A Small Semi-structural Model for Thailand: Construction and Applications

Modelling and Forecasting Team

Bank of Thailand

17 December 2008

Outline

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- Model Construction
  - Bayesian estimation
- Model Structure
- Model Properties and Applications
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  - Policy analysis
  - Forecasting
- Conclusion
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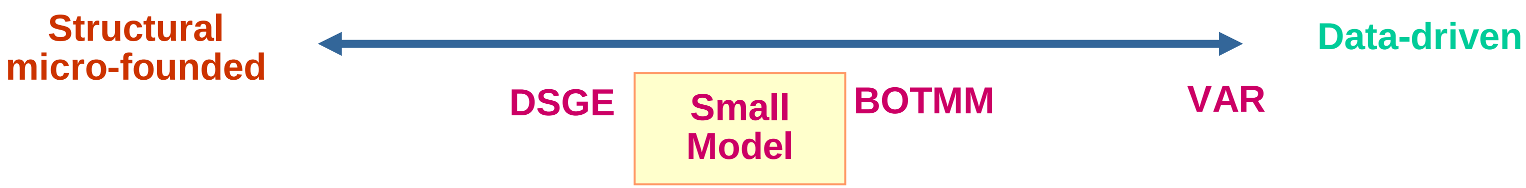
Motivation

1. **Construct a small-size model to supplement BOTMM/DSGE**
   - Comprehensive: capture the dynamics of major macroeconomic variables
   - Simple and tractable
2. **Semi-structural: a good blend between theories and empirics**



3. **Sufficiently versatile for a wide range of practical applications**
   - Policy/ shock analyses
   - Forecasting
   - Constructing fan charts from joint distributions of assumptions

Model Construction

Model Structure

New Consensus in Macroeconomics	
New Keynesian	**RBC**
- Nominal and real rigidities - AD in determining short-run output	- General equilibrium - S-side determined equilibrium output
Stylized Facts	
Literature	
International evidence	

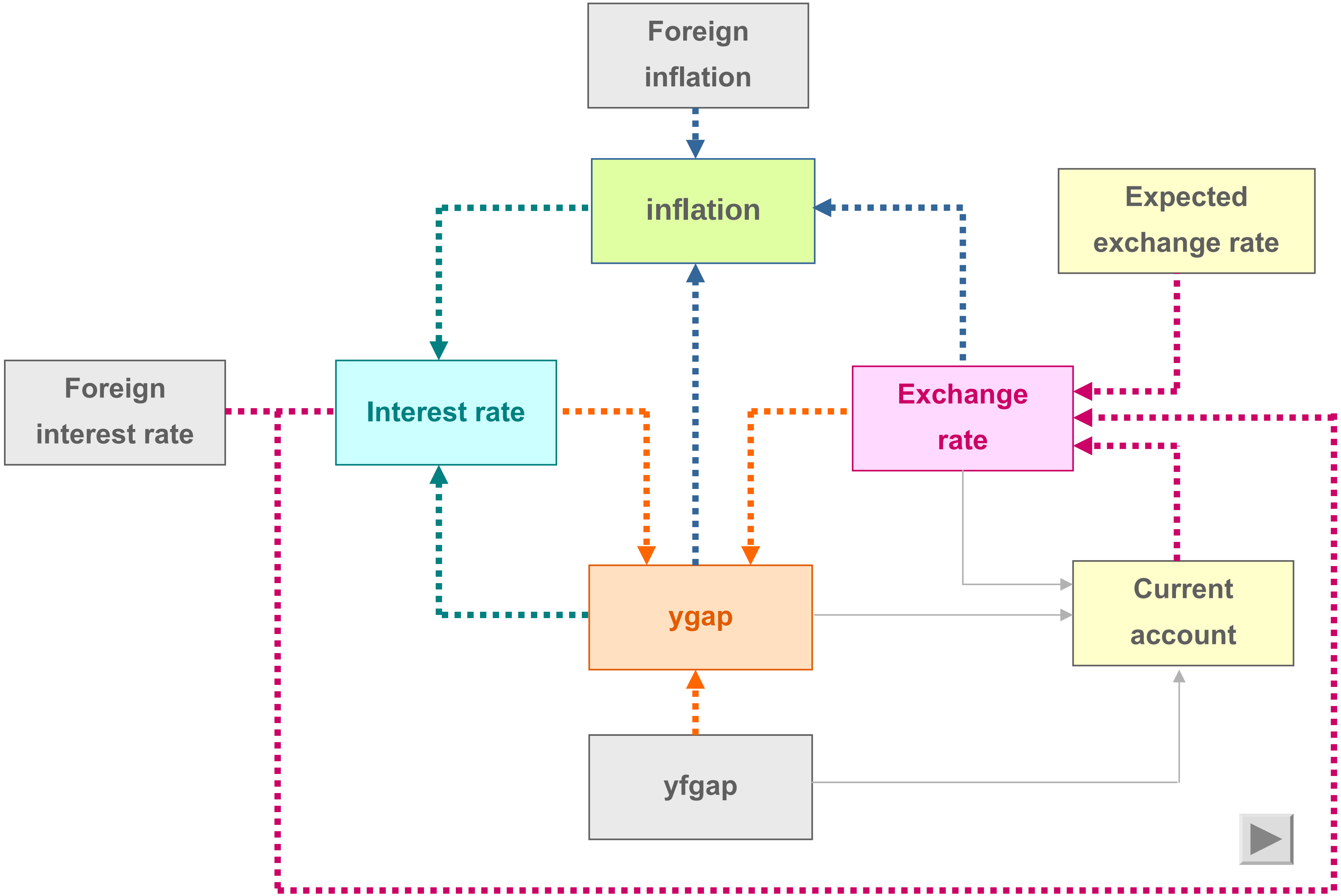
Data

Data on the Thai economy (2000-2008)
Data on 10 major trading partners* (2000-2008)

