Medium–term forecasting model

Jan Vlček
Economic Modeling Division
jan.vlcek@cnb.cz

CZECH CNB NATIONAL BANK

OVERVIEW

- medium term forecast (MTF) and the model
- structure of Quarterly Projection Model (QPM)
- responses to typical shocks

MTF - Role of the model

- designed to describe interaction of key macro-variables over medium term horizon
- provide high level description of forward looking transmission mechanism
- what needs to be done to respect the inflation target
- provide consistency check on judgements and dynamic of medium term scenario
- does not produce forecast - macro models have never been good at forecasting
- it‘s staff projection

MTF - Role of the model

- simulation tool
- provide substantial help on dealing with risks and uncertainty
- organizing and disciplining device
- comfort in communication
- consistency enhance credibility in communication
- research tool
- model is not designed to reproduce economy in literal sense - two types of model - adaptation process- rates and exchange rate endogenous

MTF - Requirements on model

- model has to embody a view on transmission (how monetary policy works, focus debate)
- good forecasting tool in medium term horizon
- MPC must view model as reflecting the world they deal with
- structural approach with economic foundations - two types of model
- open architecture => ability to incorporate (expert) information from outside the model framework
- core model + satellite model tools

MTF - What model needs

What we need for model construction

- idea about transmission
- estimation and calibration
- staff and FPAS
- near term forecast

Structure of QPM

- simple first generation model - key flows
- gap model - study the dynamic properties around equilibrium values
- semi structural model - equations depict behavior of agent in various markets
- no supply side, stocks and assets equilibrium, no stock-flow model
- estimation and calibration driven by overall model properties

Structure of QPM

Why we start with this first generation model:

- insufficient data and experience
- participation and communication
- little experience with FPAS
- the first step on the long way

Structure of QPM

- basic logic:
  - come from model's purpose
  - theory of monetary cycle => gap model
  - two separate blocks
    - block of long run equilibrium trends
    - block of cyclical fluctuations
    - blocks are irreplaceable, they enable us to isolate the key mechanism

Cyclical part of QPM

Requirements for the cyclical block:

- cyclical part should capture characteristics of Czech economy
- IT regime
- forward looking transmission mechanism
- systematic reaction of interest rate to future inflation deviation from target - focus on medium term deviations
- floating exchange rate - endogenous variable

Main cyclical mechanisms in QPM

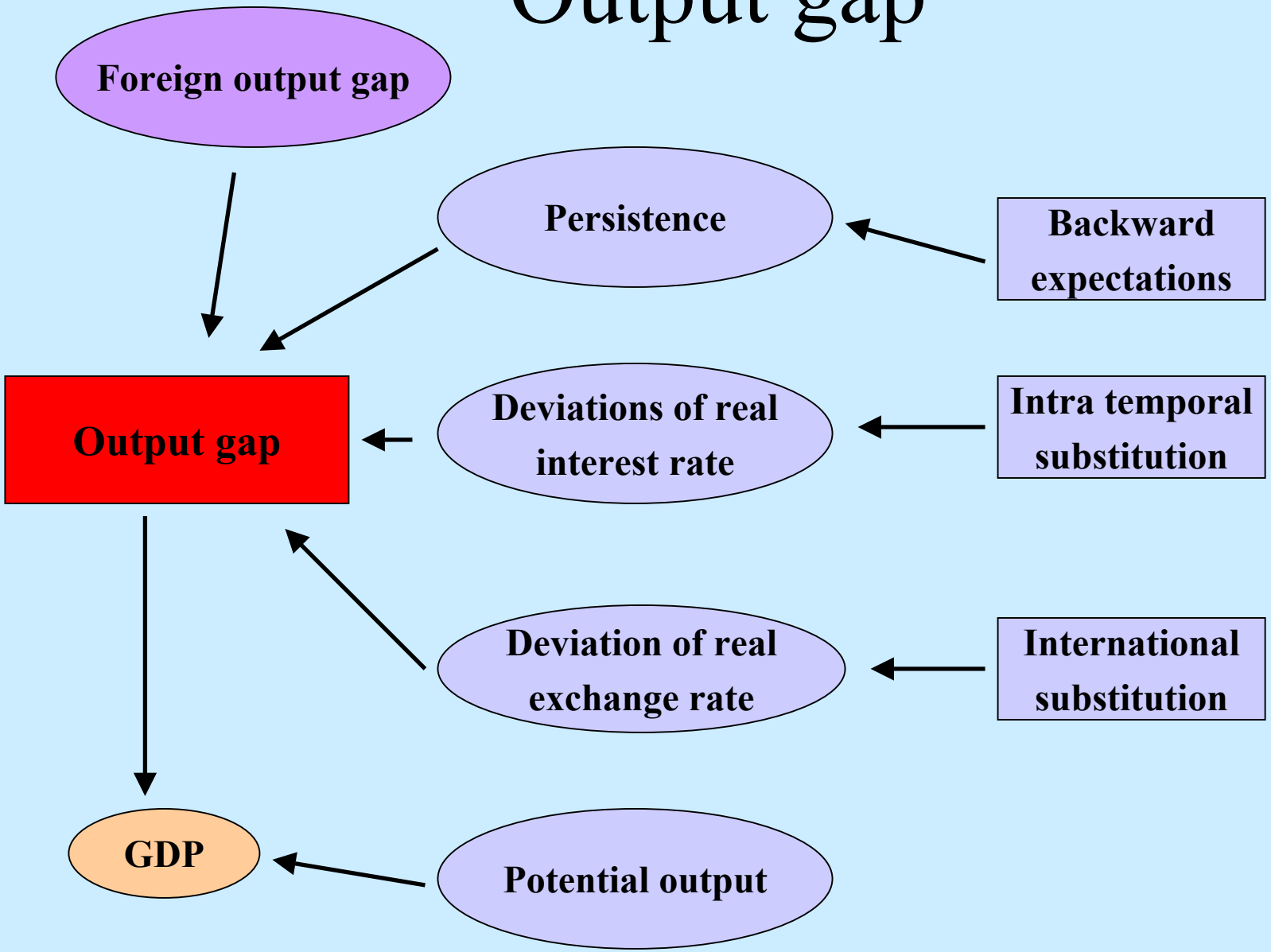
- interaction of supply and demand on markets
- inter and intra temporal substitution
- behavior of agent influenced by expectations with forward looking component
- monetary nature of business cycle:
  - wage stickiness
  - final price stickiness
  - expectation stickiness

