

# NEMO

## Norwegian Economy Model

# NEMO is based on the Framework of IMF's Global Economy Model (GEM)

- We work closely with the original architects
    - IMF Research Department
    - Paolo Pesenti from the Federal Reserve Board of New York.
  - Tight connections to other central banks who develop similar models
    - Sweden
    - Canada
    - England
    - ECB
  - Get help and advice from academia in Norway
    - UiO
    - NTNU
-

“All models are wrong. But some are useful.”

*George Box (1979)*

---

## Mission:

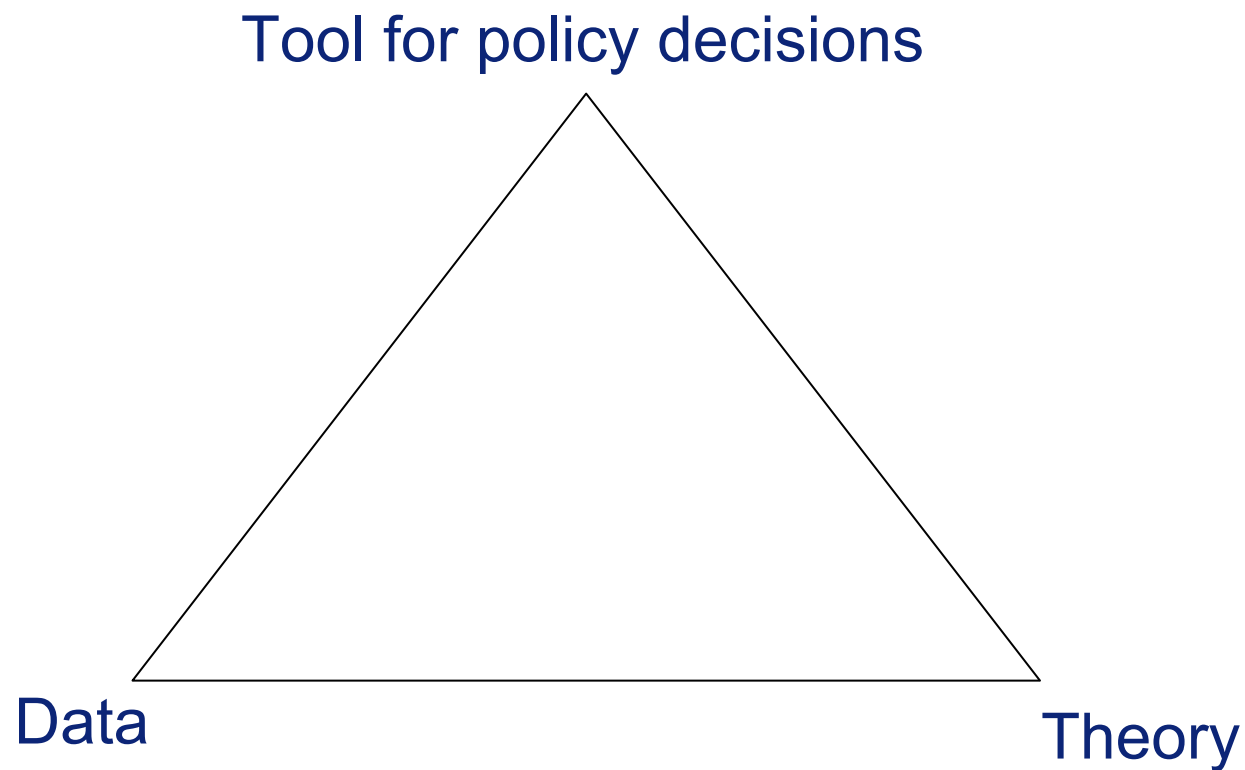
Develop a useful model for our purposes, suitable for;

- forecasts/projections
  - policy analysis and analysis of risk and uncertainty
  - communication
-

# General requirements for a core model

1. The model must represent consensus views
    - No trade-off between inflation and output in the long term
    - Monetary policy affects the real economy in the short to medium term
    - Monetary policy provides a nominal anchor
  2. Expectations must play an explicit role
  3. Mechanisms and disturbances must be economically interpretable in a consistent fashion
-

# Tensions in model building



# Outline

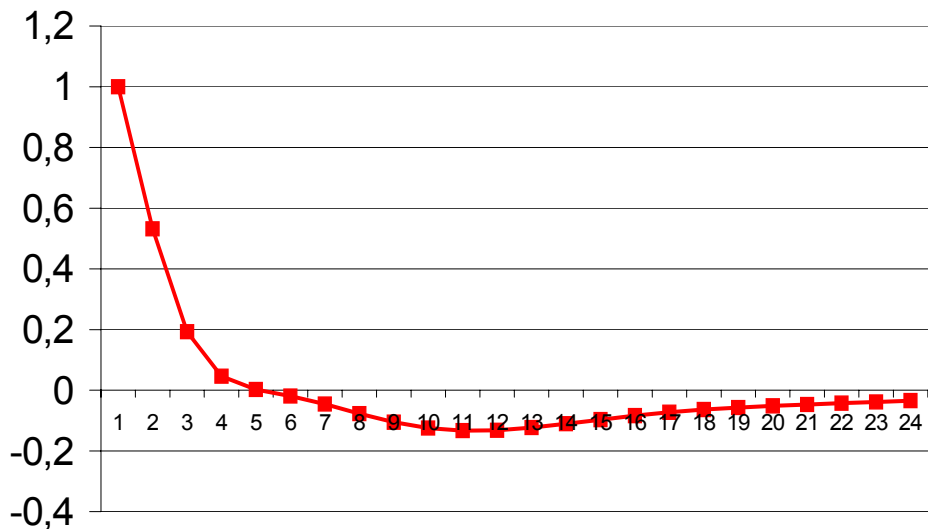
1. Key stylised facts
  2. An introduction to NEMO
  3. Some model experiments
-