Bayesian estimation of parameters → **Small Model**

* US, Japan, Euro-area, China, Singapore, Malaysia, Korea, Taiwan, Indonesia, Philippines

Model interlinkages



Model Structure

9 behavioural equations (6 domestic + 3 foreign) + 5 identities

- **IS (Output gap equation)**

$$ygap_t = \beta_1 ygap_{t-1} + \beta_2 ygap_{t+1} - \beta_3 (r_t - r*) - \beta_4 * (z_t - z^*) + \beta_5 yfgap_t + \varepsilon_t^y$$

- **AS (Phillips curve)**

$$\pi_t^Q = \delta_1 \pi_{t+4}^A + \delta_3 \pi_{t-1}^A + \delta_2 ygap_t + (1 - \delta_1 - \delta_3)(\pi_t^f - \Delta er_t) + \varepsilon_t^\pi$$

- **Exchange rate equation**

$$z_t = z_{t+1}^e + \gamma_2 (r_t - r_t^f - risk)/4 + \gamma_3 ca_t + \varepsilon_t^z$$

- **Monetary policy rule (reaction function)**

$$i_t = \alpha_1 i_{t-1} + (1 - \alpha_1)(r^* + \pi_{t+1}^Q + \alpha_2 (\pi_{t+4}^A - \pi*) + \alpha_3 ygap_t) + \varepsilon_t^i$$

- **Current account**

$$ca_t = \eta_1 (z_{t-1} - z_t) - \eta_2 ygap_t + \eta_3 ygap_t^f + \varepsilon_t^{ca}$$

- **Exchange rate expectations**

$$z_{t+1}^e = \lambda z_{t+1} + (1 - \lambda) z_{t-1} + \varepsilon_t^{zx}$$

- **Identities**

$$\Delta er_t = (z_t - z_{t-1}) + \pi_t^f - \pi_t$$

$$r_t = i_t - \pi_{t+1}^Q$$

$$\pi_t^A = (\pi_t^Q + \pi_{t-1}^Q + \pi_{t-2}^Q + \pi_{t-3}^Q)/4$$

Bayesian estimation

Bayesian estimation is a bridge between calibration (specification of priors) and maximum likelihood (confronting the model with data)

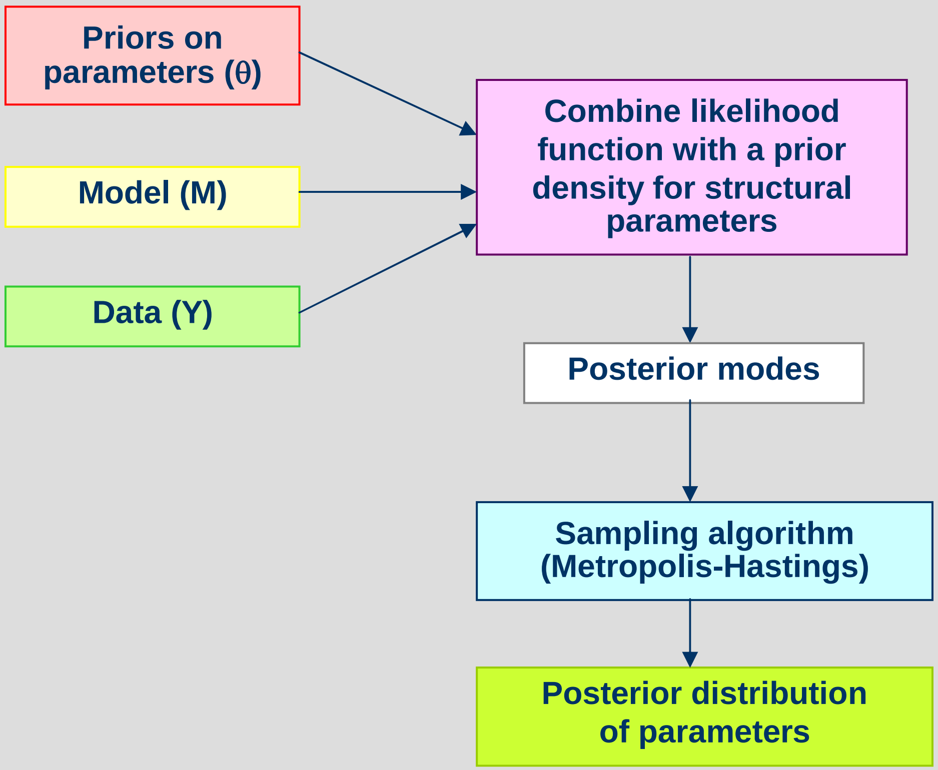
The Bayes formula

$$p(\theta|Y,M) = \frac{L(Y|\theta,M)\,p(\theta|M)}{p(Y|M)}$$

Why Bayesian?