Key equations in QPM

Crucial parts of QPM

- aggregate demand
- aggregate supply
- exchange rate equation
- monetary rule

Output gap

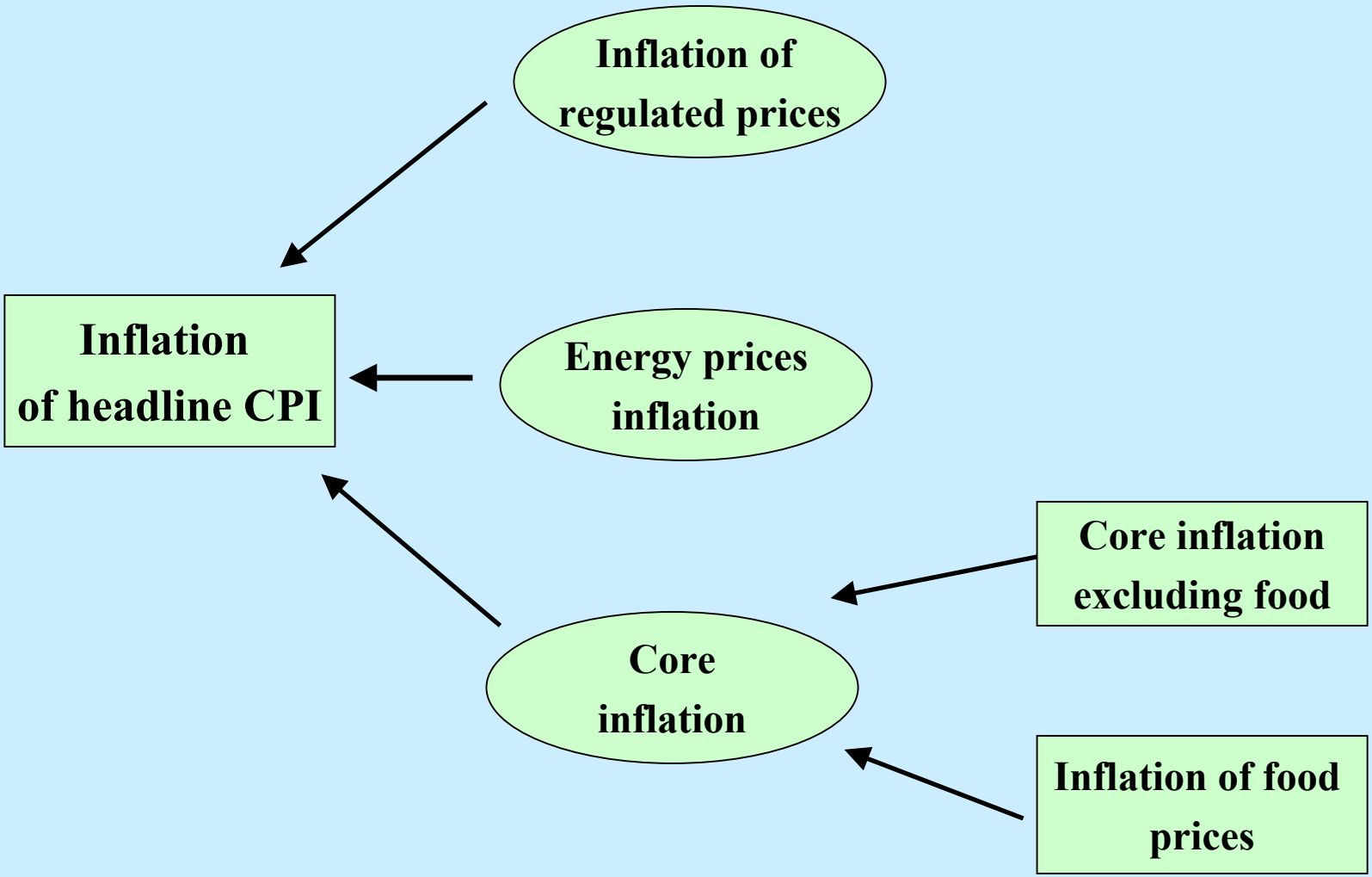

Foreign output gap
Persistence
Backward expectations
Output gap
Deviations of real interest rate
Intra temporal substitution
Deviation of real exchange rate
International substitution
GDP
Potential output

Output gap

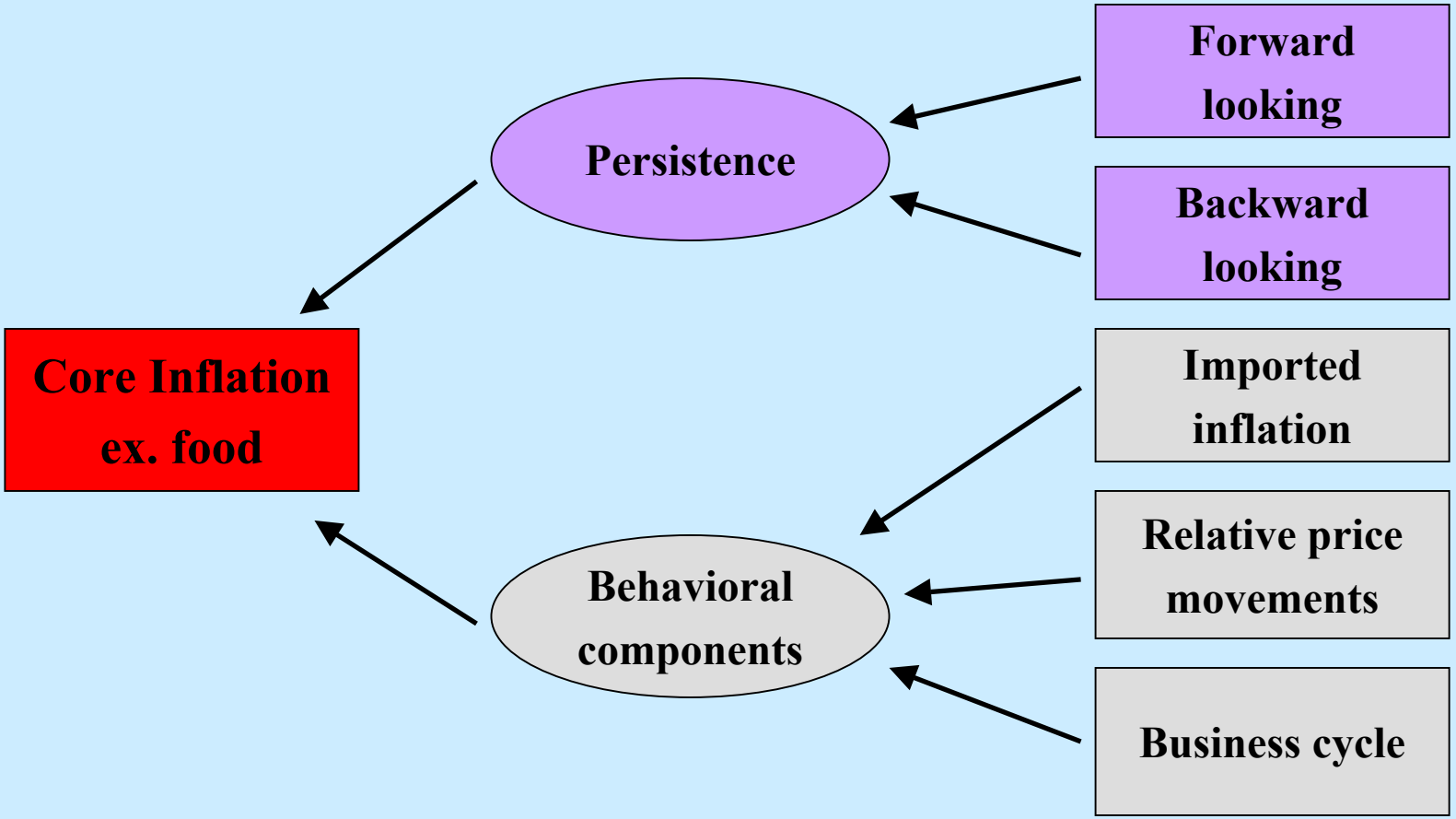
$$y\_gap_t = d_0\, y\_gap_{t-1} - rmci\_gap_{t-1} + d_1 y\_gap_t^* + \varepsilon_t^{y\_gap}$$

$$\text{rmci\_gap}_t = b_1 \left(b_3\, rc\_gap_t + b_4\, \text{rr4\_gap}_t + b_5\, \text{rr4\_gap}_t^* \right) + b_2\, \text{z\_gap}_t$$