# Key stylised facts about the monetary transmission mechanism

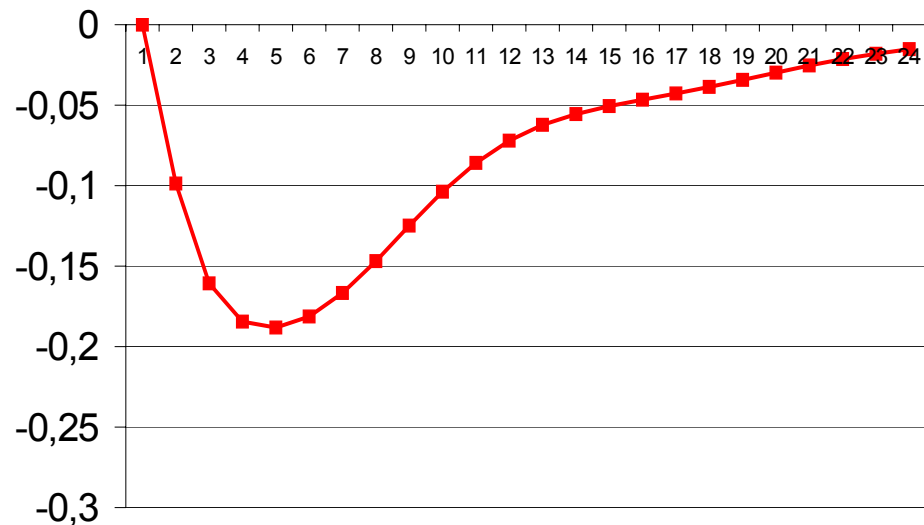
## Effects of a monetary policy tightening

- Demand and output contracts
  - Real wages and inflation falls.
  - 'Hump-shaped' and persistent responses.
  - Inflation lags output
-

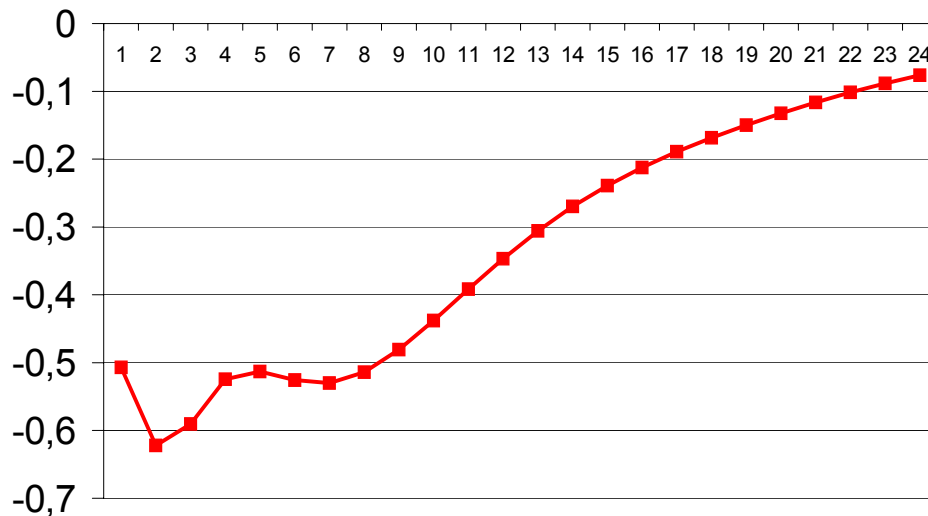
### Interest rate



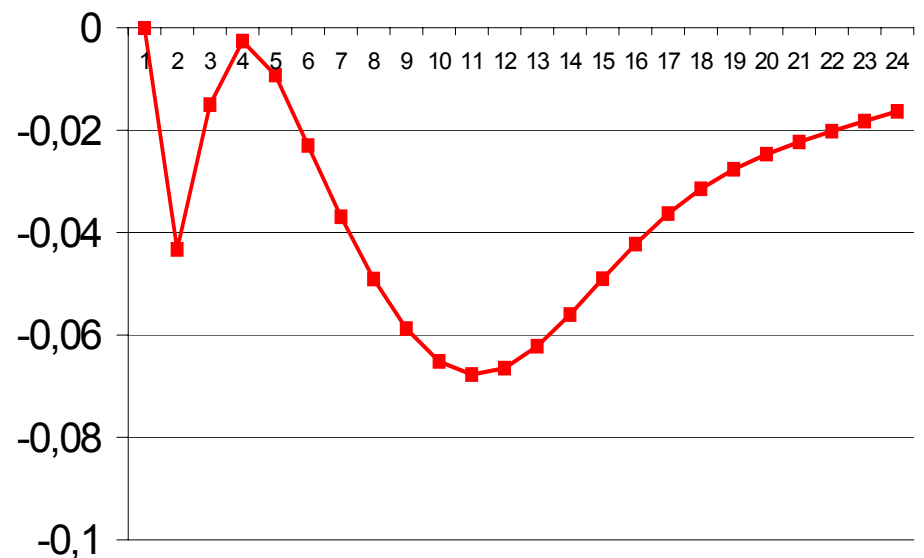
### GDP



### Real exchange rate



### Domestic inflation



# What is NEMO?

- **NEMO is a DSGE-model**
    - **D**ynamic
    - **S**tochastic
    - **G**eneral **E**quilibrium
  - Put simply, a group of equations/relations that describe the macro economy with interlinkages that **must be solved simultaneously**
  - **It is internally consistent**
    - There is a unique steady state equilibrium
    - The dynamics are stable and converge to the steady state
    - Flows (investment, current account balance) build stocks (capital stock, net foreign asset holdings)
-

