Estimating Open-Economy DSGE Models

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The goal of the talk
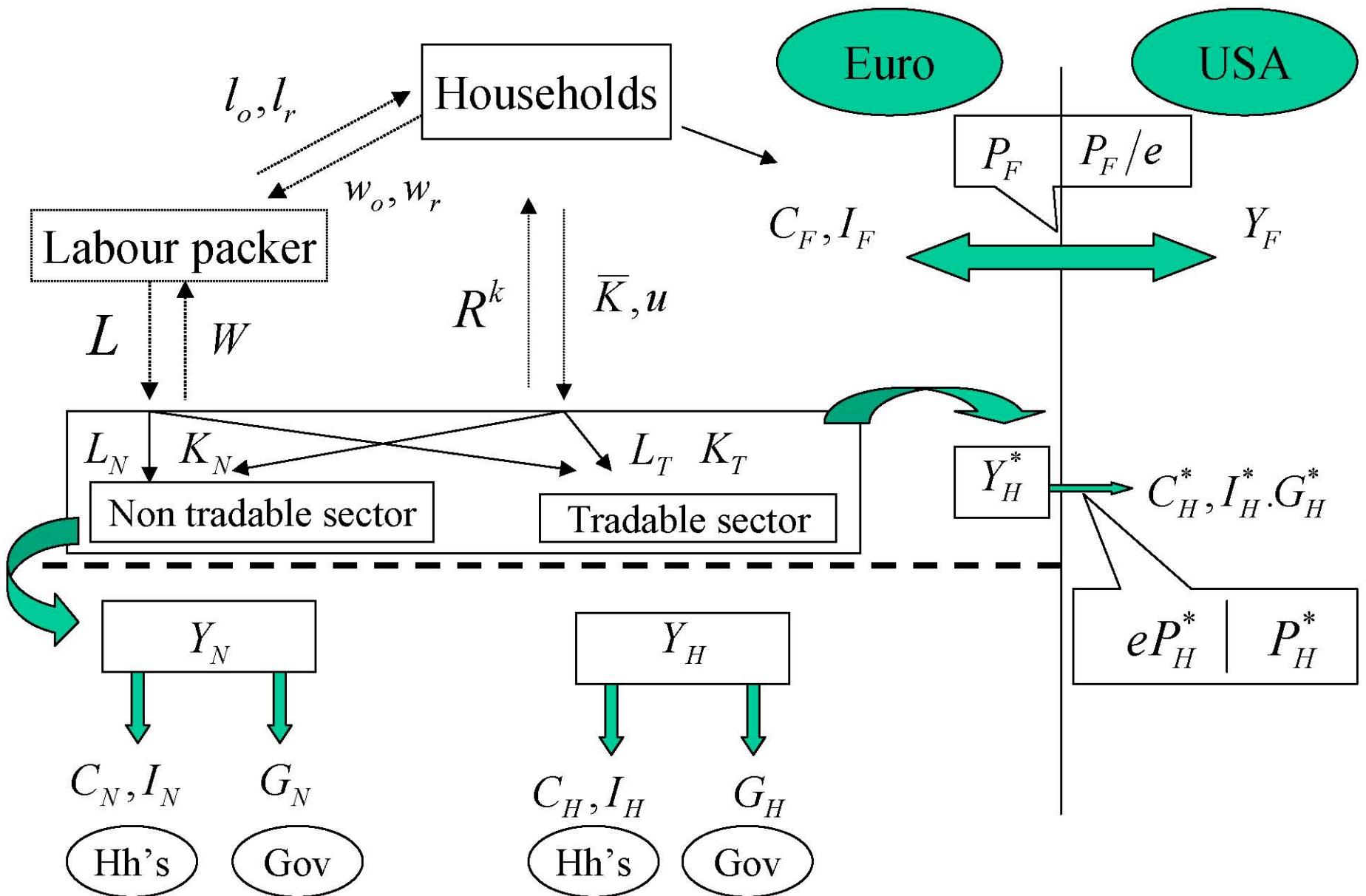
- Share the experience of more than one year of Bayesian estimation on the BdI DSGE model

- Estimation strategy: split the "full" model in simpler sub-models and estimate them separately. So far we have:

