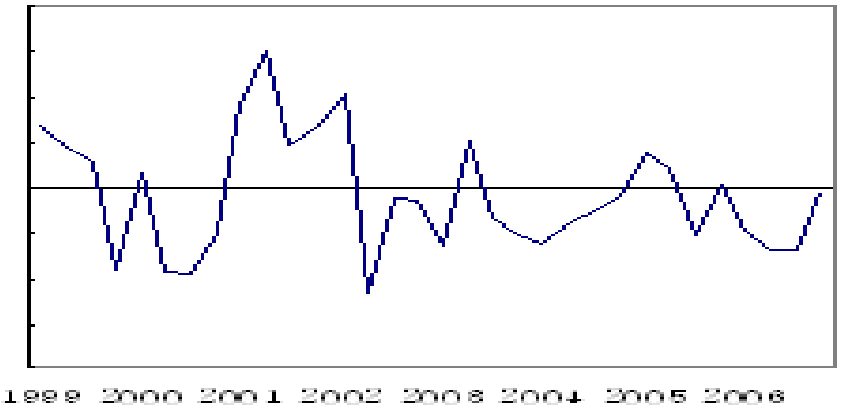


3. Model experiment

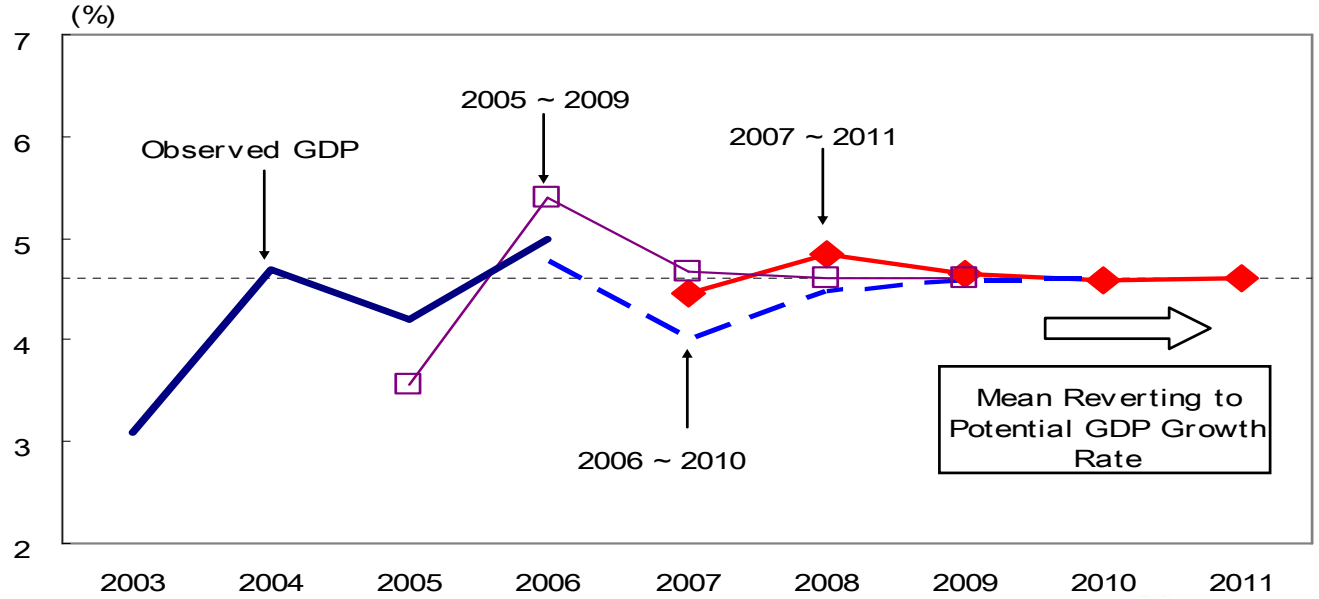
< Foreign Price Shock >



< Foreign Interest Rate Shock >



… and execute medium-term baseline forecasts



4. Current status

- completed :
  - analytical model structure
  - systematic estimation and update of the parameter values
  - analyzing conjunctural issues: stagflation, expectation shocks in line with the algorithm of Fujiwara & Kang (2008)

- in progress :
  - integration with the current forecasting system
  - optimal monetary policy: interest rate path

- future tasks :
  - Bayesian estimation of the parameter values
  - uncertainty and risk assessment
  - model extension: global model, stochastic growth