



***A Small Semi-structural Model for Thailand:***

***Construction and Applications***

**Modelling and Forecasting Team**

**Bank of Thailand**

**17 December 2008**

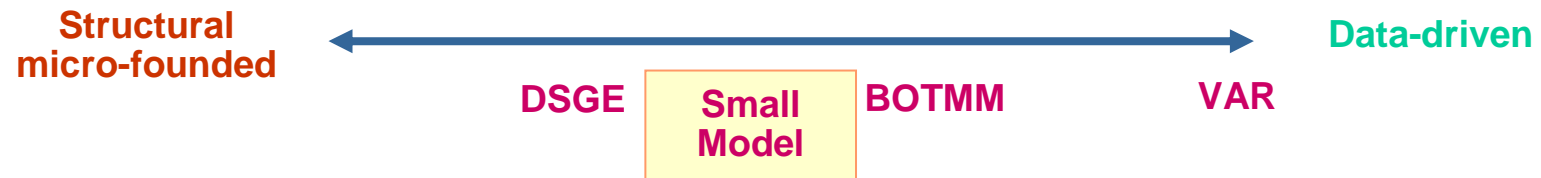
## Outline

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- **Model Structure**
- **Model Properties and Applications**
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  - **Policy analysis**
  - **Forecasting**
- **Conclusion**
- **Issues for discussions**