# What is NEMO?

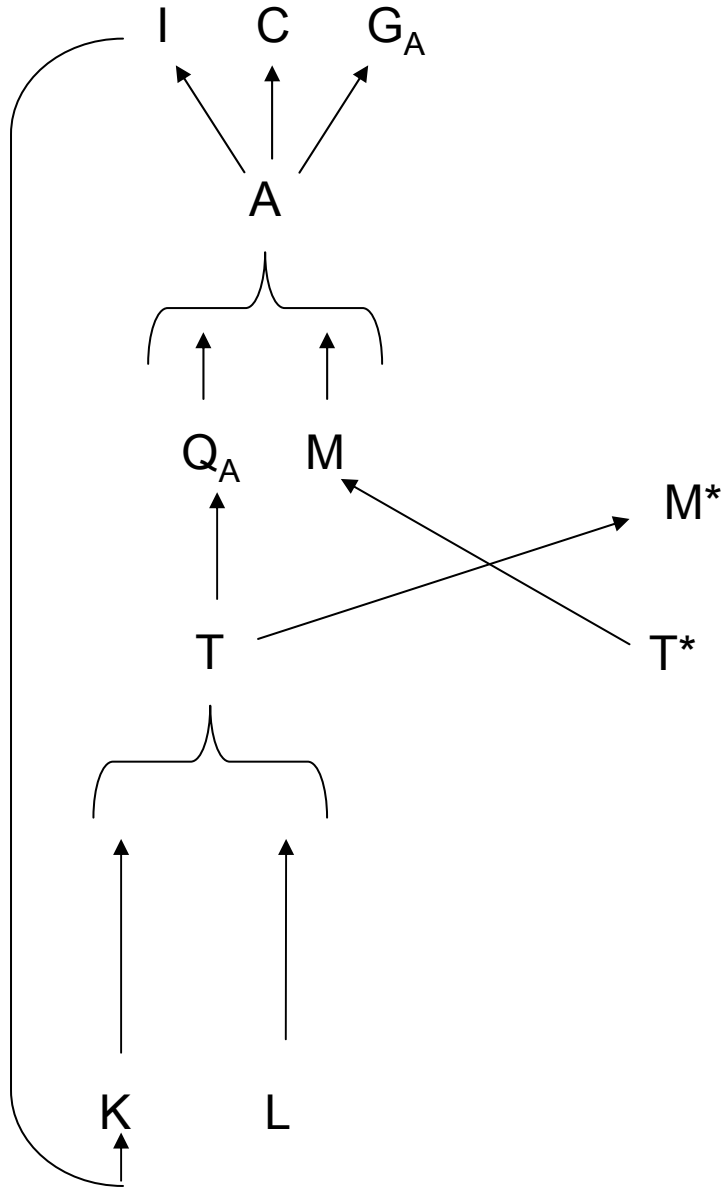
- **The behaviour of different economic agents is modelled explicitly.**
    - Households maximise expected utility
    - Firms maximise expected profits
    - Monetary policy targets inflation using the key interest rate
  - **Nominal rigidities and monopolistic competition**
  - >> **New Neo-classical Synthesis:**
    - Classical long-term properties
    - Keynesian features in the short term
-

# How does NEMO meet our general requirements?

1. NEMO represent consensus views
    - No trade-off between inflation and output in the long term
    - Monetary policy affects the real economy in the short to medium term
    - Monetary policy provides a nominal anchor
  2. Expectations play an explicit role in NEMO
  3. In NEMO, mechanisms and disturbances are economically interpretable in a consistent fashion
-

# Features of NEMO

- Its dynamics are quarterly
  - Consists of two countries - Norway and its Trading Partners
  - Balanced growth
  - One-good model
  - Monopolistic (imperfect) competition in the product market
  - Monopolistic (imperfect) competition in the labour market
  - External balance in the long run (transaction costs/endogenous risk premium)
-



# Features of NEMO to map stylised facts

- Real rigidities
    - Adjustment costs on capital (resembles time to build)
    - Habit formation in consumption
  - Nominal rigidities
    - Adjustment costs on prices
    - Adjustment costs on wages
  - Variable capacity utilisation of capital
  - Variable labour effort (resembles labour hoarding)
  - “Spenders” as well as “savers”
-

# Quantifying NEMO

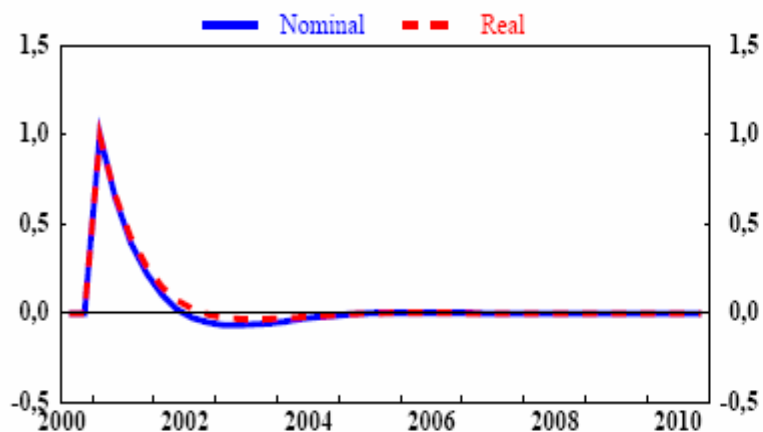
We incorporate data with theory through two steps:

1. First step: Calibration based on a range of information:
    - Great ratios
    - Identified VARs
    - Moment-analysis/stylised facts (Stock/Watson)
    - Single equation (econometric) analysis
    - Micro evidence
    - Evidence from other countries
    - Experience and knowledge within the institution
  
  2. Next step: Bayesian system estimation
    - Need priors for the distribution of parameters.
-

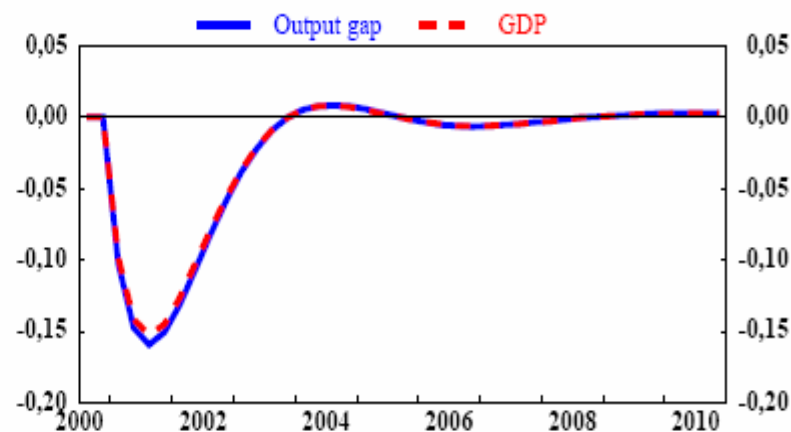
# Using NEMO as a Policy Tool

- We can demonstrate individual shocks with the model as a first step for policy analysis
    - We are working on using NEMO for forecasting and projections
  - Standard
    - Monetary policy shock
    - Demand shock
  - Structural changes
    - Increased competition
-