Inflation


Inflation of regulated prices
Inflation of headline CPI
Energy prices inflation
Core inflation excluding food
Core inflation
Inflation of food prices

Core inflation ex. food



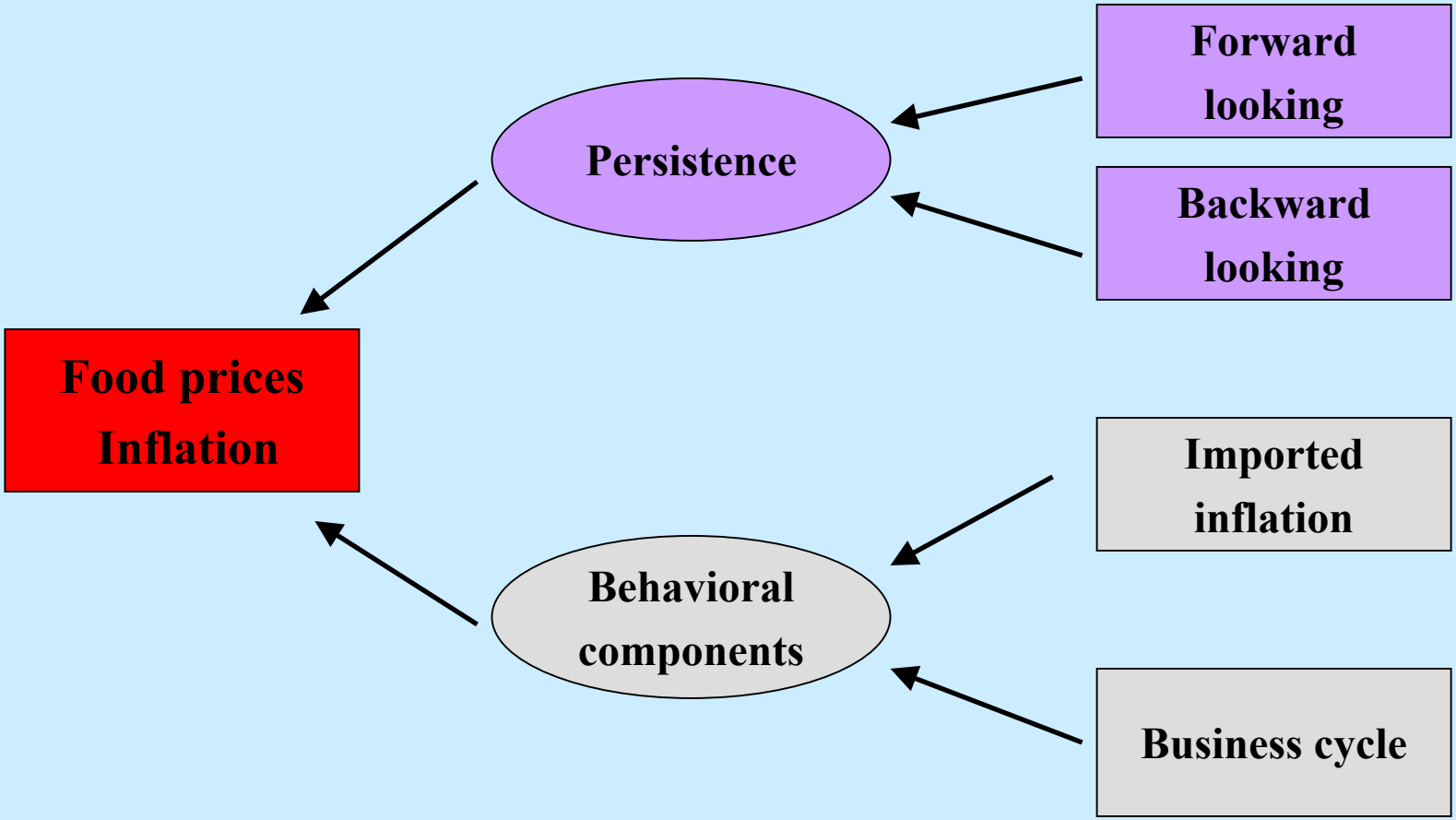
Core inflation ex. food

$$\pi\_xcore_t = a_0\left(\pi_t^M + \Delta z\_eq_t\right) + a_1 E\pi_{t+1} + a_2\,\pi\_xcore_{t-1} + \ldots$$