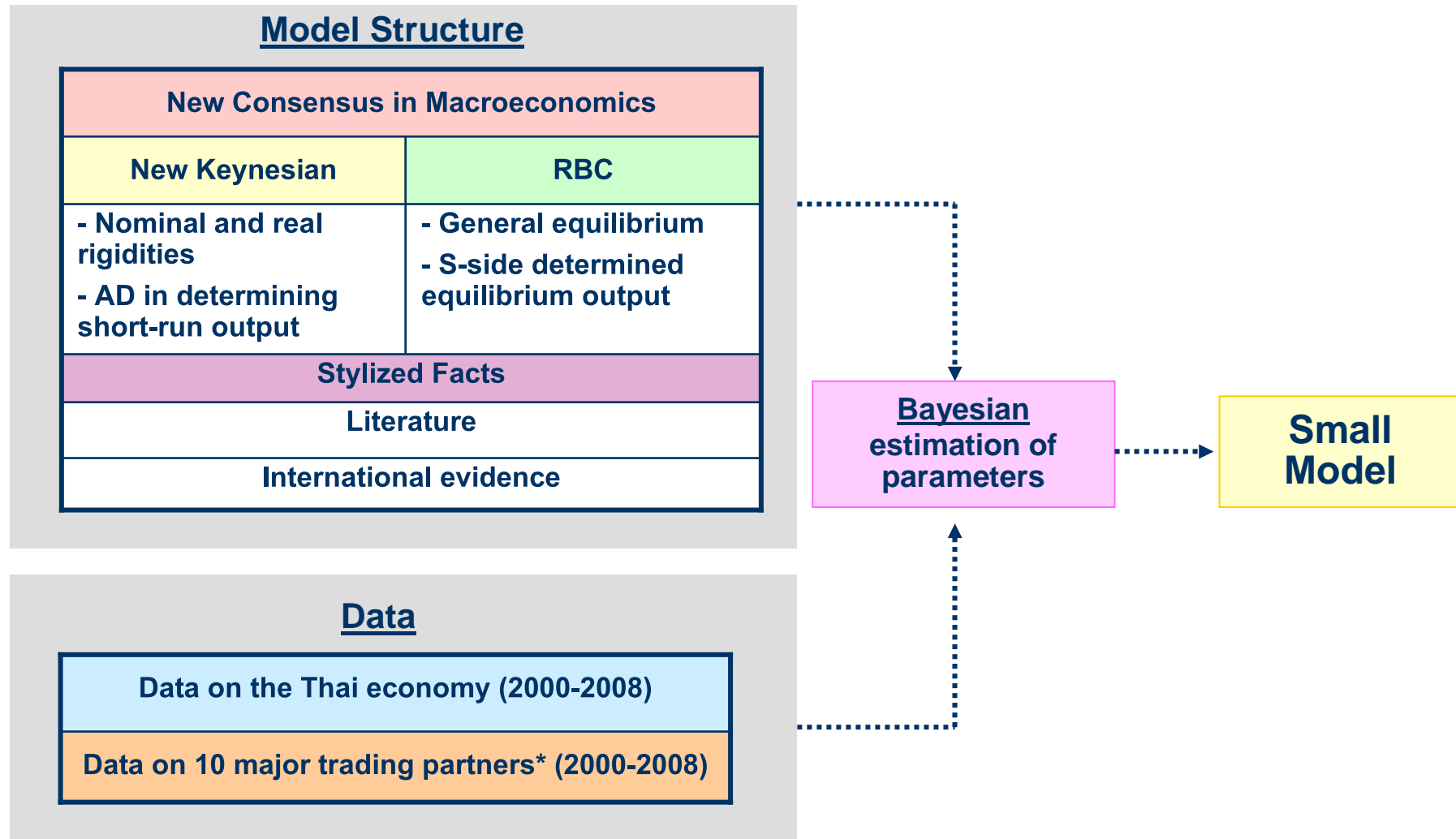
## Motivation

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**



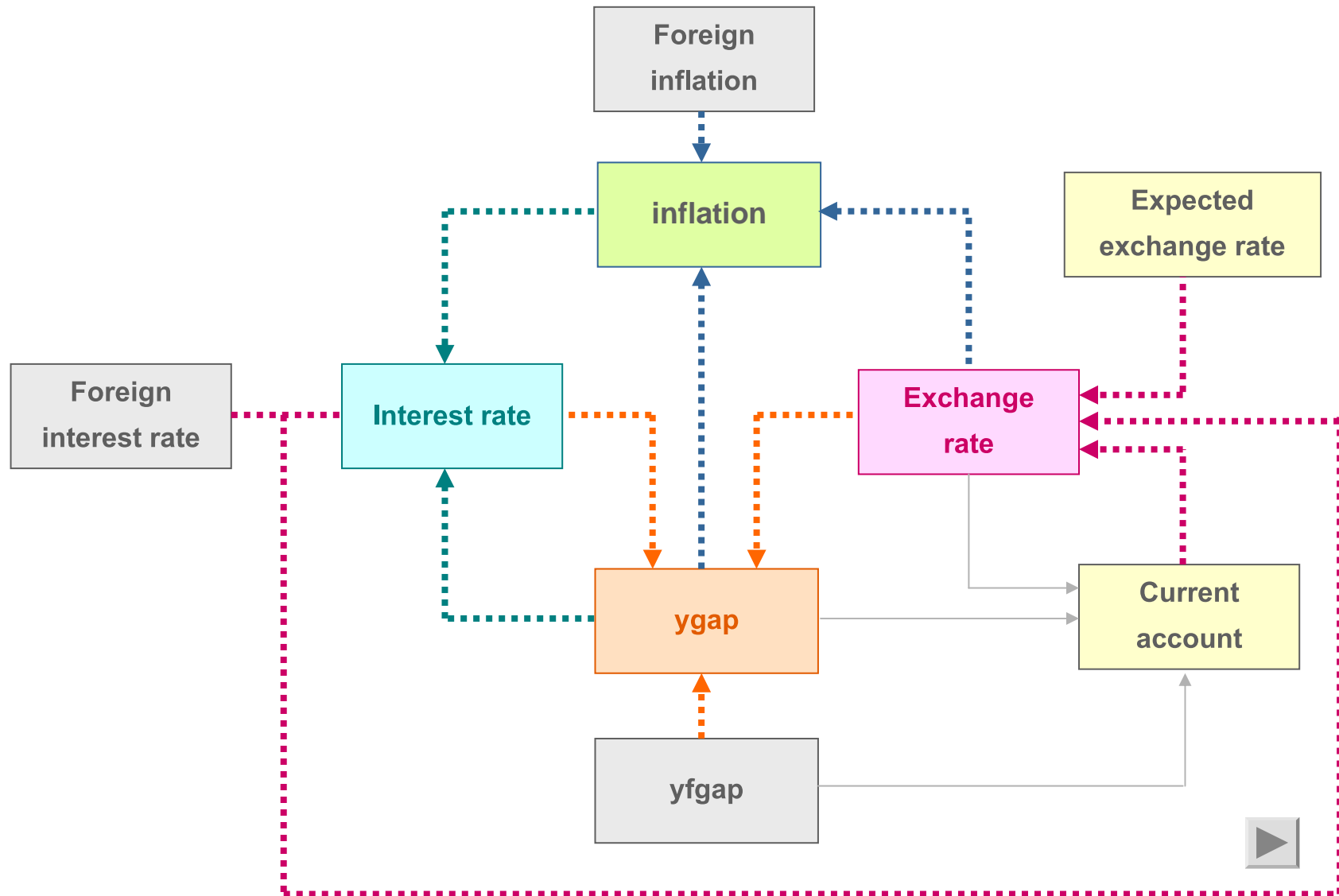
3. Sufficiently **versatile** for a wide range of practical applications
  - **Policy/ shock analyses**
  - **Forecasting**
  - **Constructing fan charts from joint distributions of assumptions**

# Model Construction



\* 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)