  - A Closed-economy model focusing on fiscal policy issues
  - A two-country Open-economy model

- Today's presentation based on estimation of the open economy model

- Focus of this model is on reproducing the dynamics of the Euroarea – U.S. **real exchange rate**

Main Features of the model

- ☐ Consumption: two layers of CES aggregators
  - ➢ Home-tradables + Foreign-tradables (home-bias)
  - ➢ Tradables + Non-tradables

- ☐ Households: consume, supply labor and decide on bond holdings

- ☐ Production functions (trad. & non-trad. firms) is linear in labor (no capital)

- ☐ Incomplete exchange rate pass-through at the border & at consumer level:
  - ➢ Local Currency Pricing
  - ➢ Distribution sector (à la Corsetti-Dedola-Leduc)

- ☐ Nom. price & wage rigidities (à la Rotemberg), no indexation

- ☐ Incomplete markets at the international level

- ☐ Monetary policy: Taylor rules responding to $\boldsymbol{\pi}_t$, $\boldsymbol{Y}_t$, and $\boldsymbol{\Delta e}_t$

BdI DSGE: Structure - overall view

Bayesian estimation: the components

- ☐ 9 observables: consumption, CPI inflation, nontradable price inflation, nominal interest rates, real exchange rate

- ☐ 11shocks: tradable technology, nontradable technology, monetary, preference, wage markup, UIP

- ☐ Around 40 estimated parameters

- ☐ Independent prior distributions

- ☐ Posterior maximization: simplex+csminwel

- ☐ Posterior simulation: MHMC algorithm

Bayesian estimation: main results

- Good success in matching moments of the real exchange rate
- Large movements in exchange rate do not translate in equally large movements in CPI
- Variance of real exchange rate mainly due to international price discrimination
- Real exchange rate is mainly explained by UIP and preference shocks
- Other variables mainly by domestic preference shocks
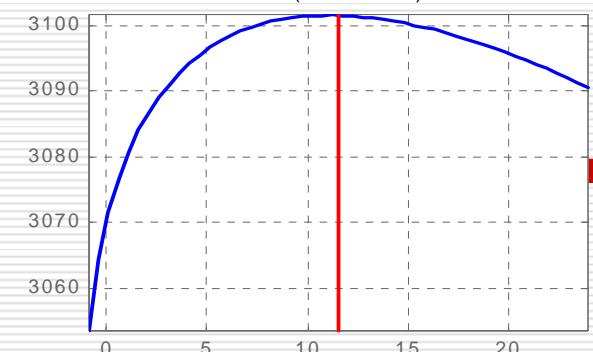
Bayesian estimation: problems encountered
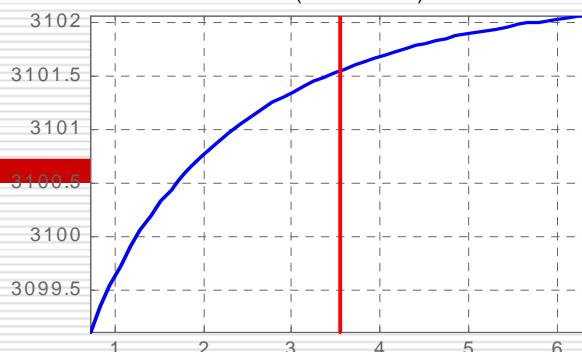
Lack of identification along key **open economy** dimensions:

- Nominal price rigidities of tradable goods

- Risk premium parameter

- Home bias parameter
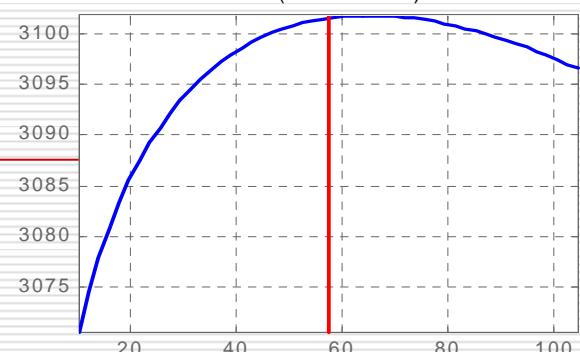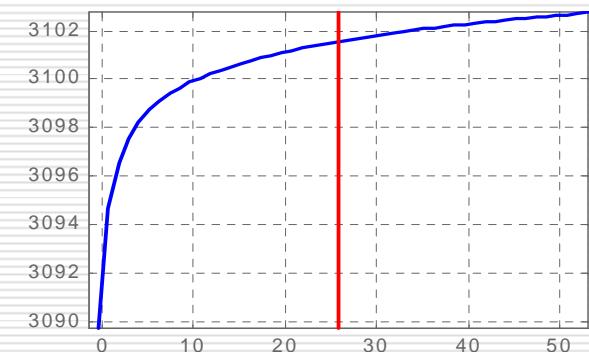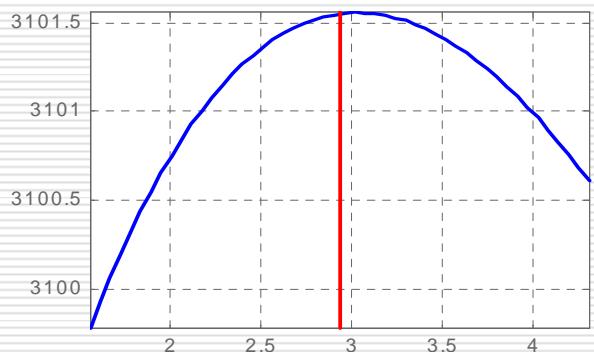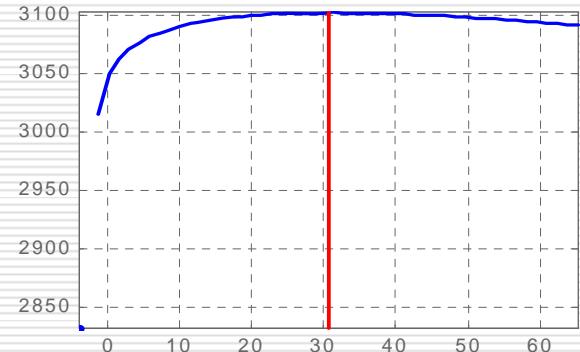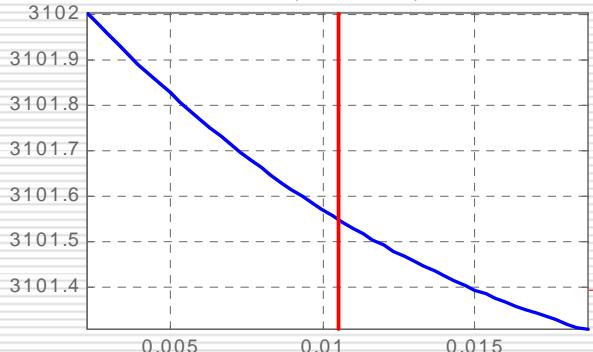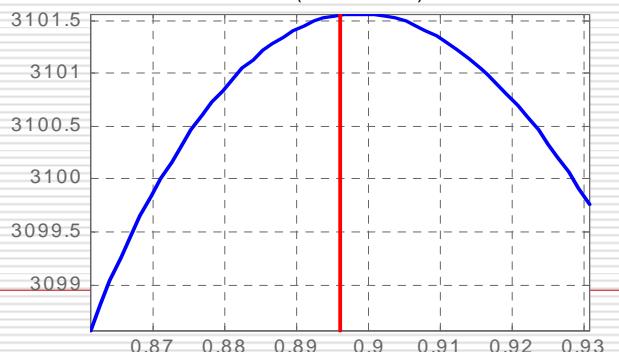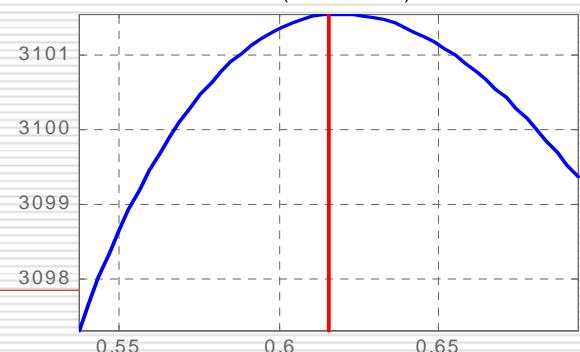
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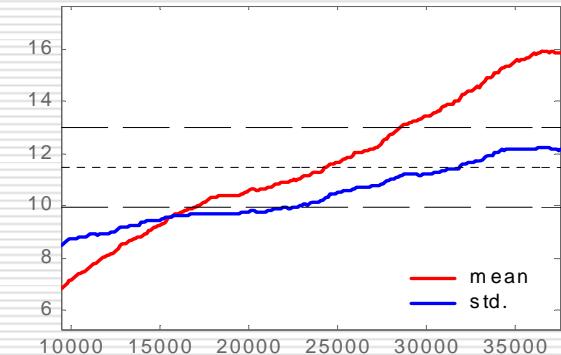
Lack of convergence of the posterior distribution:
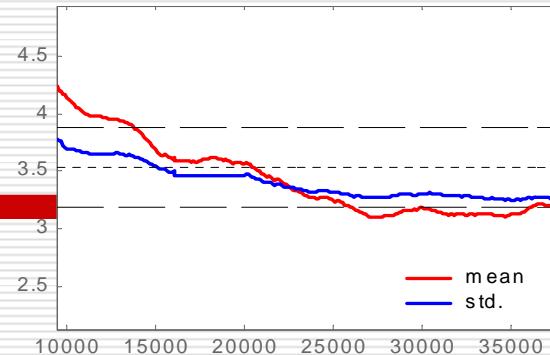
- ☐ We run one very long MHMC chain (one million draws)
- ☐ We keep a draw every 20
- ☐ We discard the first 25% of the sample
- ☐ Final sample size: 37500 draws