$$+ a_3\, y\_gap_{t-1} + \varepsilon_t^{\pi\_xcore}$$

$$a_0 + a_1 + a_2 = 1$$

Inflation of food prices



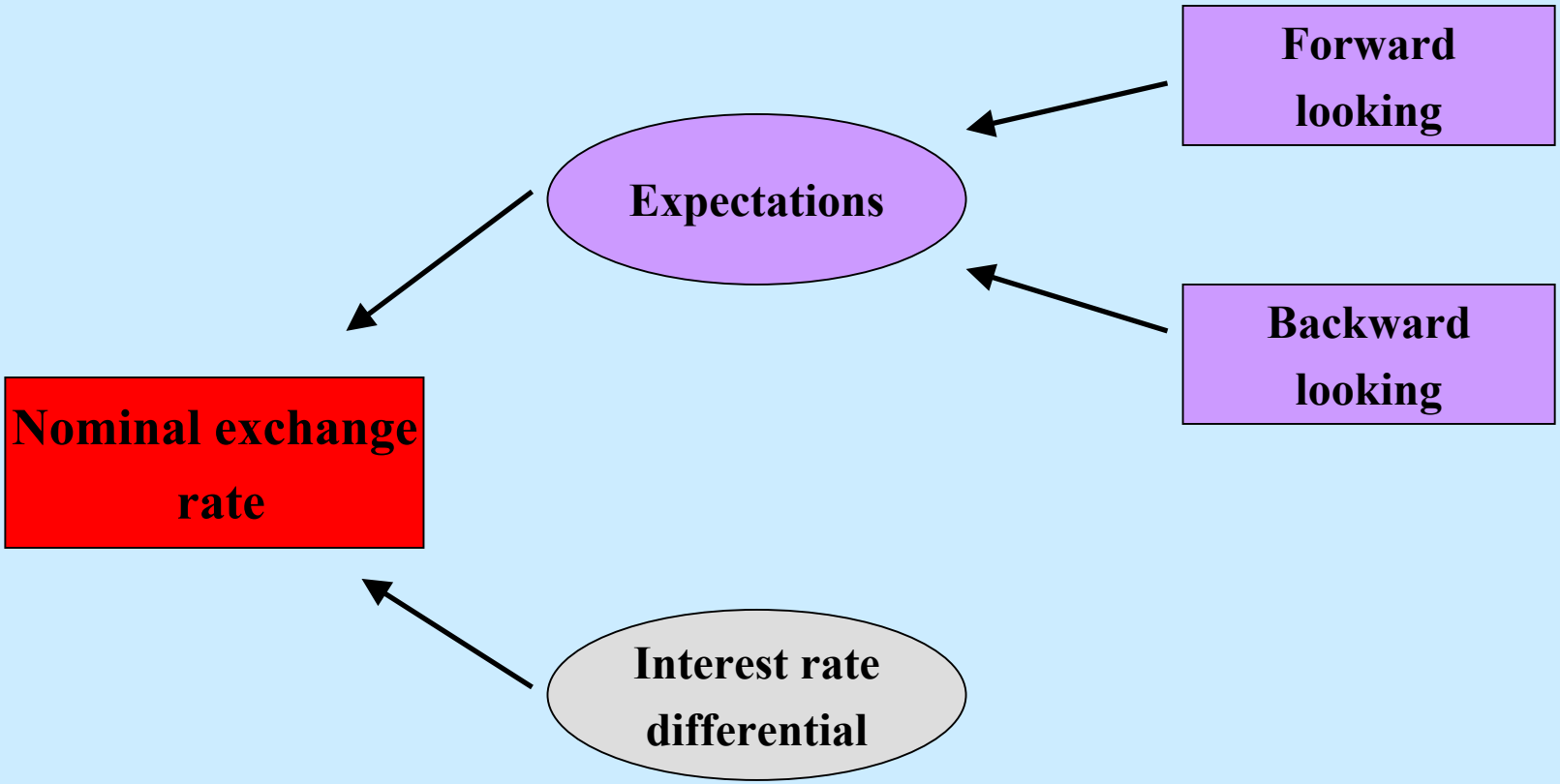
Inflation of food prices

$$\pi\_\text{food}_t = g_0\,\pi_t^{MF} + g_1 E\pi_{t+1} + g_2\,\pi\_\text{food}_{t-1} + \ldots$$
$$+ g_3\, y\_gap_{t-1} + \varepsilon_t^{\pi\_\text{food}}$$

$$g_0 + g_1 + g_2 = 1$$

Nominal exchange rate

Expectational form of UIP

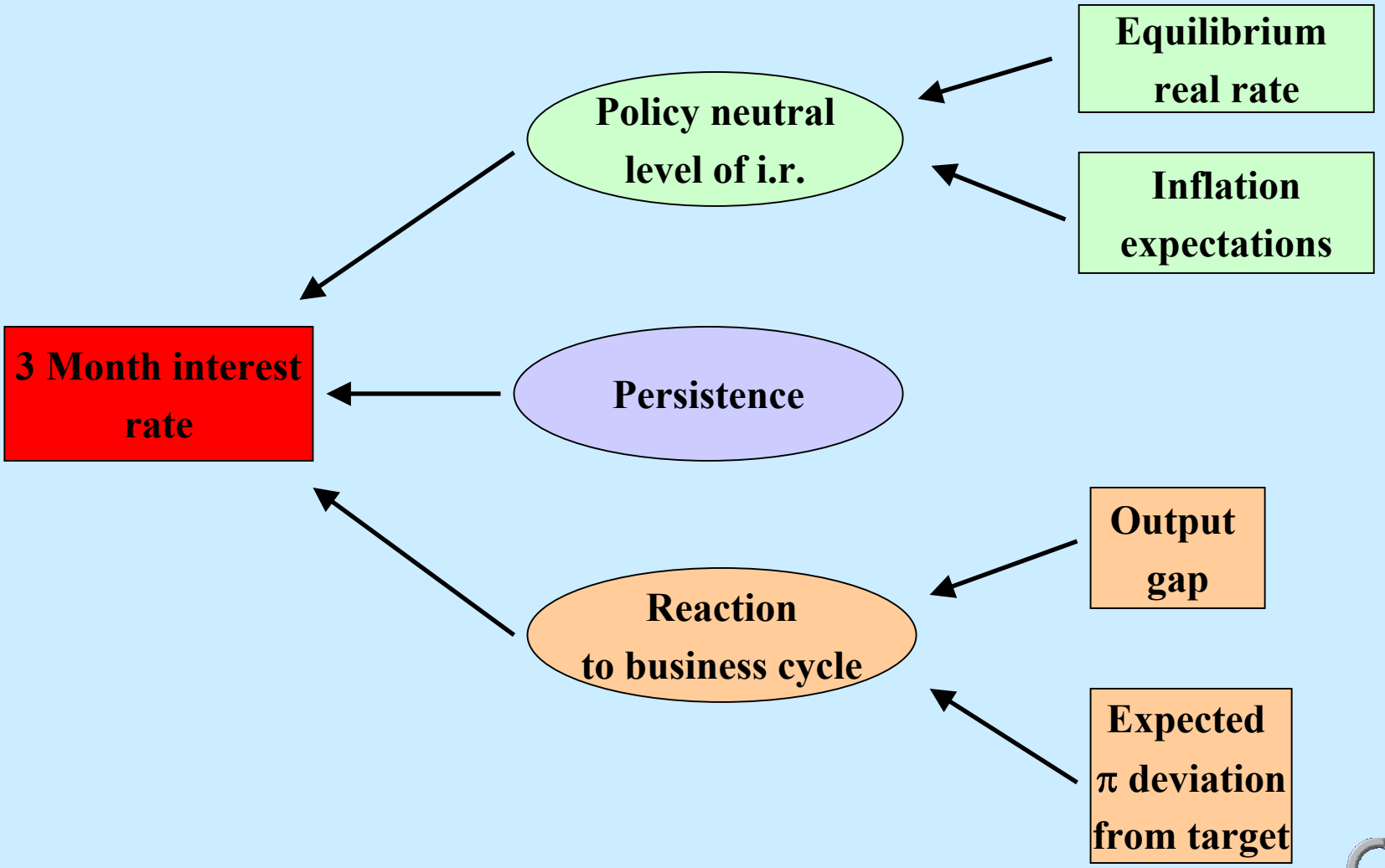


Nominal exchange rate

$$s_t = g_0 s_{t+1} + (1-g_0)\left[s_{t-1} - 2(\pi_{t+1} - \pi^*_{t+1}) + 2\Delta z\_eq_t\right] + \ldots$$

$$+ \frac{i_t}{4} - \frac{i^*_t}{4} - prem_t + \varepsilon^s_t$$

Interest Rate Rule



Interest Rate Rule

$$rs_t = \lambda rs_{t-1} + (1-\lambda)\left[rs\_\mathrm{eq}_t + \Pi_t\right] + \varepsilon_t^i$$

$$\Pi_t = \kappa(E\pi_{t+4} - \pi_{t+4}^{\mathrm{target}}) + \eta y\_gap_t$$

$$rs\_eq_t = rr\_eq_t + \pi_{t+4}$$

Model properties - Calibration versus Estimation

- calibrated model, partially estimated
- problems with estimation
  - short data sample
  - it is not possible to estimate some parameters

- calibration - parameters set on the basis of model properties
  - restriction from economic theory
  - responses on typical shocks

Model properties - Calibration versus Estimation

- adaptive strategy
- econometric estimates - limiting guidance
- parameters come from theory and behavior in responses

Verification

- within sample simulation
- ‘curve fitting’ estimates

Model properties

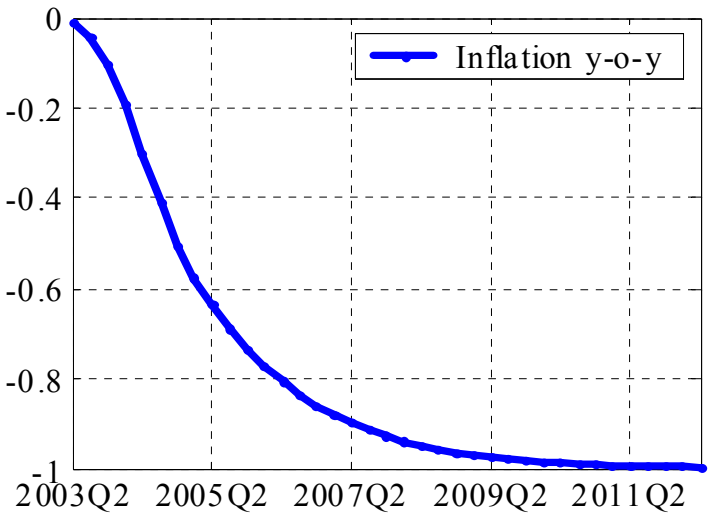
properties given by:

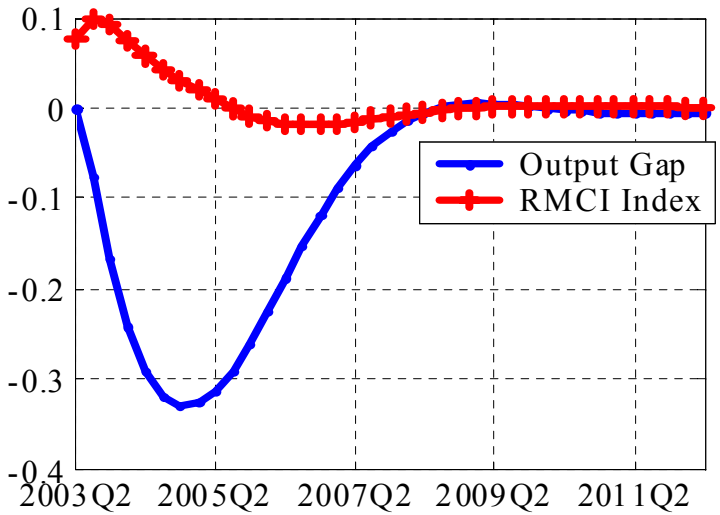
- model structure
- parameters
- reaction function

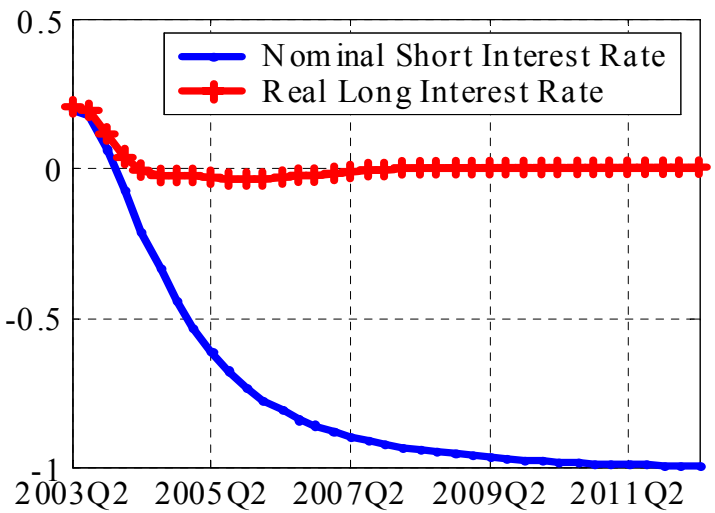
verify model properties:

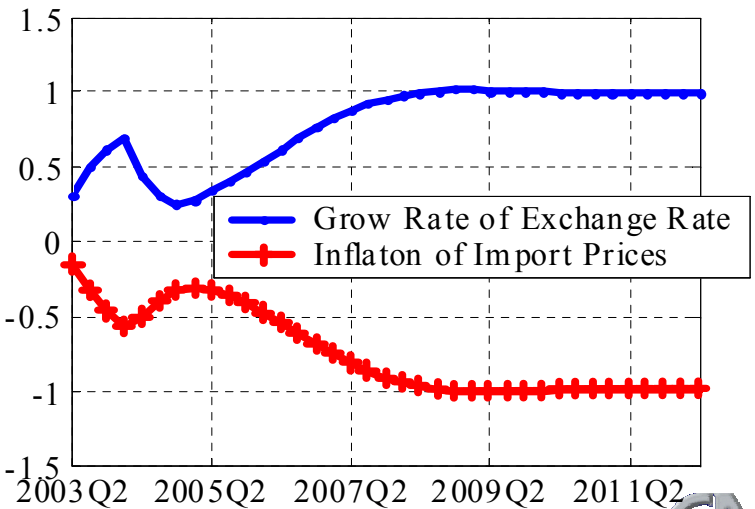
- reaction on all possible shocks
- simulation experiments

Shock I

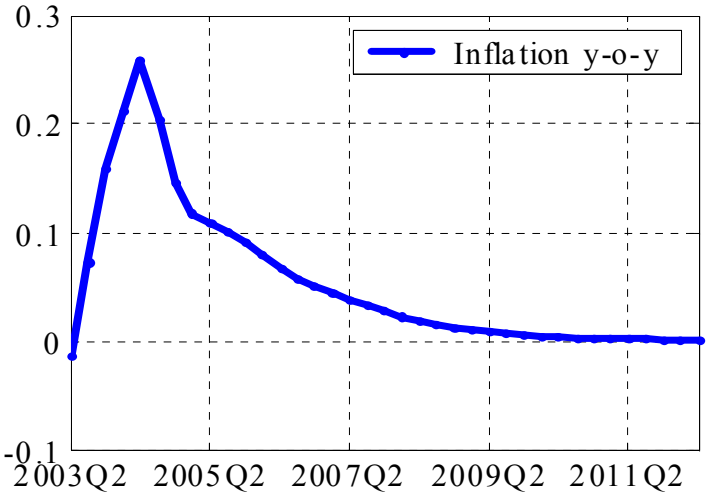

Inflation y-o-y
0
-0.2
-0.4
-0.6
-0.8
-1
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

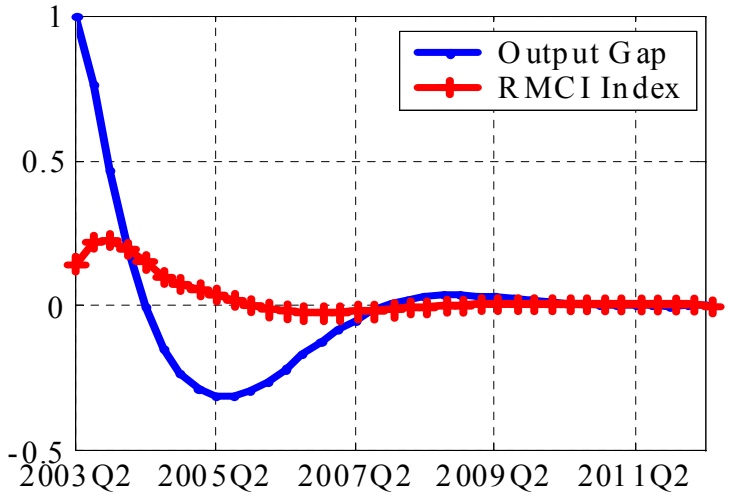

Output Gap
RMCI Index
0.1
0
-0.1
-0.2
-0.3
-0.4
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