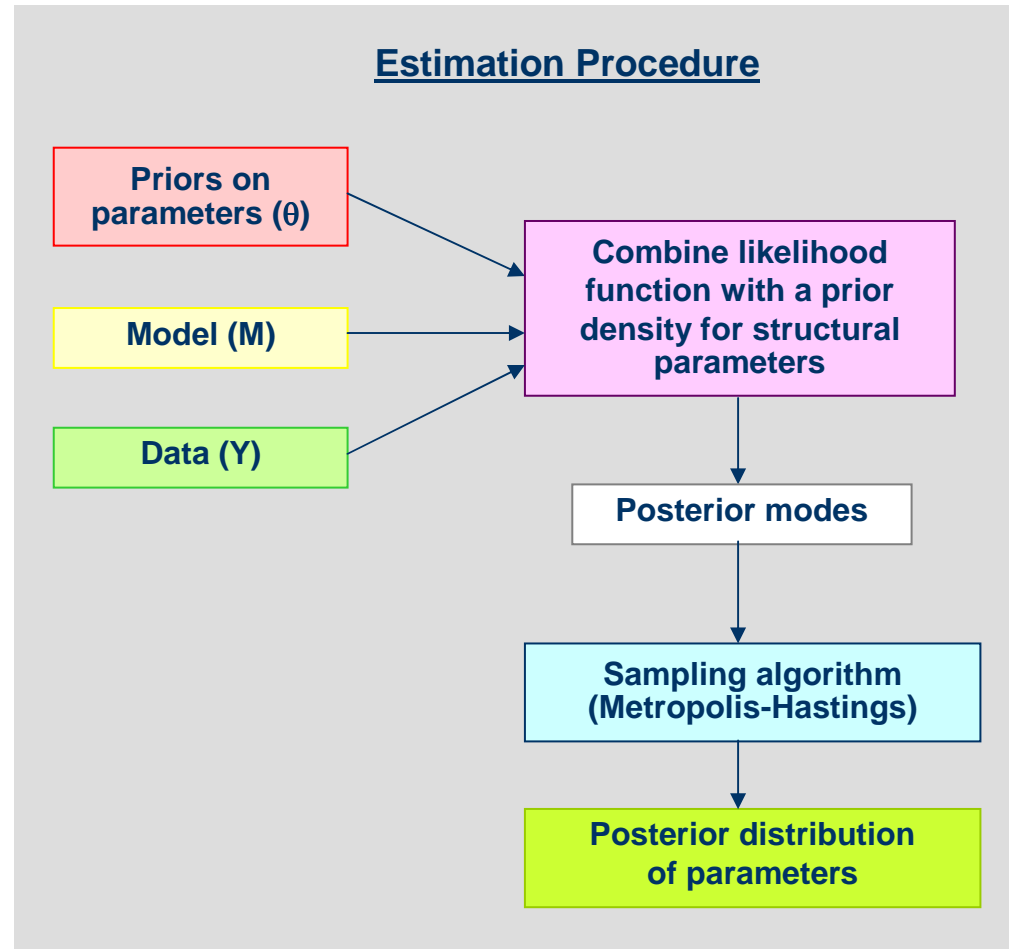
## The Bayes formula

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

## 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

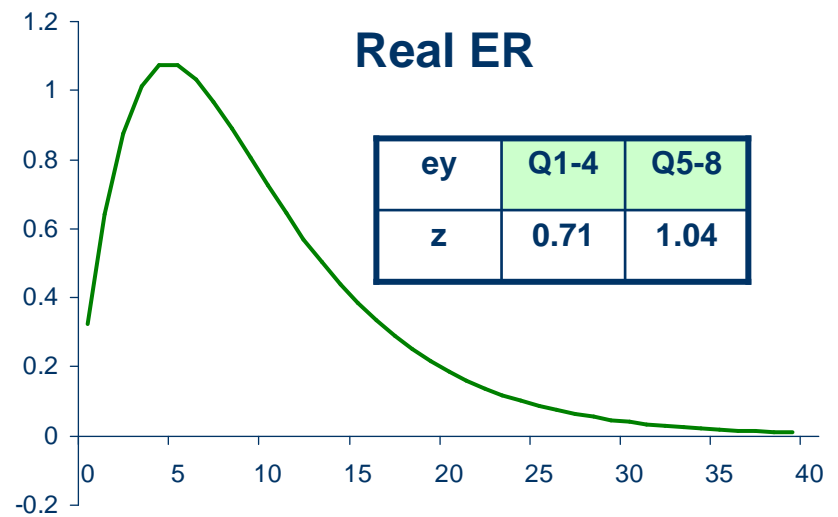
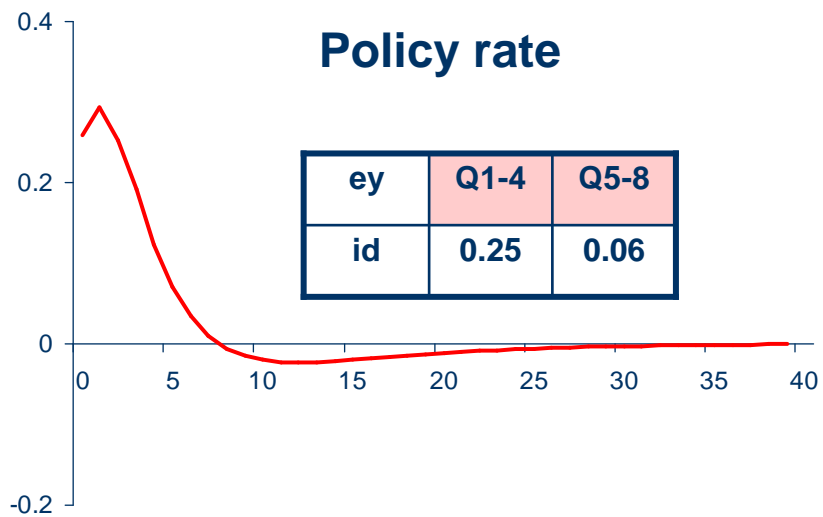
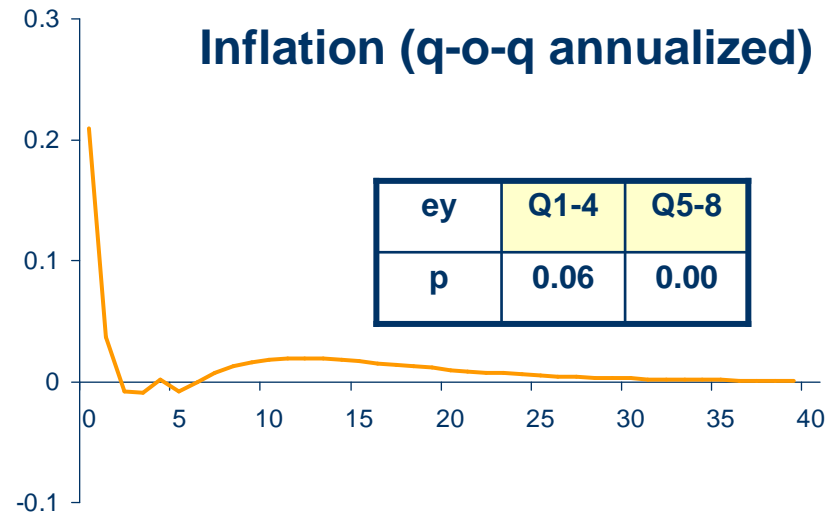
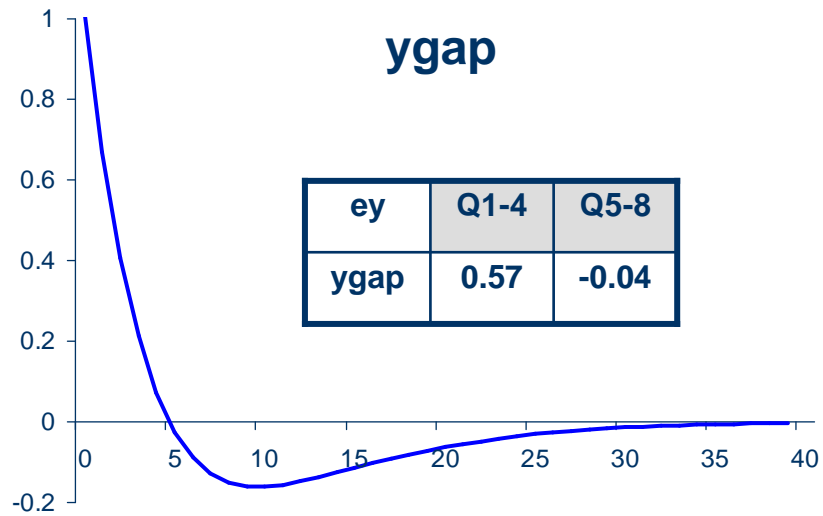