- ✓ Able to cope with some shortcomings of calibration and maximum likelihood analysis
- ✓ By allowing the consideration of priors, it avoids the posterior distribution peaking at strange points where the likelihood peaks.
- ✓ The inclusion of priors helps identifying parameters
- ✓ Bayesian estimation explicitly addresses model misspecification by including shocks – observation errors in the structural equations
- ✓ Allows model comparisons based on fit

Estimation Procedure



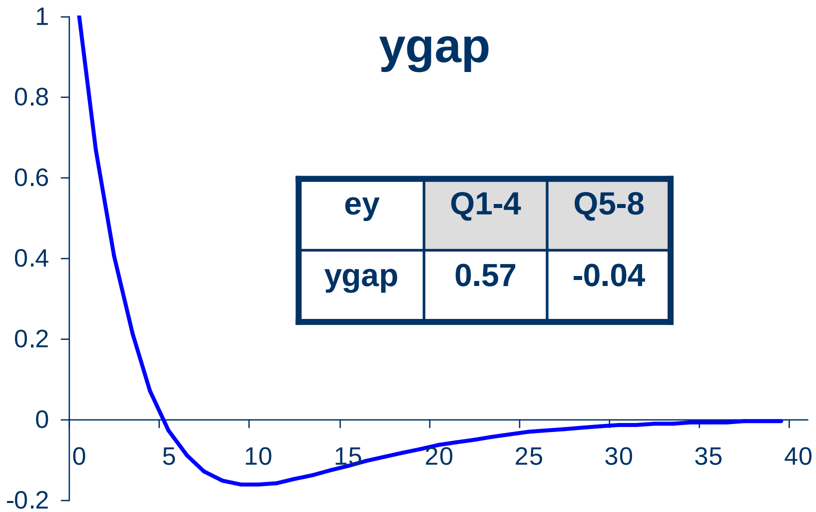
Model Properties and Applications

- ✓ **Simulation results**
  - **- Output and inflation shocks**
- ✓ **Policy analysis**
  - **- Shocks to policy variables: policy rate and exchange rate**
  - **- Policy shock:**
    - **Anticipated and unanticipated**
    - **Temporary and prolonged**
- ✓ **Forecasting**
  - **- based on MPC December 08 assumptions and current data**

Model Properties: Simulation

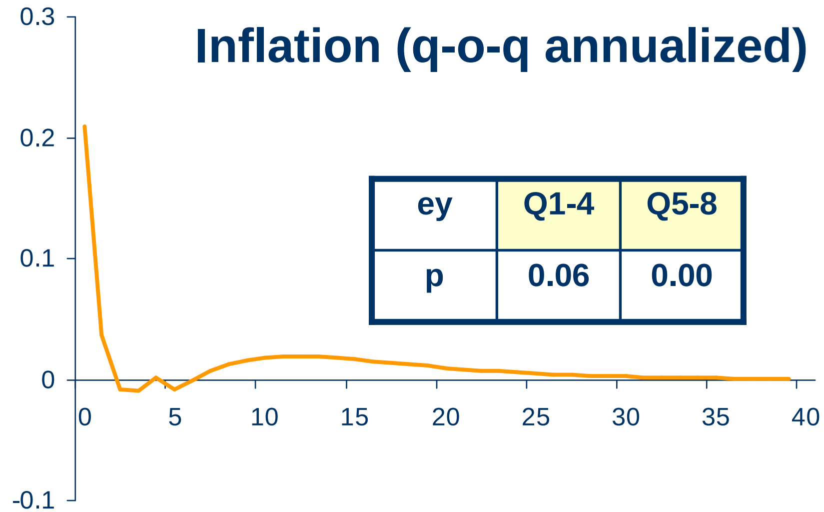
Shock propagation: 1% shock to ygap equation

ygap



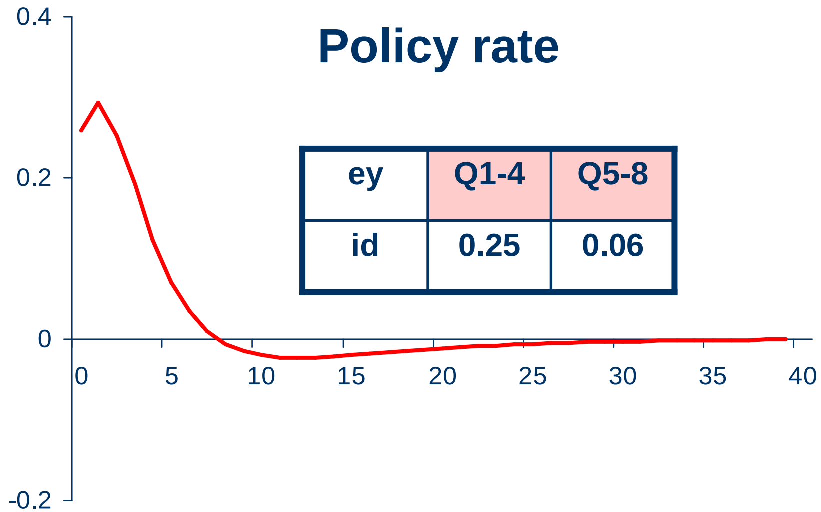
ey	Q1-4	Q5-8
ygap	0.57	-0.04

Inflation (q-o-q annualized)