Nominal Rigidities Parameters
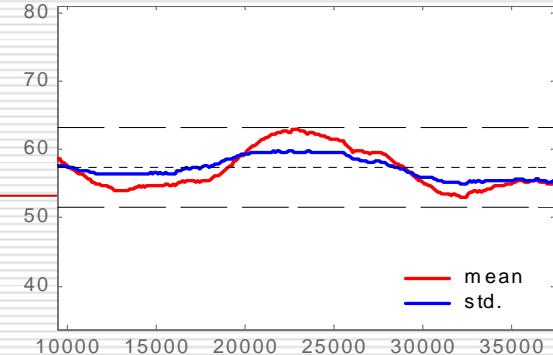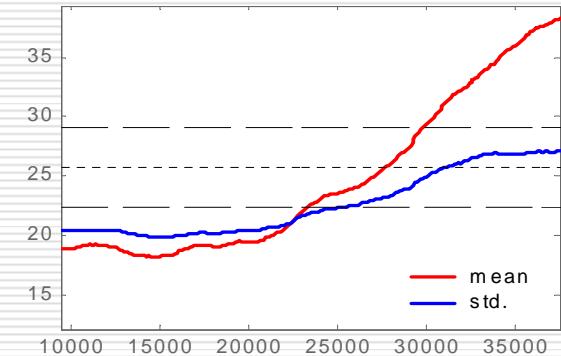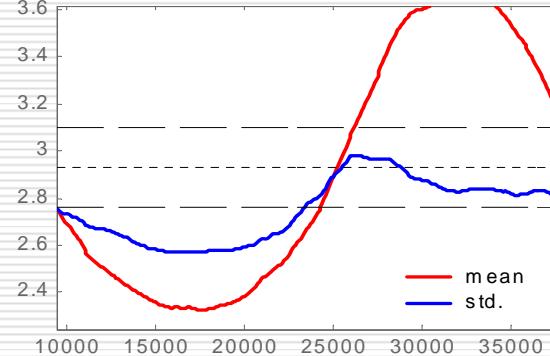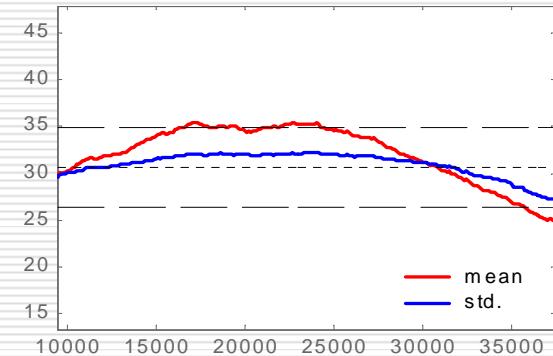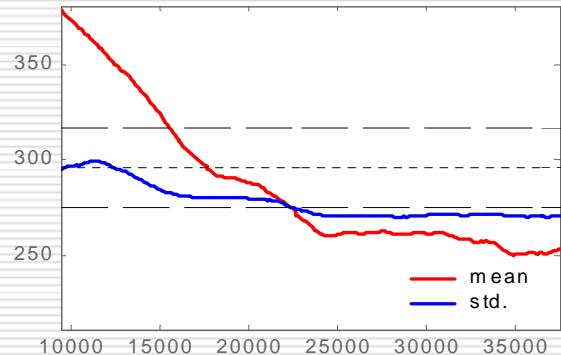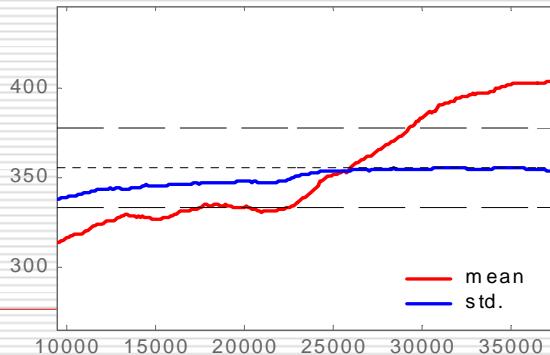