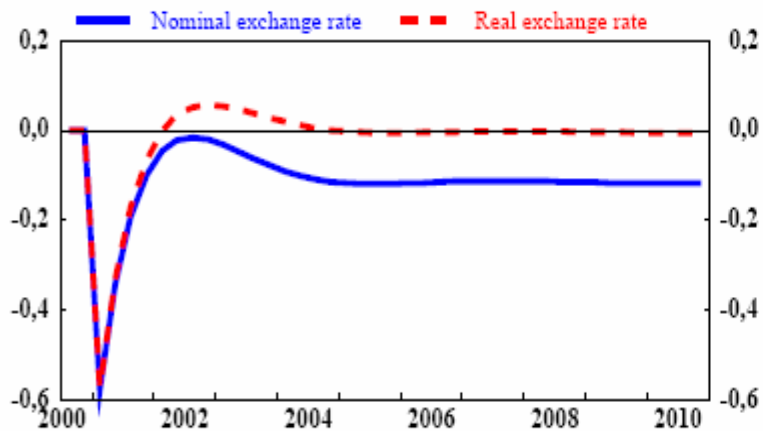
### Interest Rates



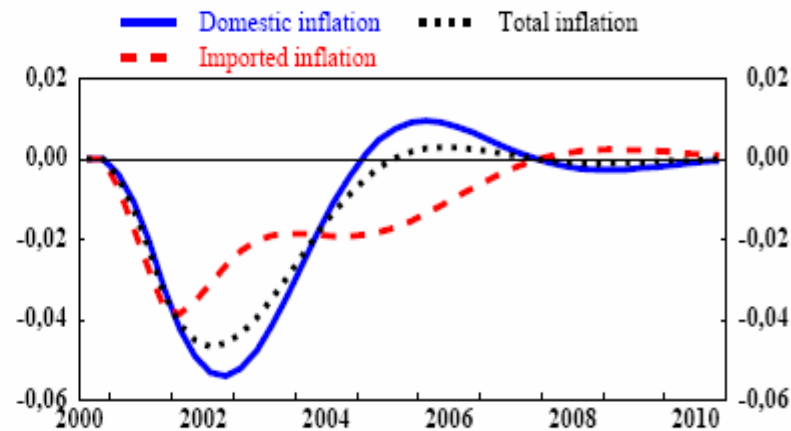
### GDP and Output Gap



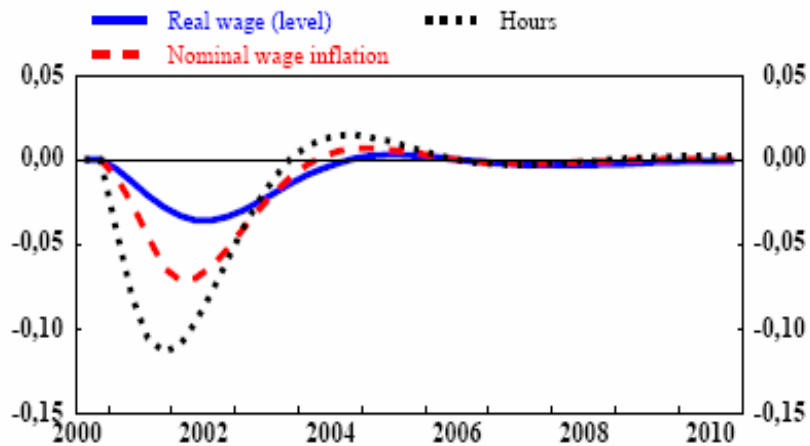
### Exchange Rates (+=depreciation)