## Model Properties and Applications

- ✓ **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

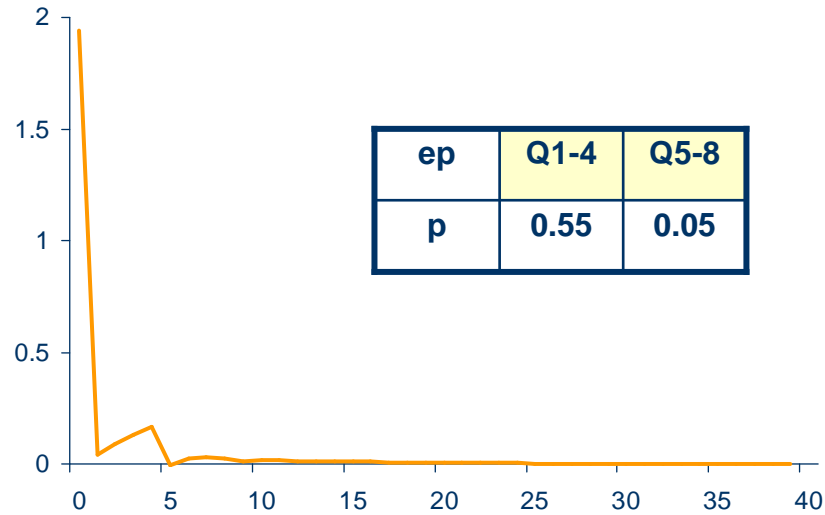
Shock propagation: 1% shock to ygap equation