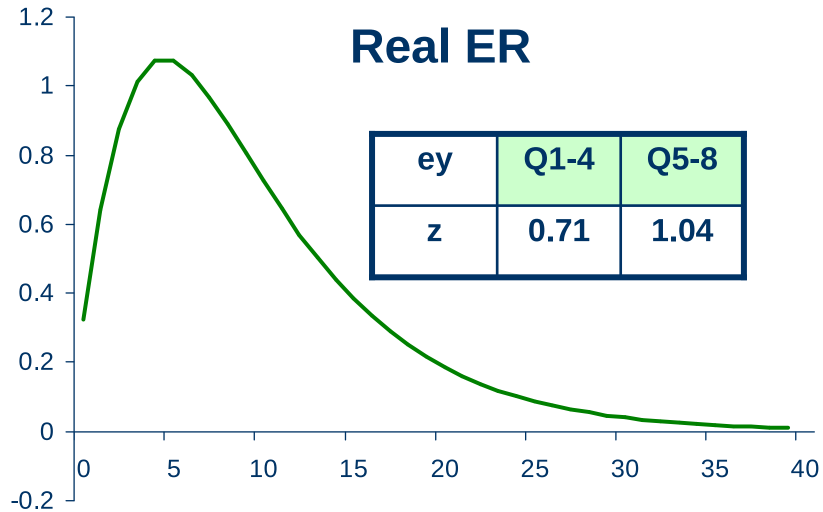
ey	Q1-4	Q5-8
p	0.06	0.00

Policy rate



ey	Q1-4	Q5-8
id	0.25	0.06

Real ER

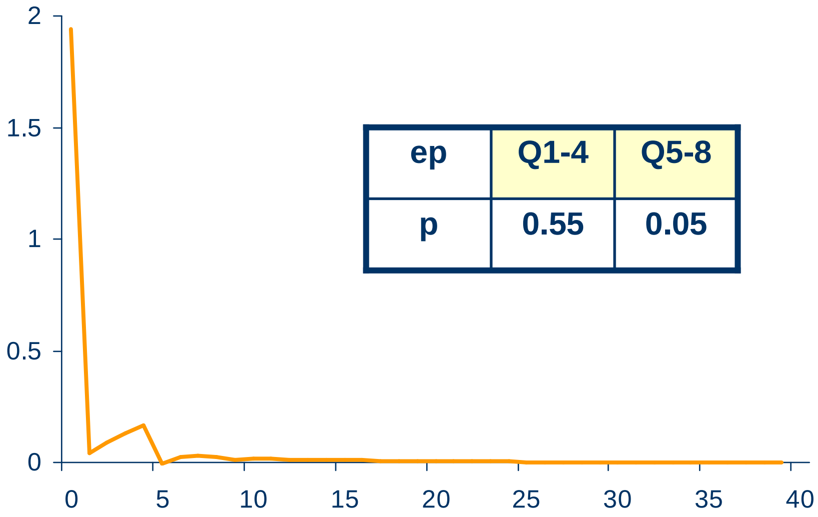


ey	Q1-4	Q5-8
z	0.71	1.04

Model Properties: Simulation

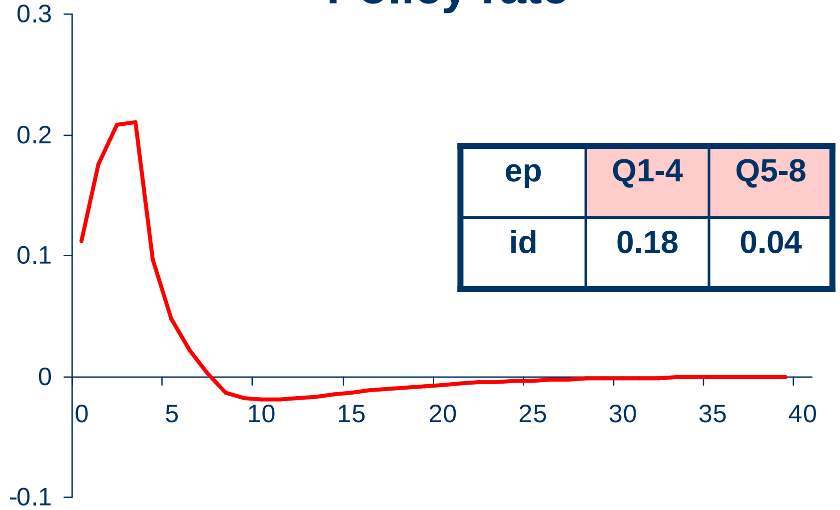
Shock propagation: 1% shock to inflation equation

Inflation (q-o-q annualized)