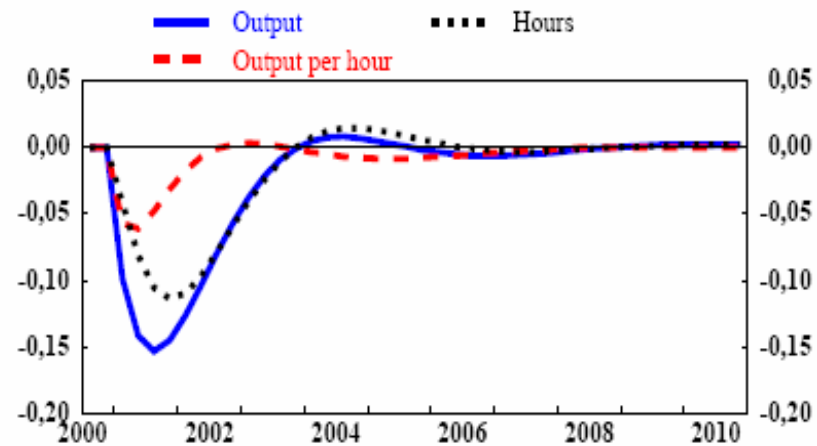
### Inflation by Sector



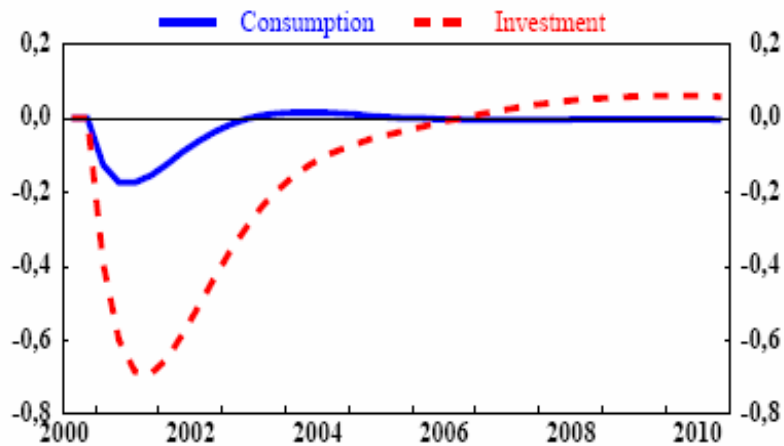
### Wages and Hours



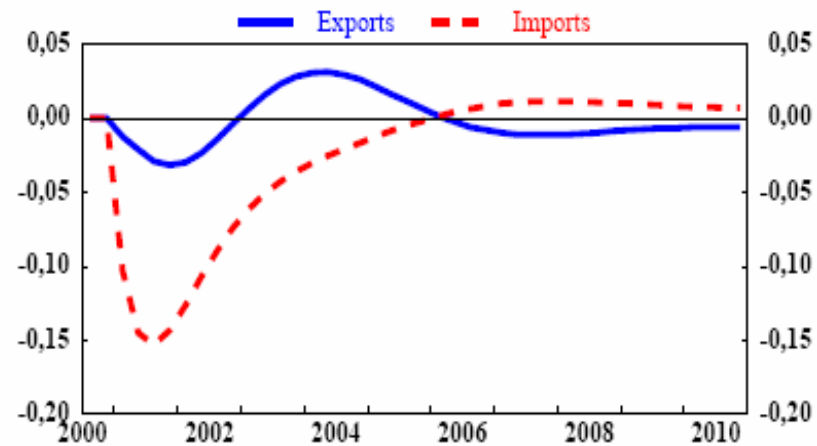
### Output and Hours

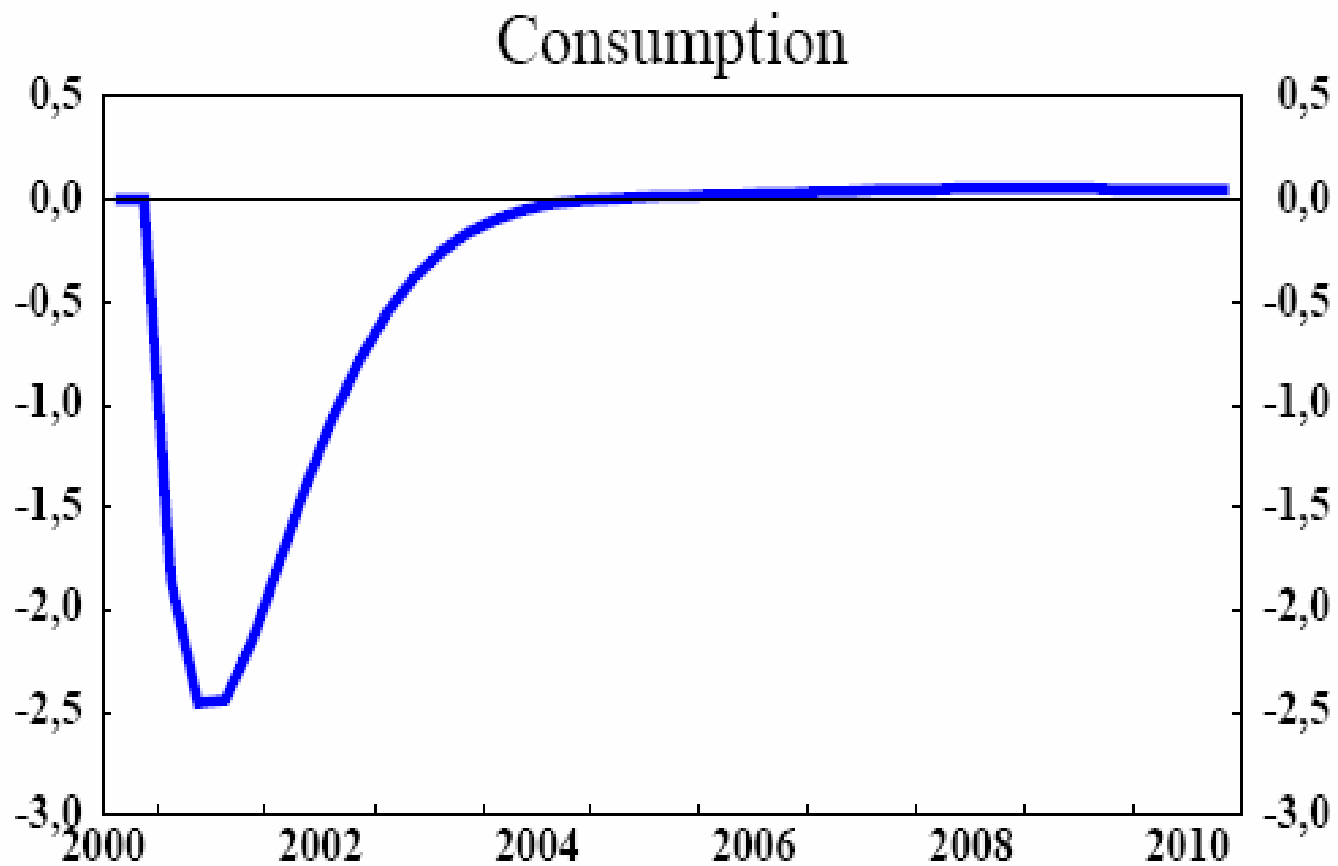


### Demand components

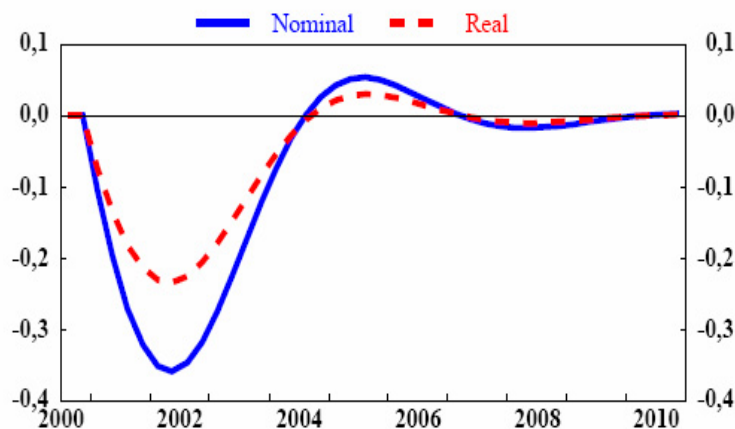