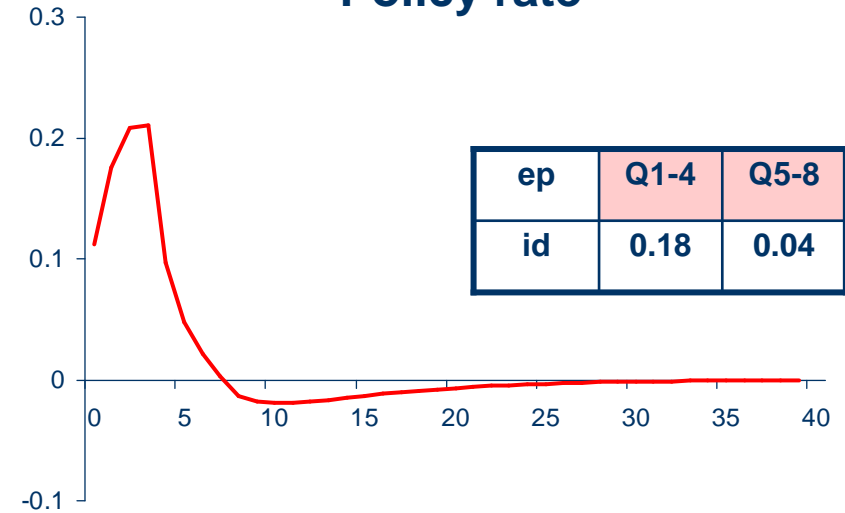
## Model Properties: Simulation

Shock propagation: 1% shock to inflation equation

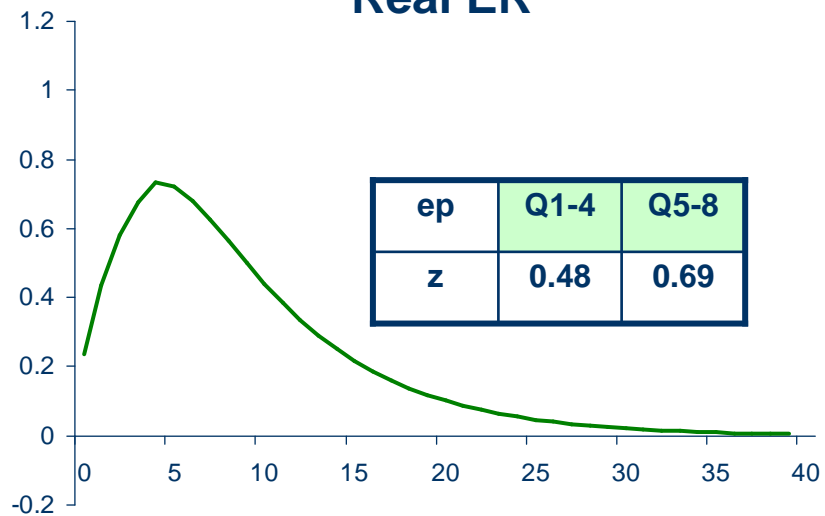
### Inflation (q-o-q annualized)



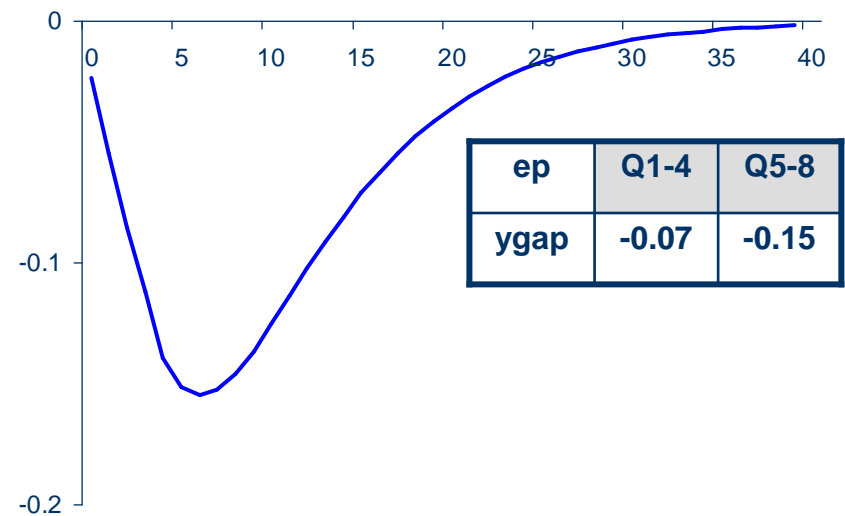
### Policy rate



### Real ER

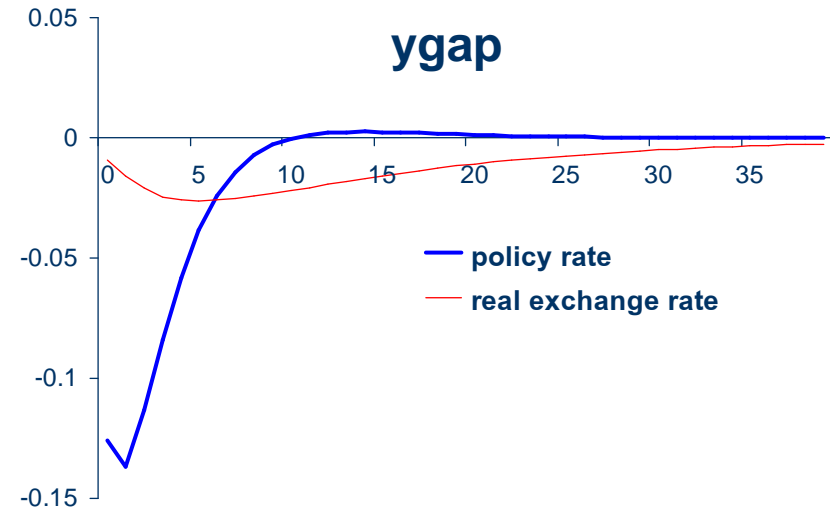
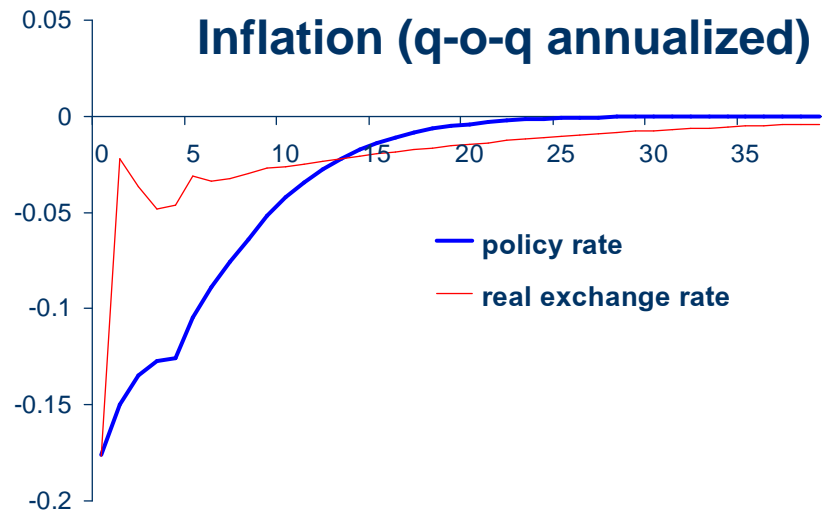