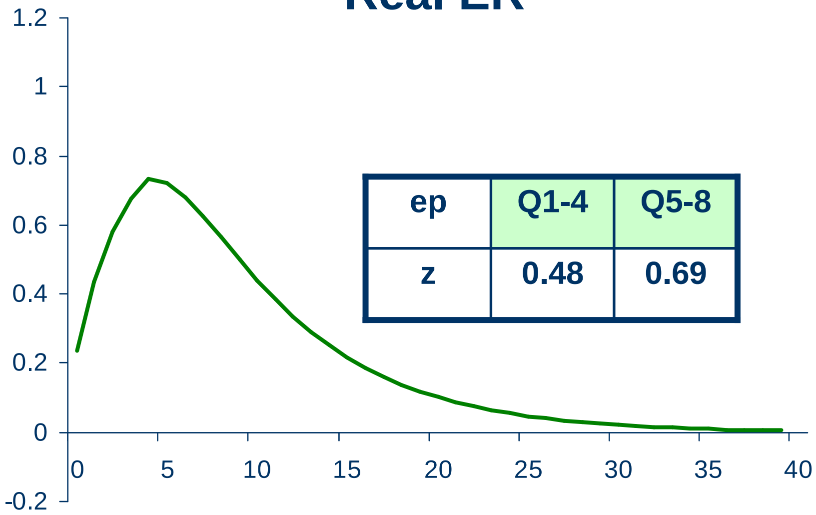
ep	Q1-4	Q5-8
p	0.55	0.05

Policy rate



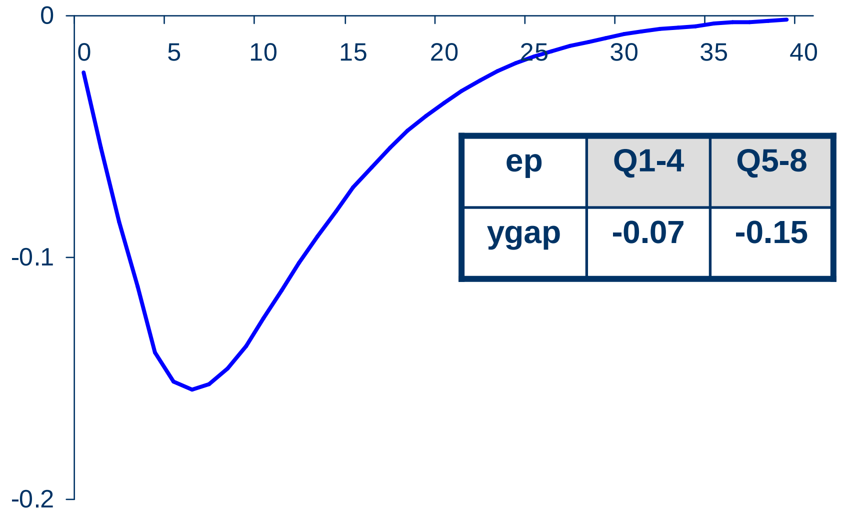
ep	Q1-4	Q5-8
id	0.18	0.04

Real ER



ep	Q1-4	Q5-8
z	0.48	0.69

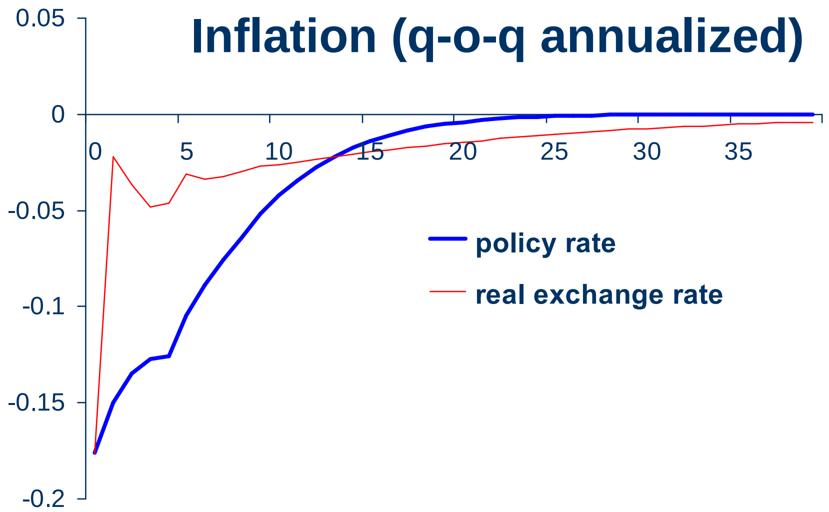
ygap

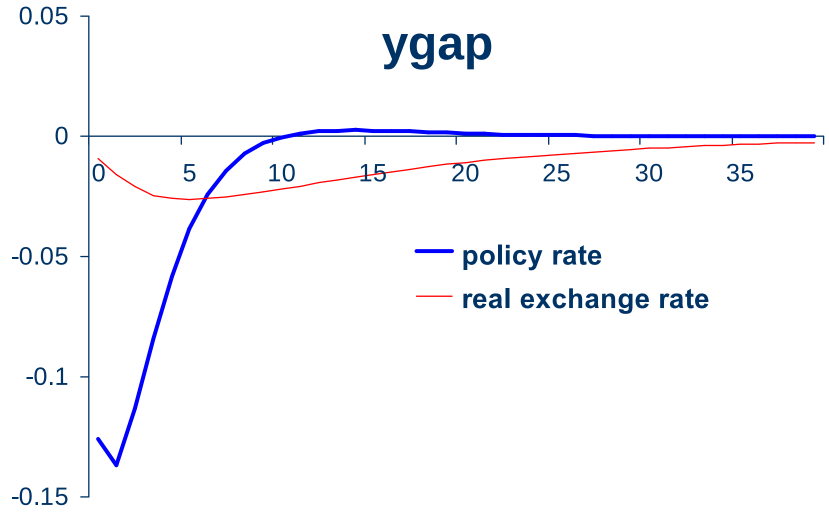


ep	Q1-4	Q5-8
ygap	-0.07	-0.15

Model Properties: Policy Analysis