### Net trade

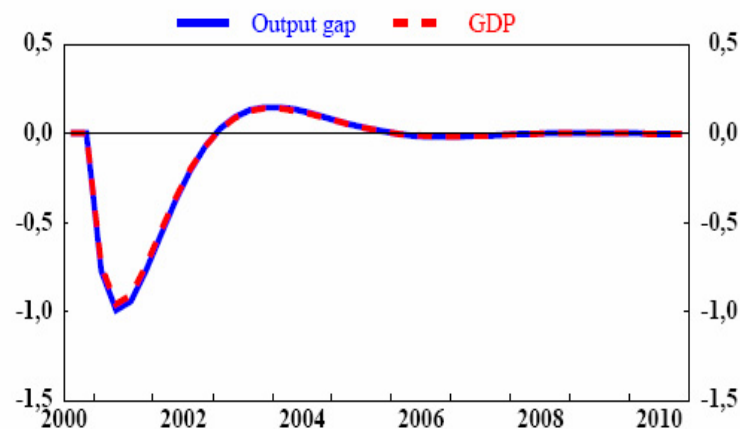




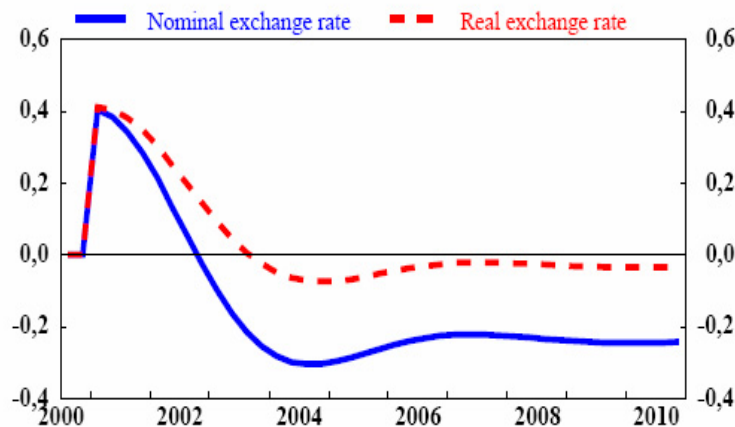
### Interest Rates



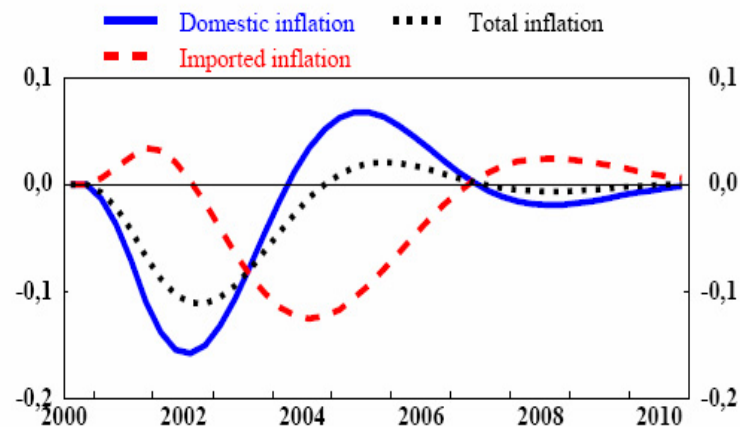
### GDP and Output Gap

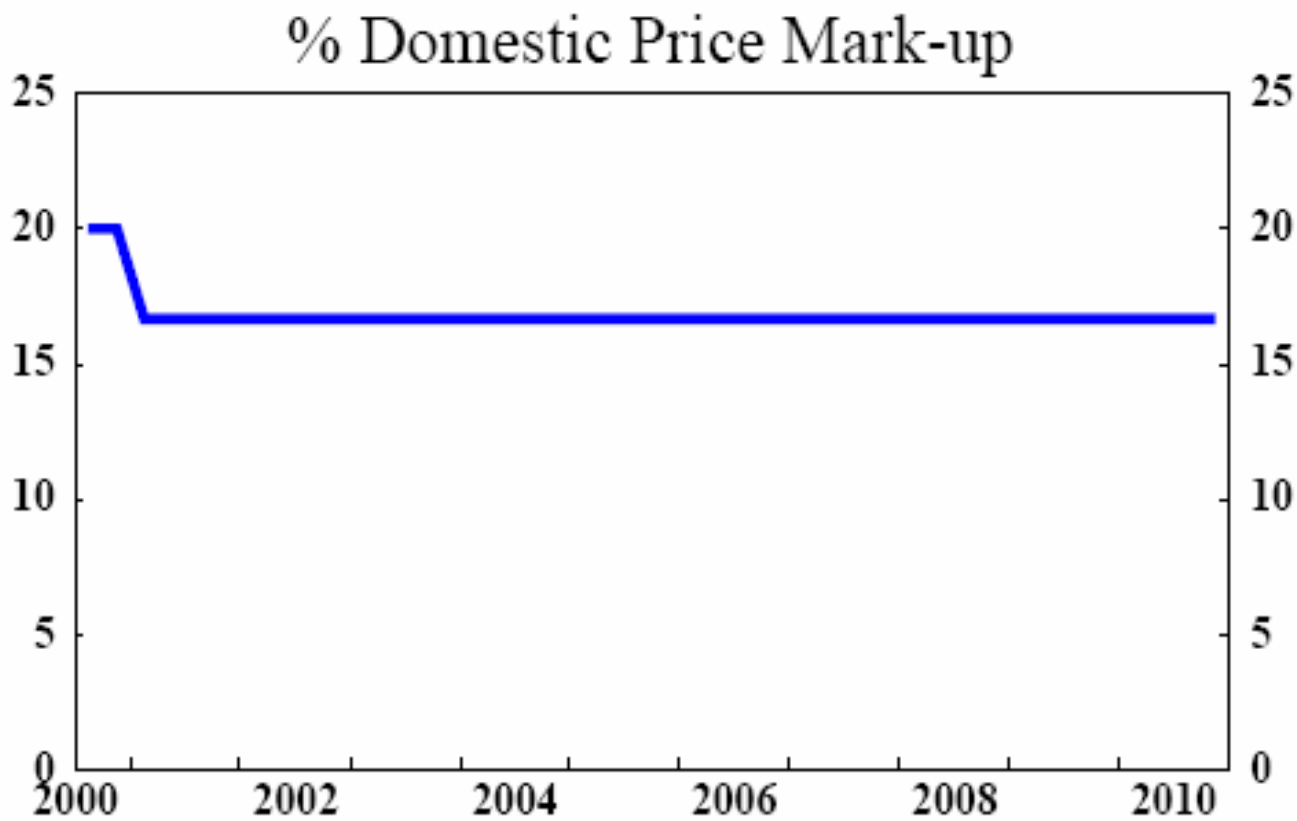


### Exchange Rates (+=depreciation)

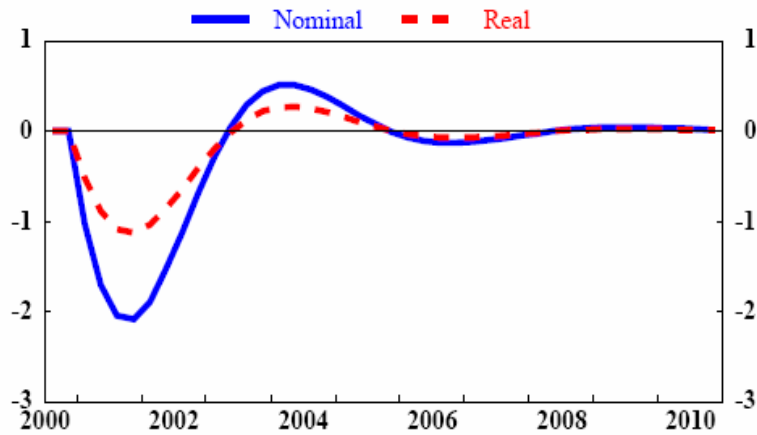