### ygap



## Model Properties: Policy Analysis

### Policy rate and exchange rate

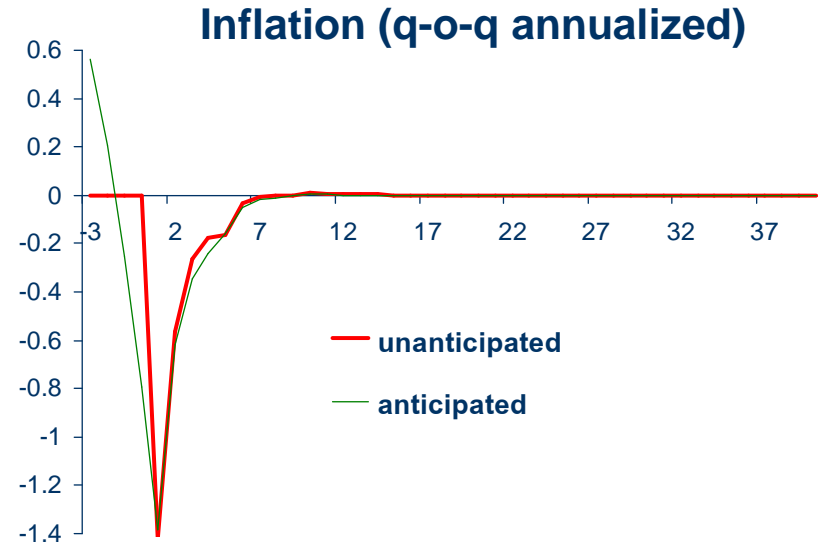
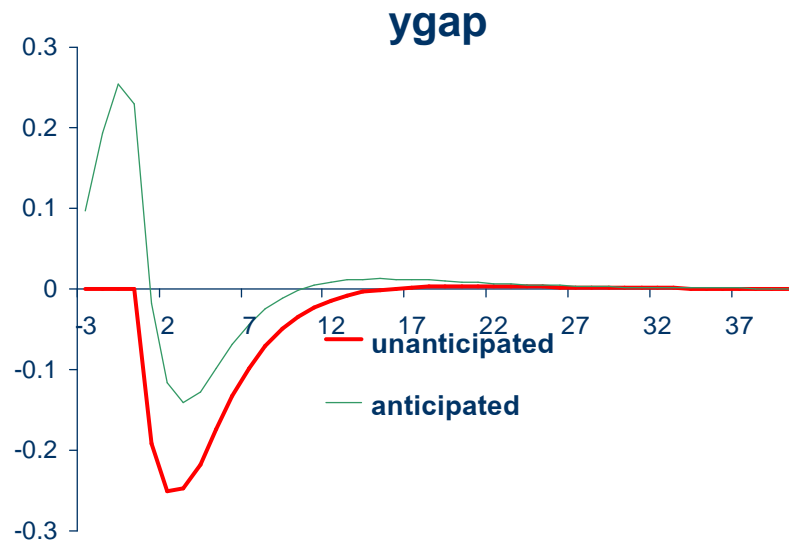


1% increase in	Output gap deviation from steady state (%)		Inflation deviation from steady state (%)	
	Average Q1-Q4	Average Q5-Q8	Average Q1-Q4	Average Q5-Q8
Policy rate*	-0.12	-0.03	-0.15	-0.10
REER**	-0.13	-0.19	-0.52	-0.22