Policy rate and exchange rate



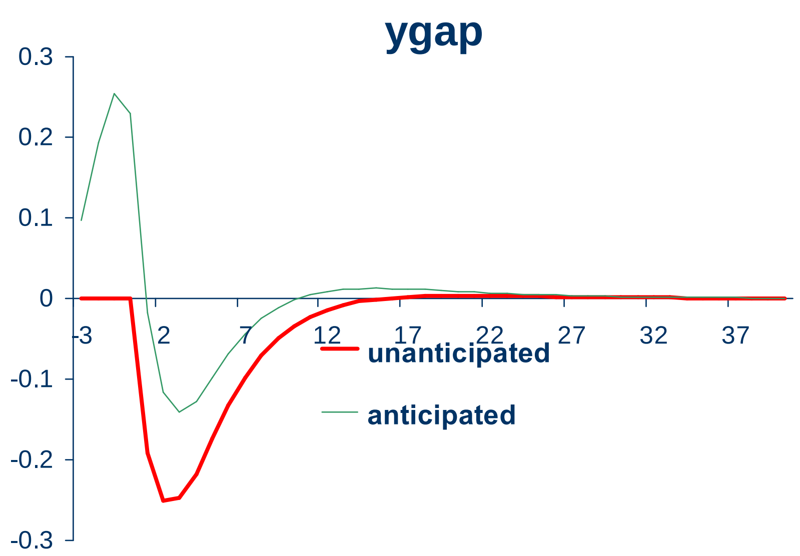


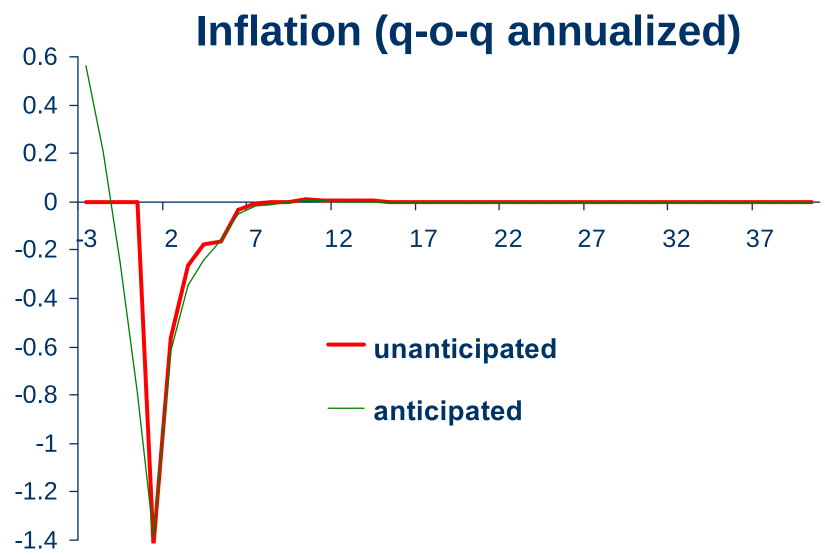
1% increase in	Output gap deviation from steady state (%)		Inflation deviation from steady state (%)	
	Average Q1-Q4	Average Q5-Q8	Average Q1-Q4	Average Q5-Q8
Policy rate*	-0.12	-0.03	-0.15	-0.10
REER**	-0.13	-0.19	-0.52	-0.22