### Inflation by Sector

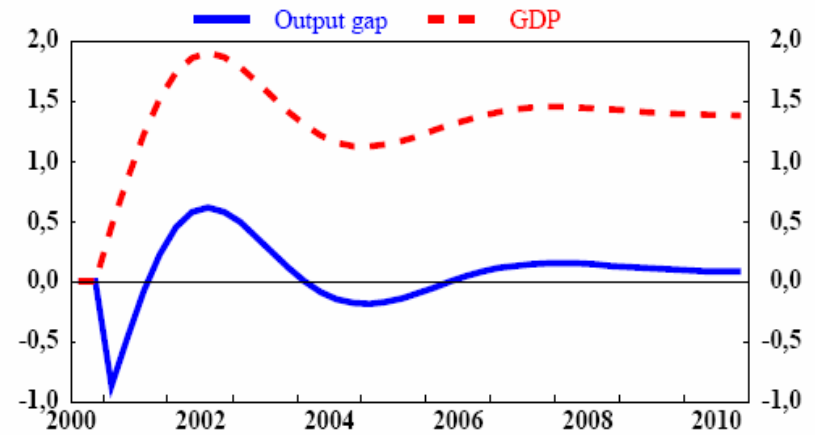




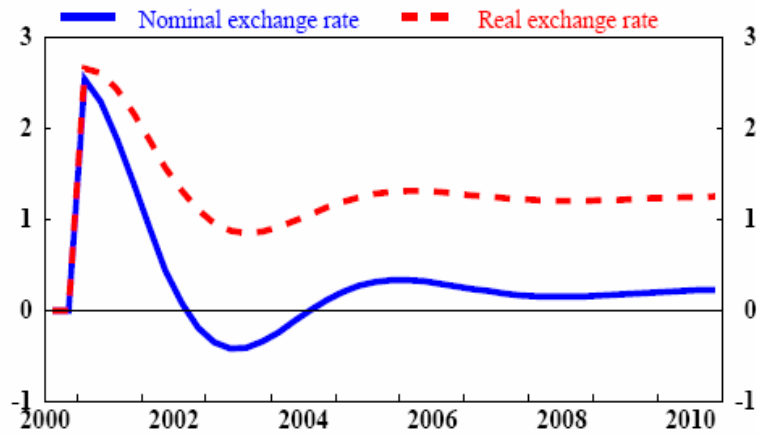
### Interest Rates



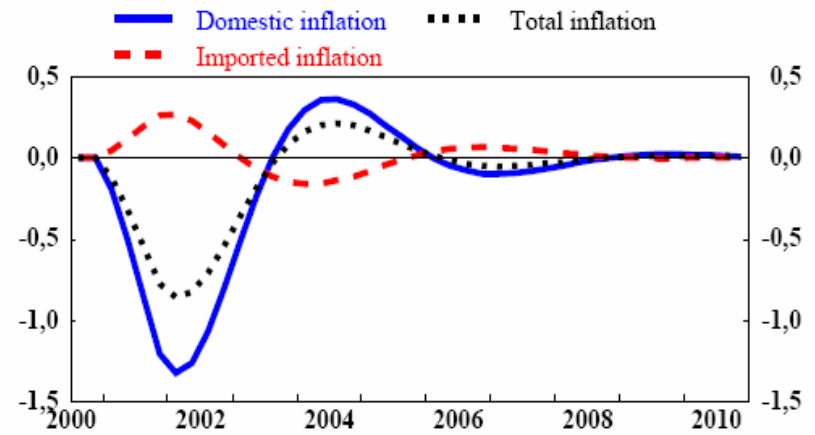
### GDP and Output Gap



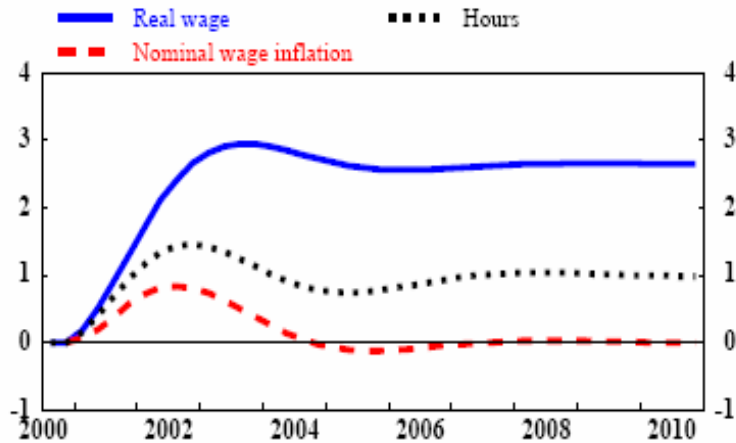
### Exchange Rates (+=depreciation)