\* Without exchange rate movements \*\* without interest rate movements

## Model Properties: Policy Analysis

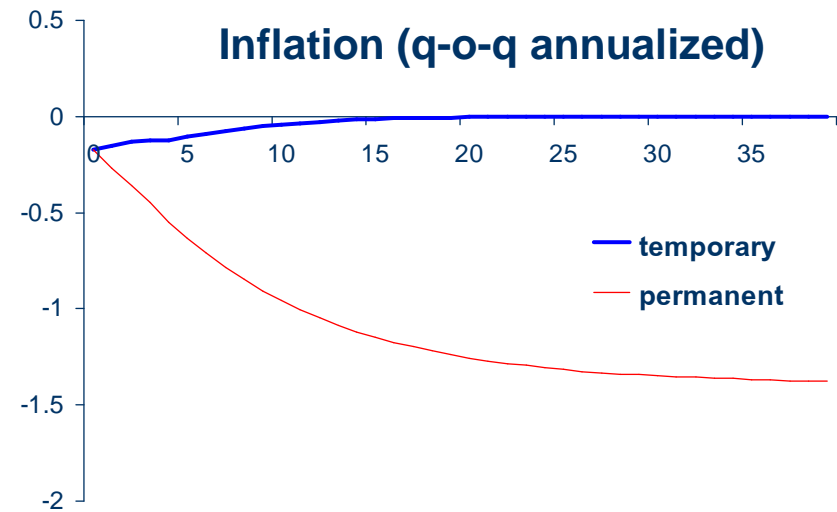
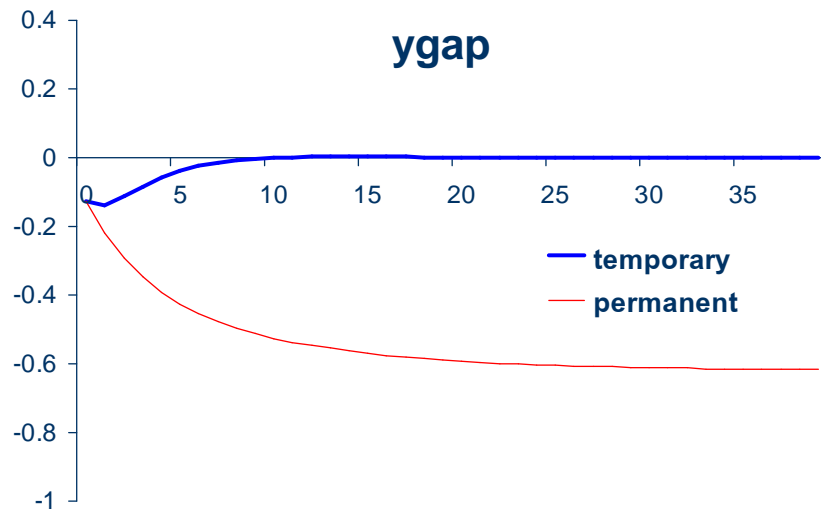
### Anticipated and unanticipated 1% increase in interest rate



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

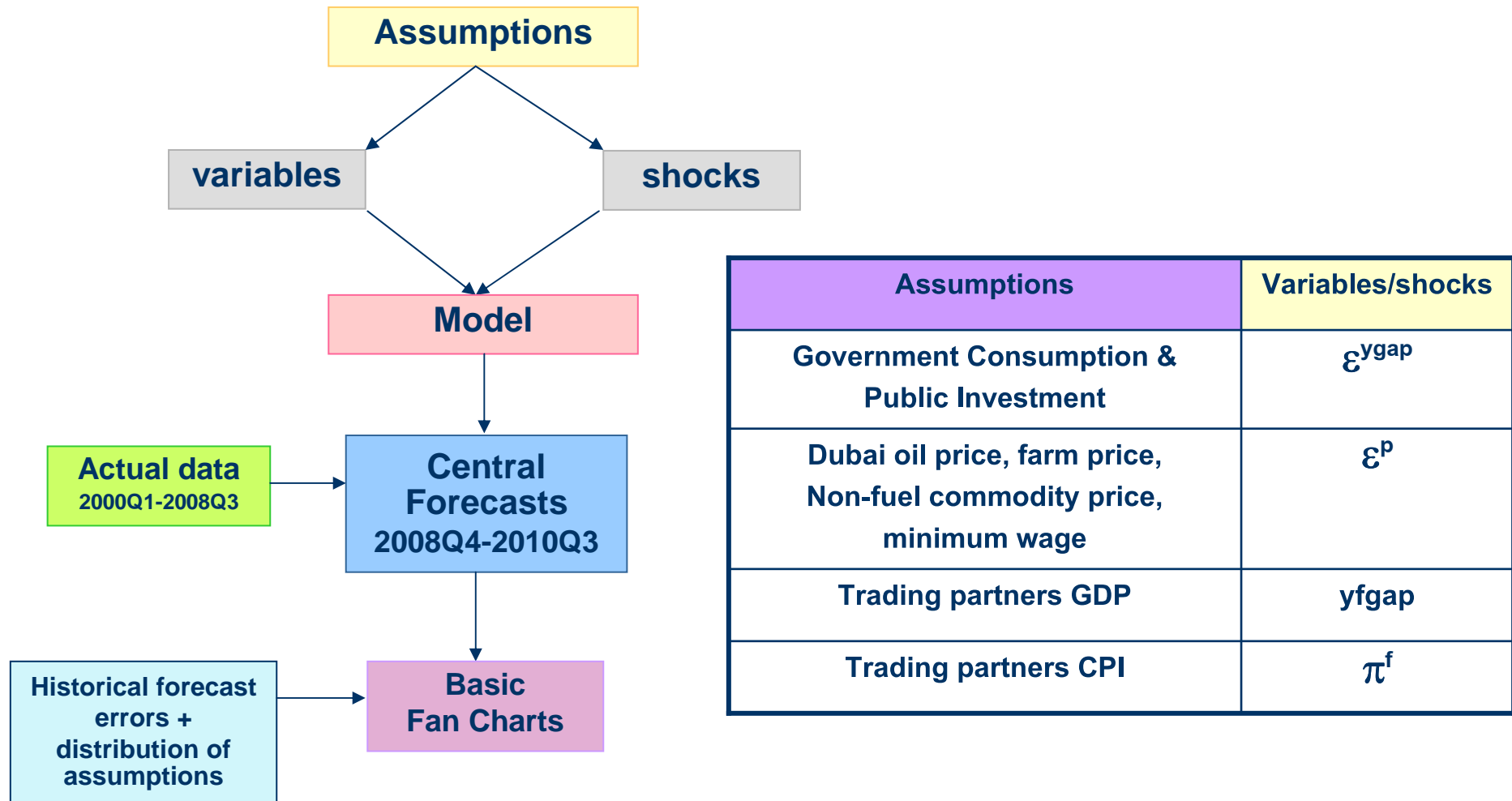
Model Properties: Policy Analysis  
Temporary and prolonged policy rate shocks