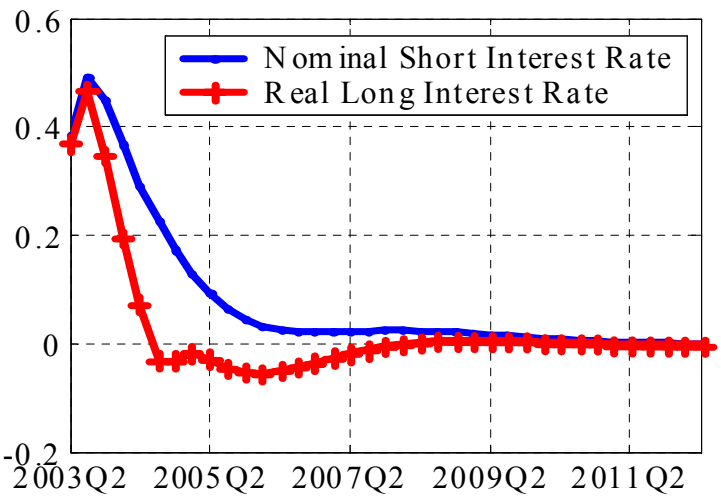

Nominal Short Interest Rate
Real Long Interest Rate
0.5
0
-0.5
-1
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

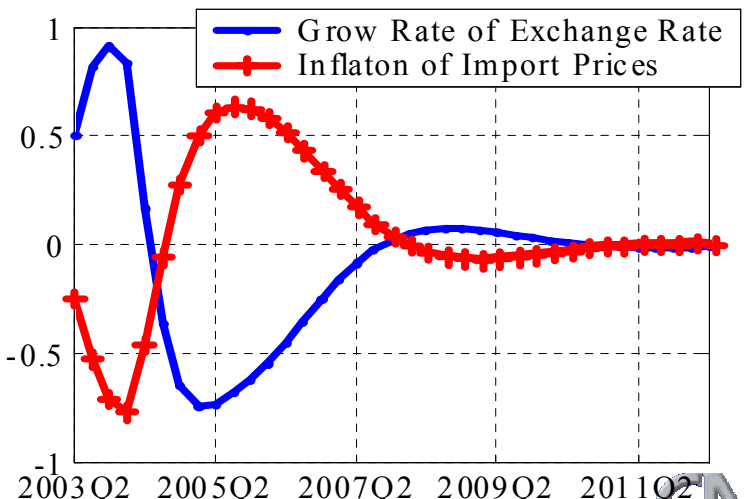

Grow Rate of Exchange Rate
Inflaton of Import Prices
1.5
1
0.5
0
-0.5
-1
-1.5
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

Shock II

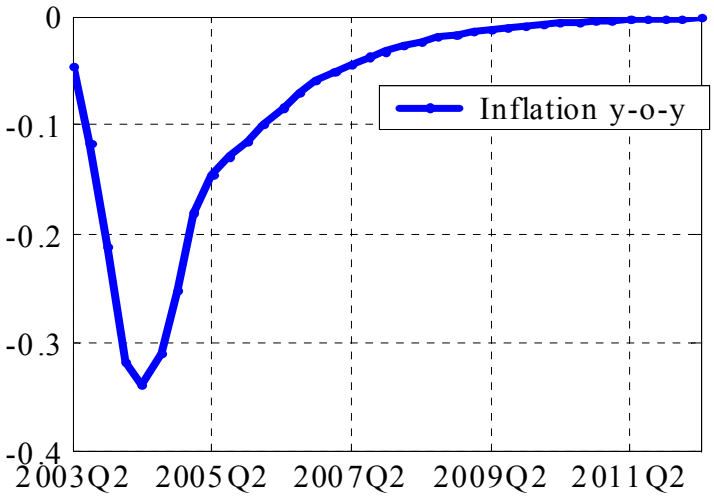

Inflation y-o-y
0.3
0.2
0.1
0
-0.1
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

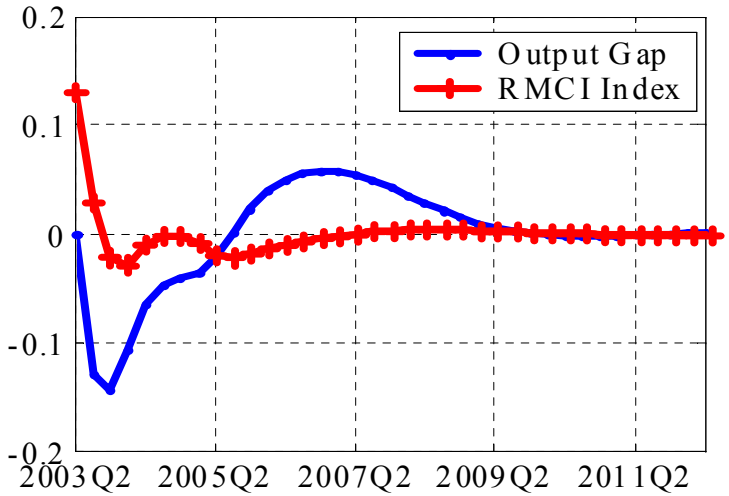

Output Gap
RMCI Index
1
0.5
0
-0.5
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

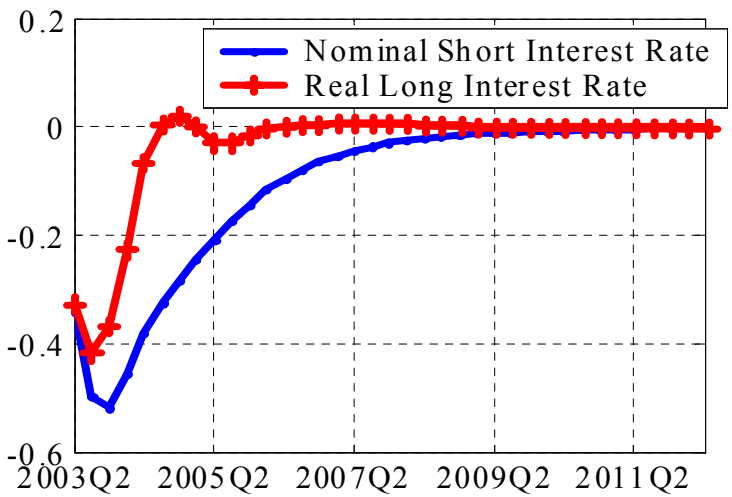

Nominal Short Interest Rate
Real Long Interest Rate
0.6
0.4
0.2
0
-0.2
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

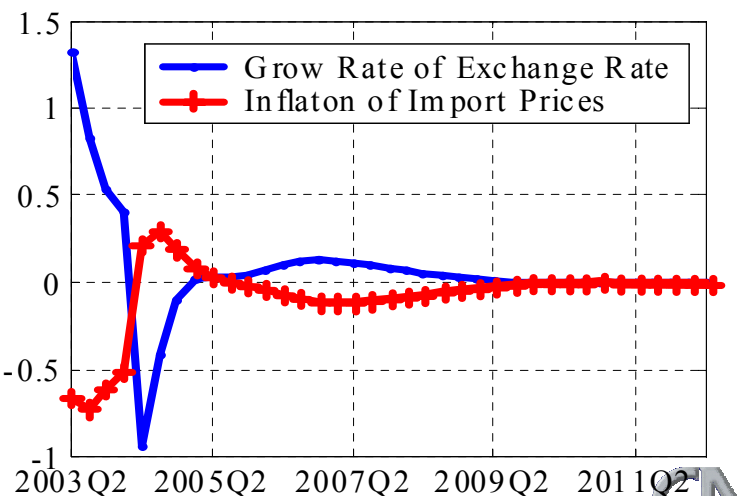

Grow Rate of Exchange Rate
Inflaton of Import Prices
1
0.5
0
-0.5
-1
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