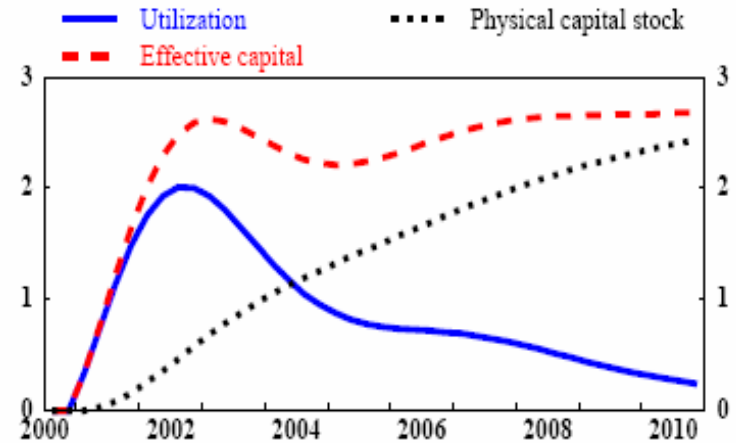
### Inflation by Sector



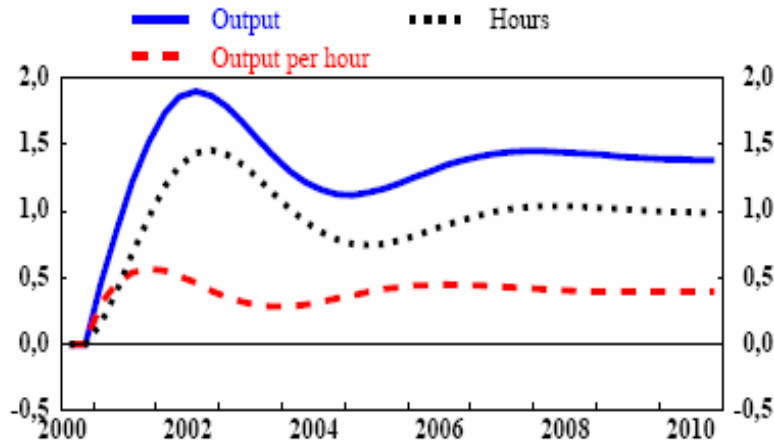
### Wages and Hours



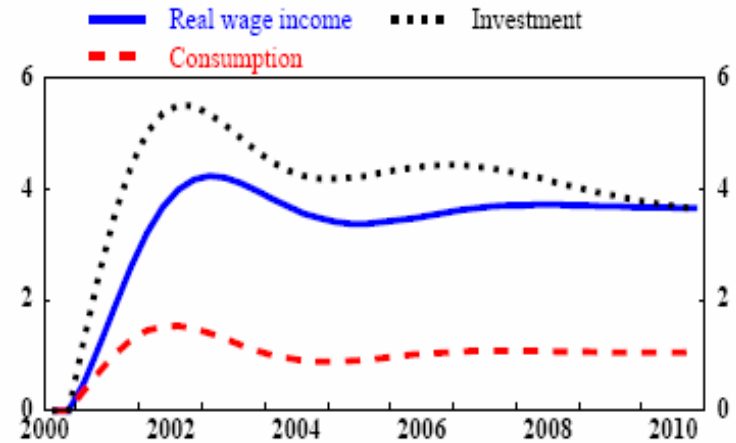
### Capital and its Utilization



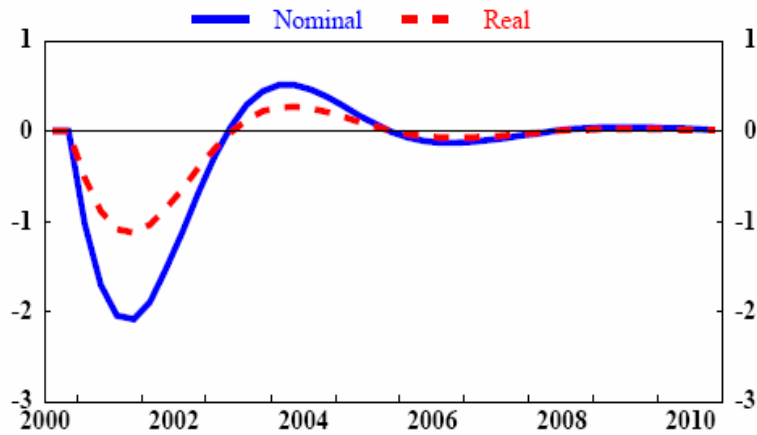
### Output and Hours



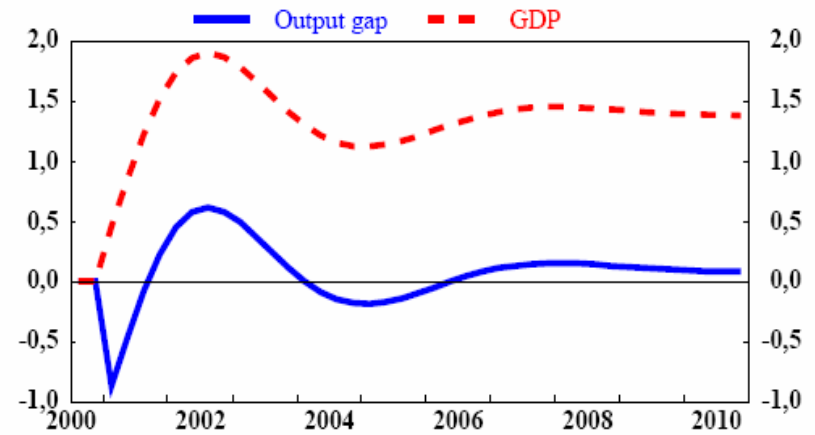
### Income, Consumption and Investment



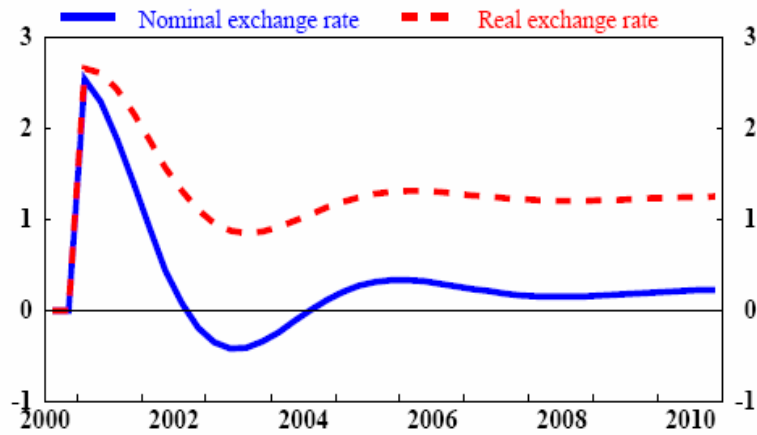
### Interest Rates



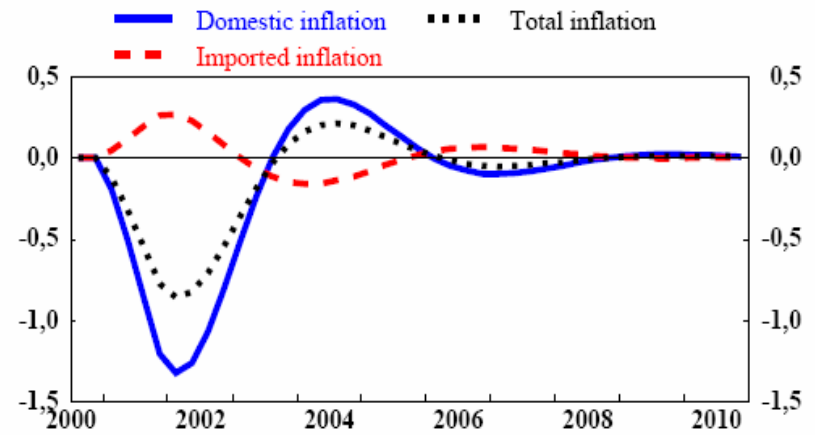
### GDP and Output Gap



### Exchange Rates (+=depreciation)



### Inflation by Sector



# NEMO is still work in progress

## Completed:

- Analytical model structure
- First pass calibration

## In progress:

- Integration with the forecasting system
  - Estimation
-