Temporary and prolonged policy rate shock of 1%



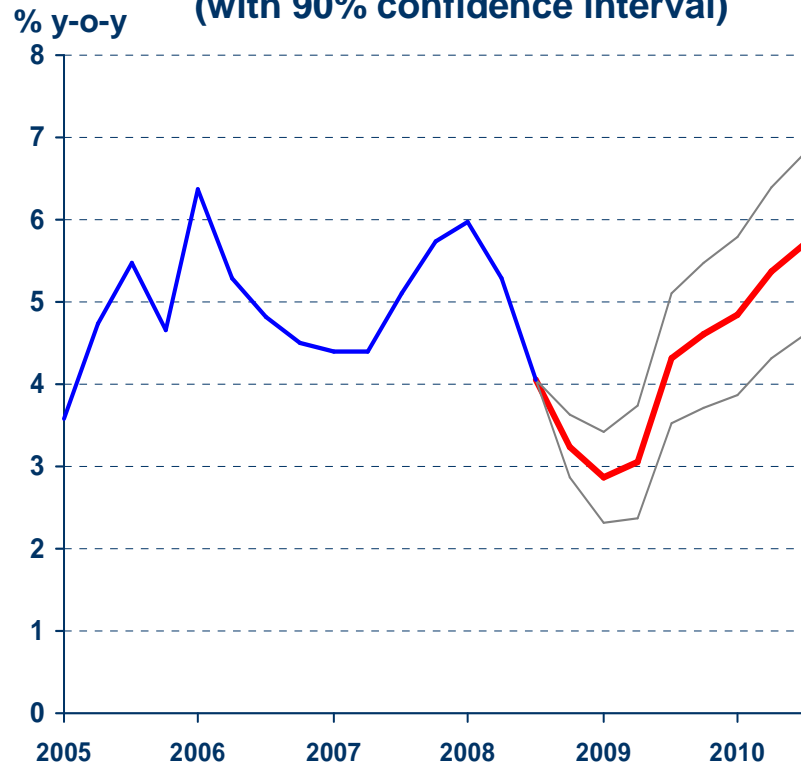
## Model Properties: Forecasting

### Forecasting procedure

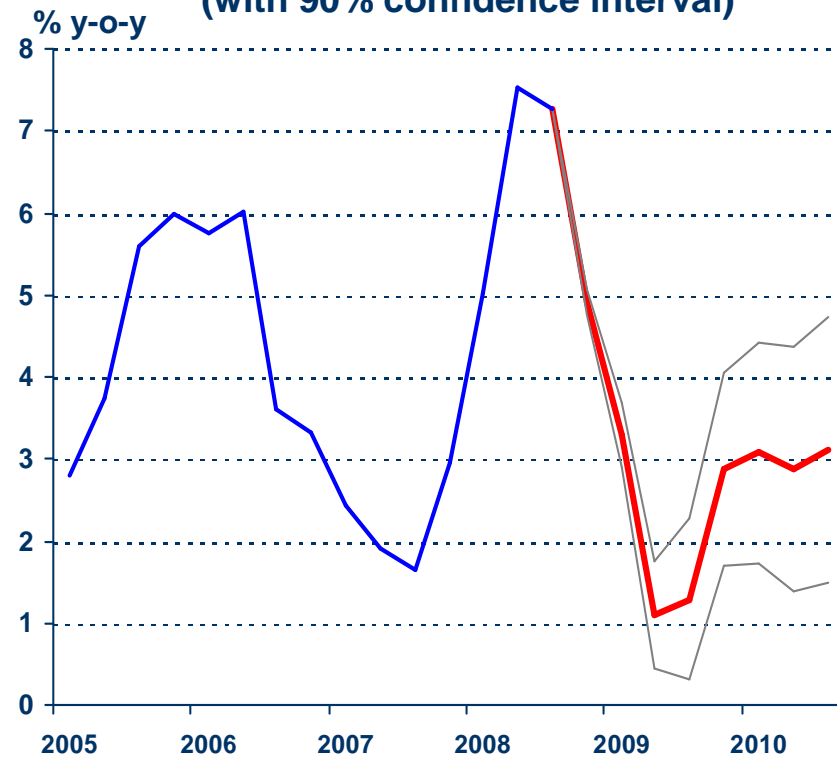


## Model Forecasts without judgments

**GDP growth**  
(with 90% confidence interval)



**Inflation (y-o-y)**  
(with 90% confidence interval)



**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

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- 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**.