Shock III

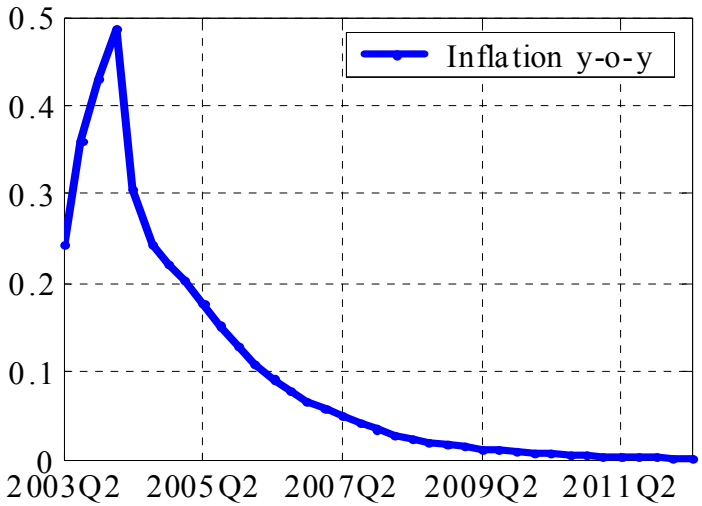

0
-0.1
-0.2
-0.3
-0.4
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2
Inflation y-o-y

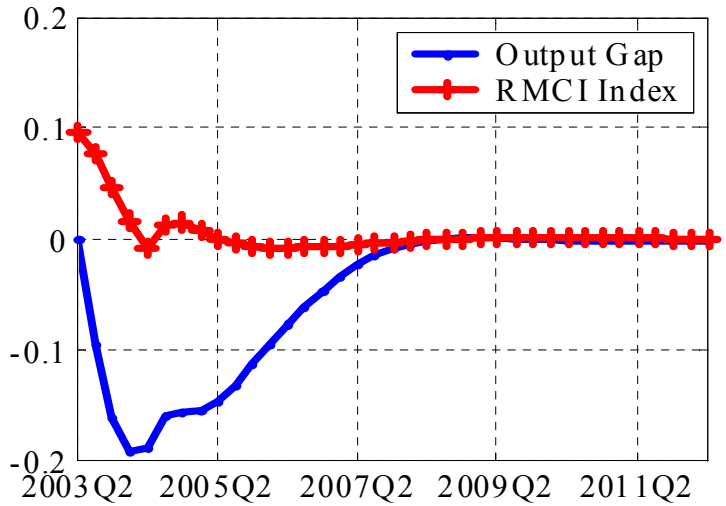

0.2
0.1
0
-0.1
-0.2
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2
Output Gap
RMCI Index

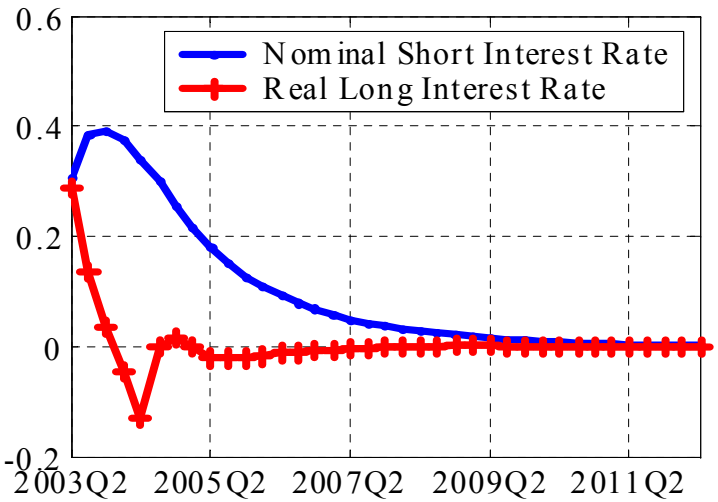

0.2
0
-0.2
-0.4
-0.6
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2
Nominal Short Interest Rate
Real Long Interest Rate

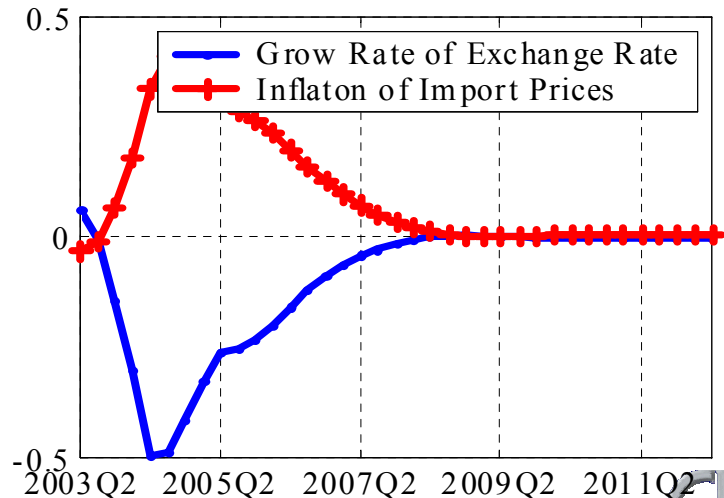

1.5
1
0.5
0
-0.5
-1
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2
Grow Rate of Exchange Rate
Inflaton of Import Prices

Shock IV

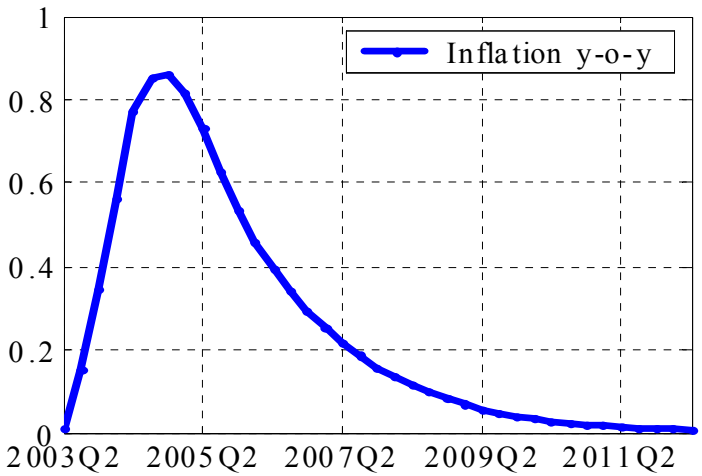

Inflation y-o-y
0.5
0.4
0.3
0.2
0.1
0
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

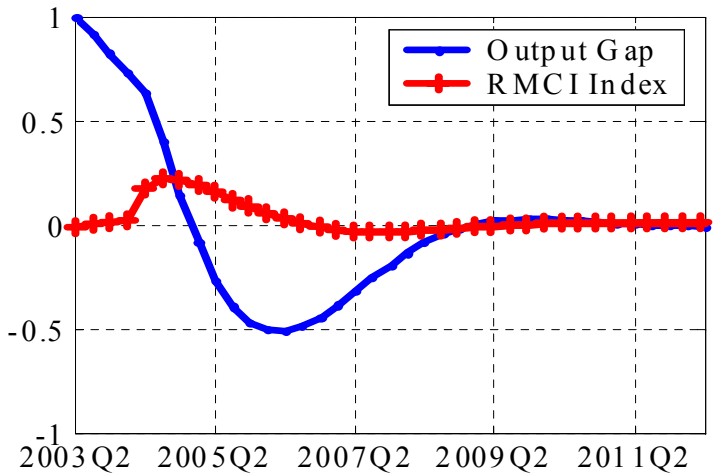

Output Gap
RMCI Index
0.2
0.1
0
-0.1
-0.2
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