* Without exchange rate movements ** without interest rate movements

Model Properties: Policy Analysis

Anticipated and unanticipated 1% increase in interest rate

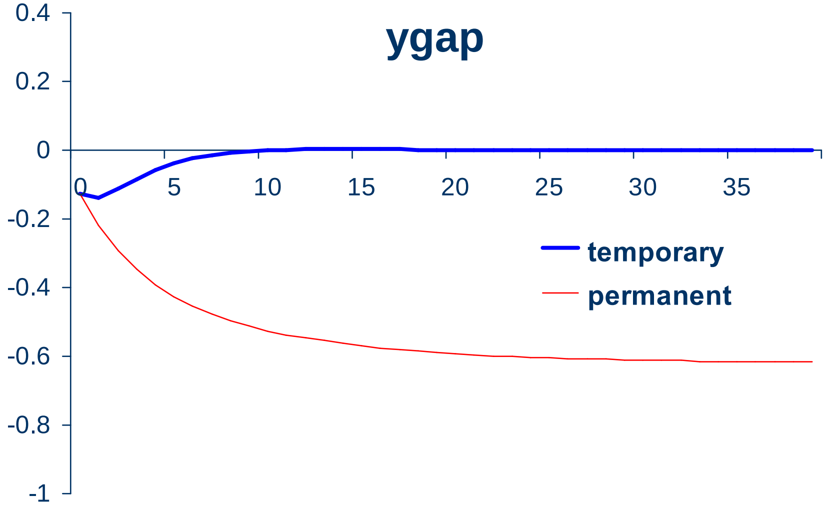


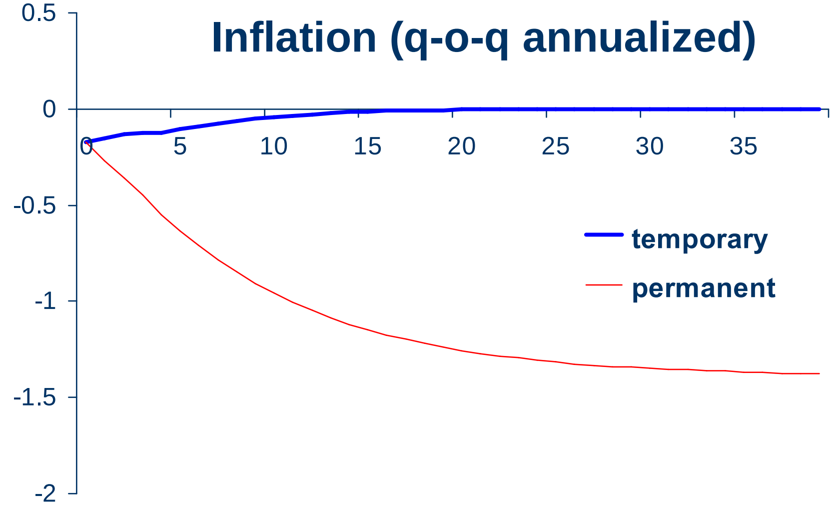


1% Policy rate shock (at t = 1)	Output gap deviation from steady state (%)		Inflation deviation from steady state (%)	
	Average Q1-Q4	Average Q5-Q8	Average Q1-Q4	Average Q5-Q8
Anticipated	-0.10	-0.06	-0.65	-0.06
Unanticipated	-0.23	-0.12	-0.61	-0.05

Temporary and prolonged policy rate shocks

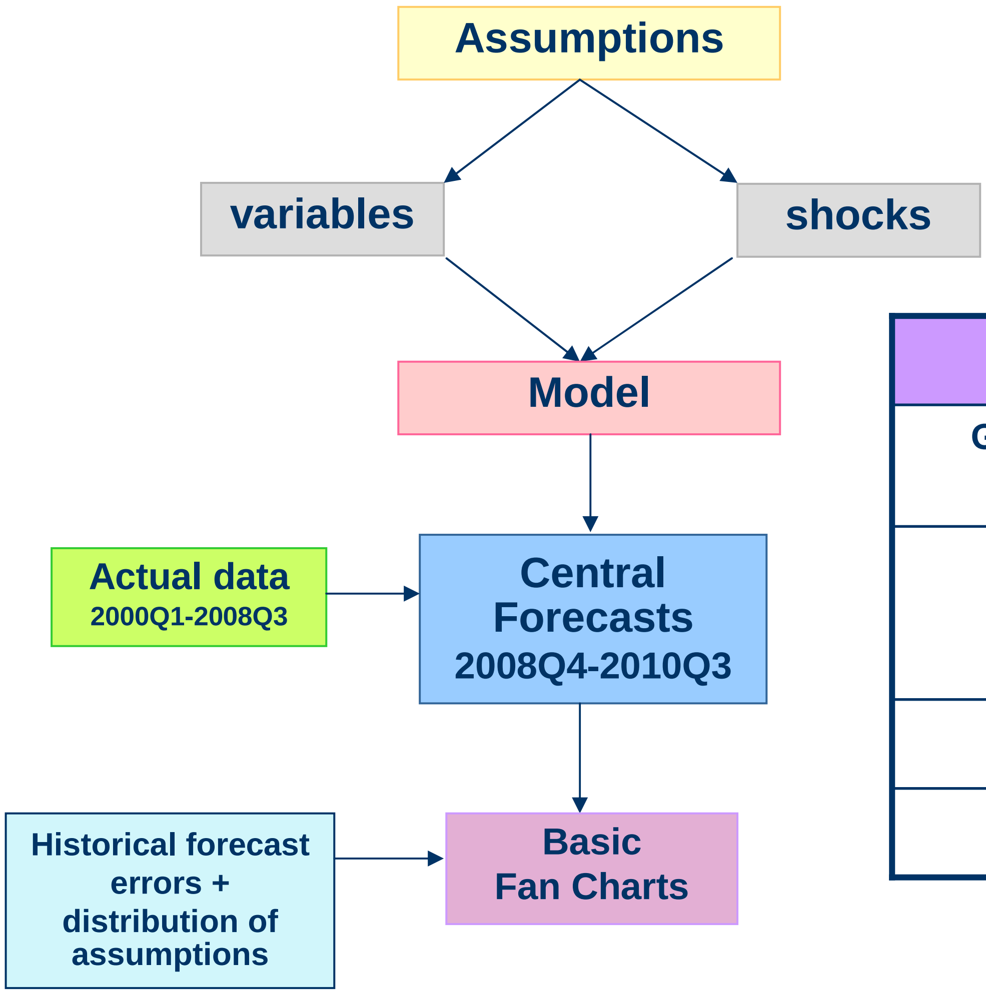
Temporary and prolonged policy rate shock of 1%