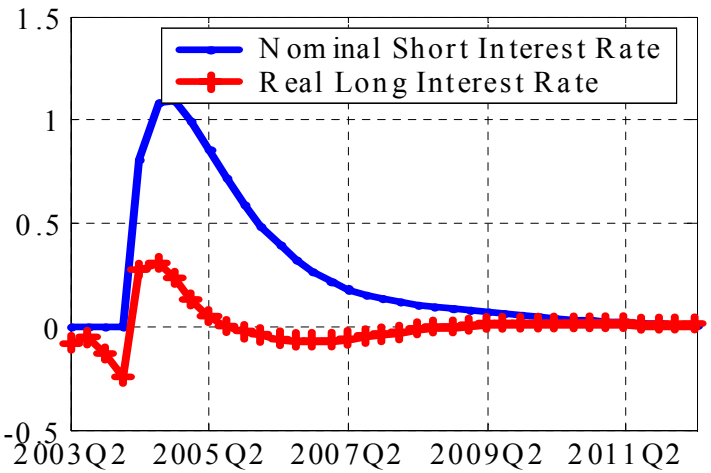

Nominal Short Interest Rate
Real Long Interest Rate
0.6
0.4
0.2
0
-0.2
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

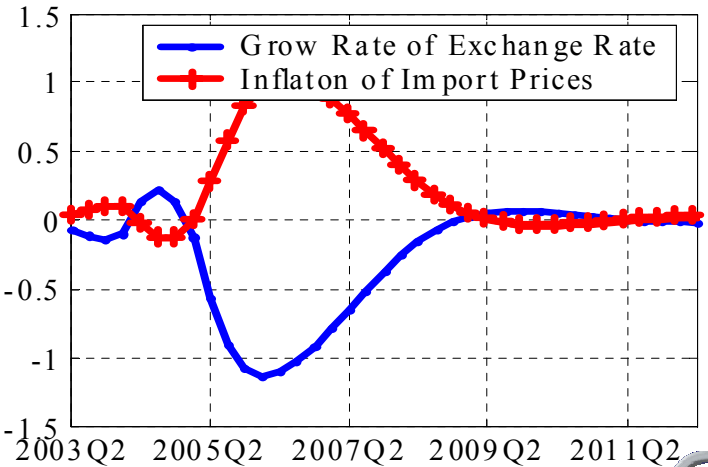

Grow Rate of Exchange Rate
Inflaton of Import Prices
0.5
0
-0.5
2003Q2
2005Q2
2007Q2
2009Q2
2011Q2

Delayed Policy Response

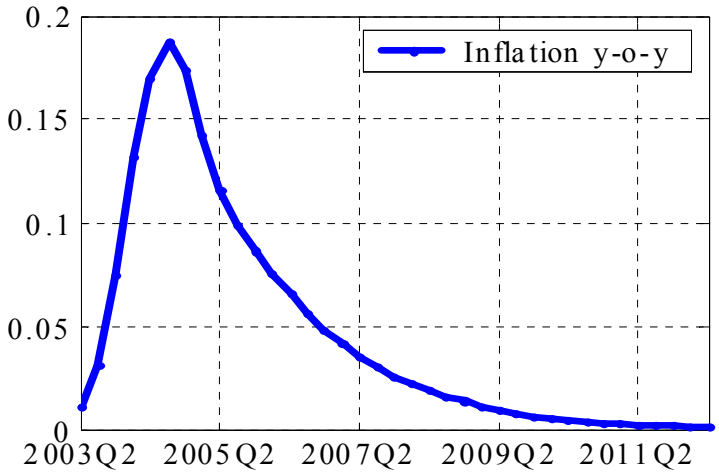


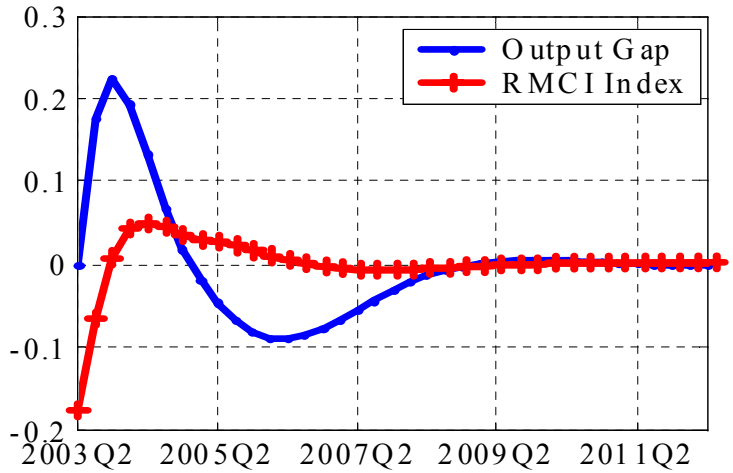


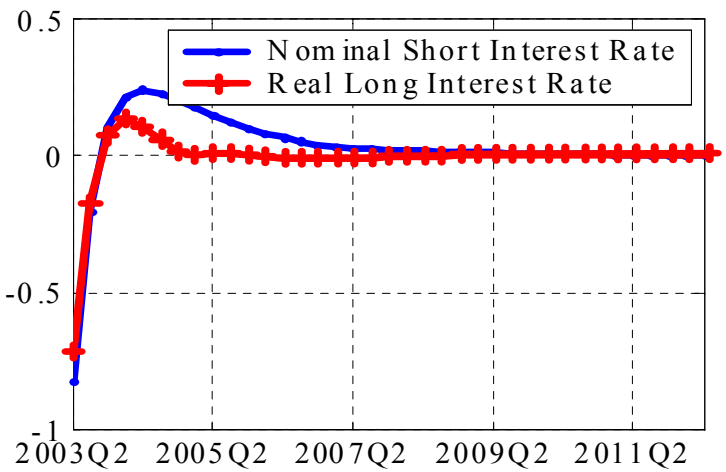


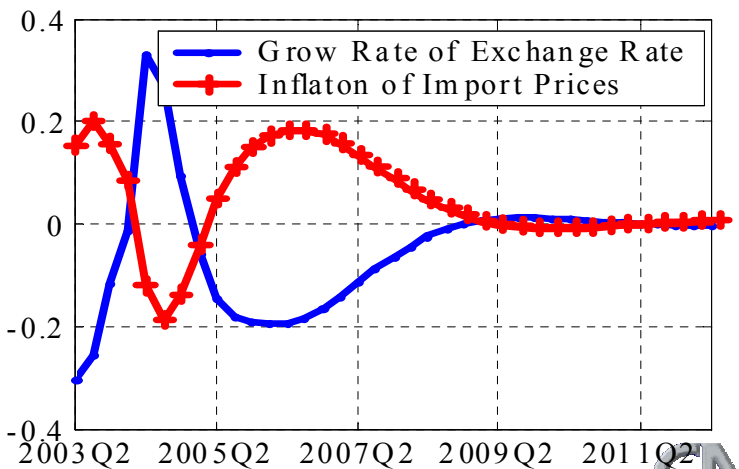


Policy shock









Way ahead - 1st, 2nd and 3rd Model Generation

- First Generation model
  - simple gaps model of transmission
  - emphasize on expectations
  - insight on the role of monetary policy
  - starting point, but with useful insights
- Second Generation model
  - C, I, G, X, Q
  - supply side with stock-flow accounting
- Third Generation model
  - multi sector
  - fully based on dynamic optimization theory

Thank you for your attention