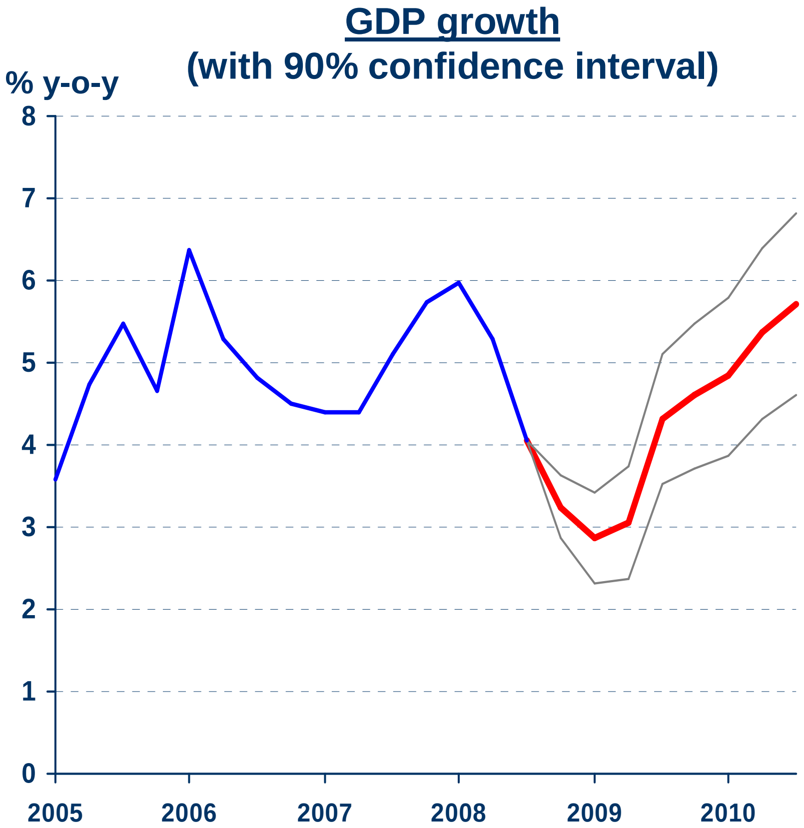
Model Properties: Forecasting

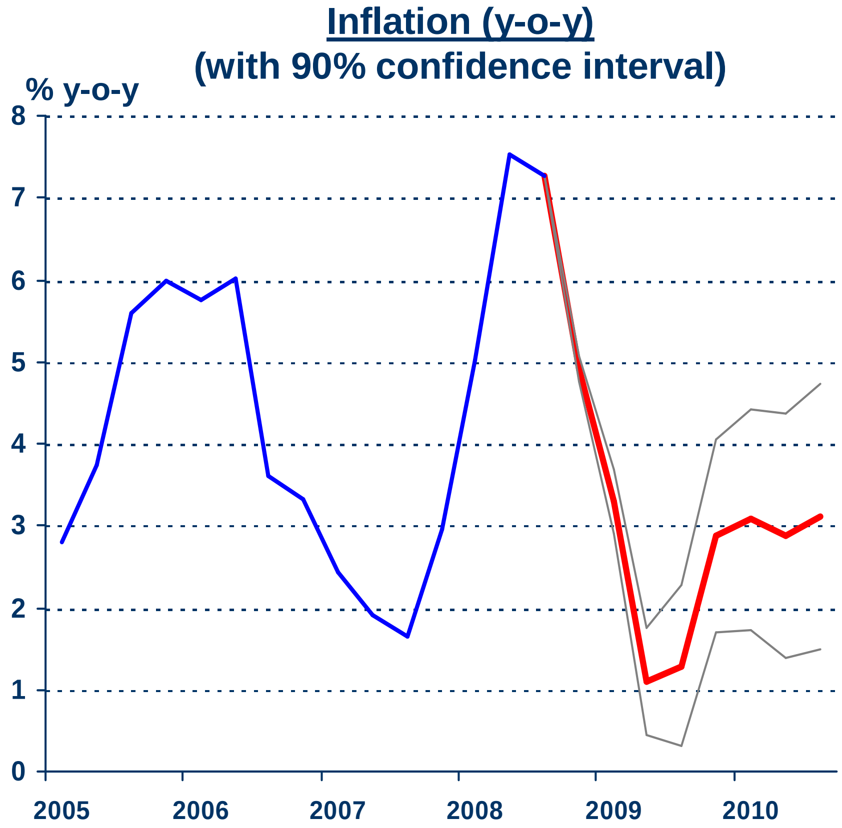
Forecasting procedure



Assumptions	Variables/shocks
Government Consumption & Public Investment	ε^{ygap}
Dubai oil price, farm price, Non-fuel commodity price, minimum wage	ε^{p}
Trading partners GDP	yfgap
Trading partners CPI	π^{f}

Model Forecasts without judgments





Note:
- **Keeping domestic and foreign policy rates constant**
- **Based on Dec08 (as of 1 Dec 08) assumptions**

Conclusion

- **The purpose of a Small Semi-structural Model:**
  - **supplement large-scale models (BOTMM and DSGE) in the monetary policy process**
    - **Simulation (shock propagation)**
    - **Policy analysis**
    - **Forecasting**
- **Bayesian estimation technique was employed in the model parameterization**
- **Further development to forecasting process**
  - **Improve assumption conversion process**
  - **Incorporate joint distributions of assumptions**
  - **Incorporate judgments into the fan charts**

Issues for discussion

- What is your view on the forecasting procedure? Please suggest how it could be improved.
- How should judgment play a role in forecasting? If so, at what stage?
- Despite the growing popularity of the Bayesian technique in the literature, would you have any reservations with regard to using this technique in modelling?
- Suggestions on model specification.