Our approach to the problem
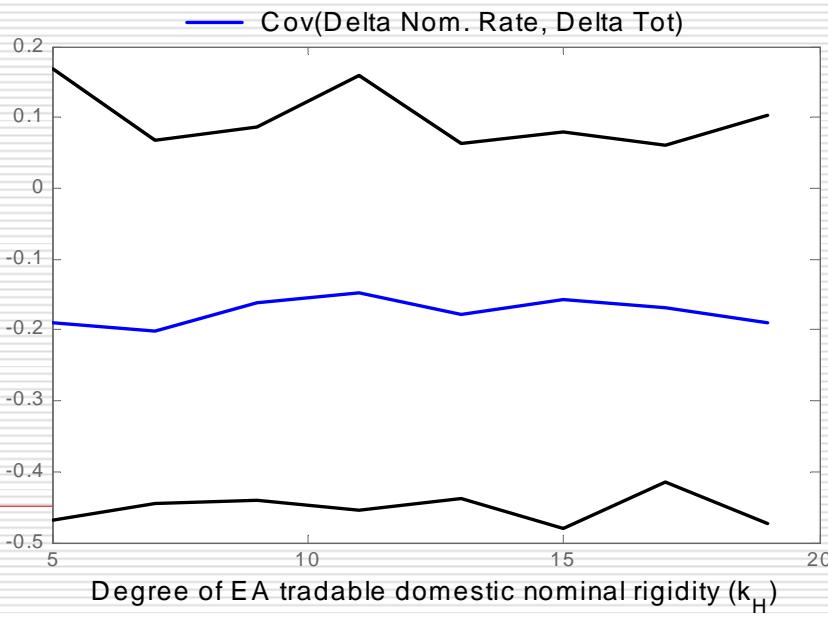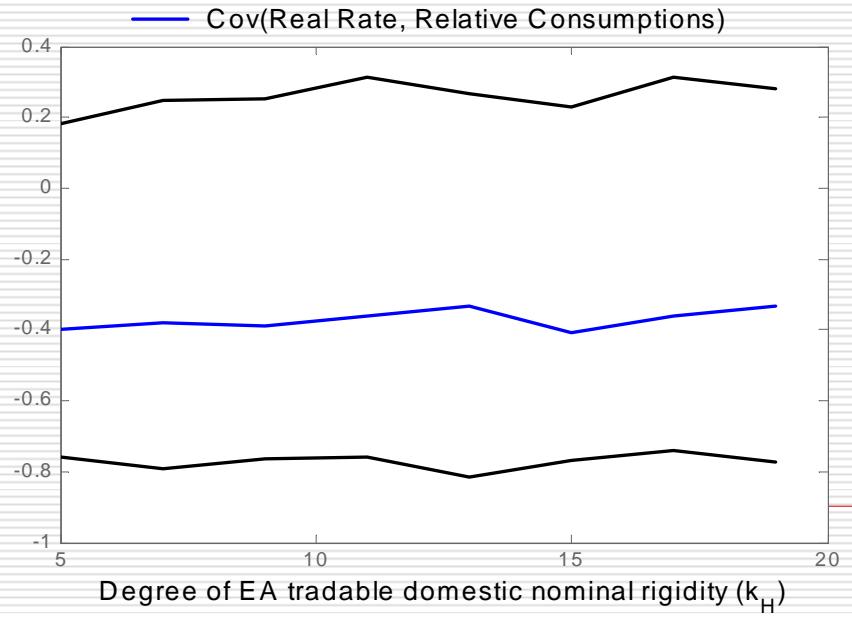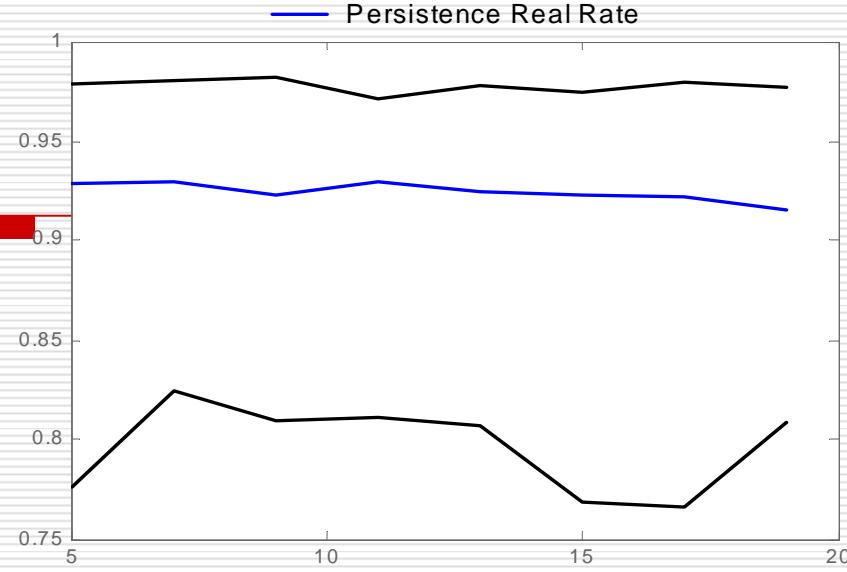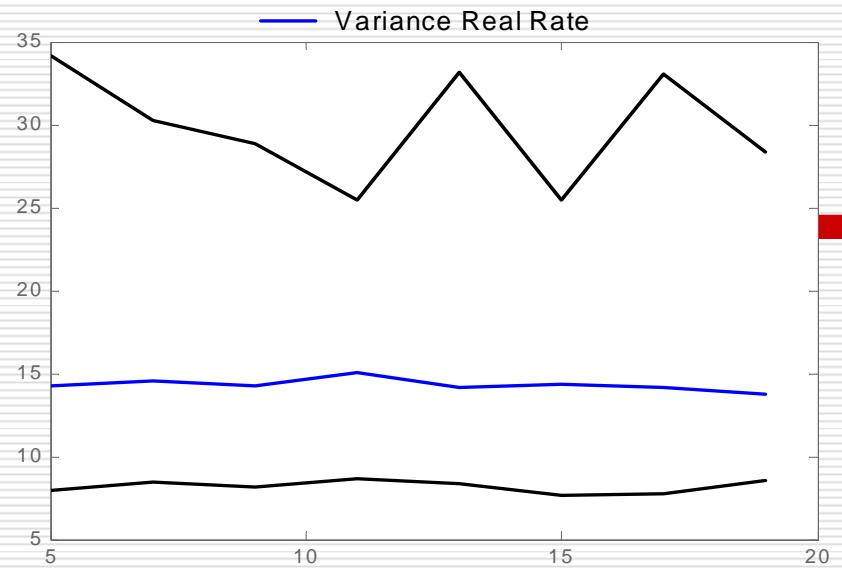
- ☐ We do not solve the problems of lack of convergence and identification

- ☐ Economic approach: we investigate their <u>economic</u> implications

- ☐ In our case, we investigate the relation between the moments of the real exchange rate and the unidentified parameters

Our approach to the problem
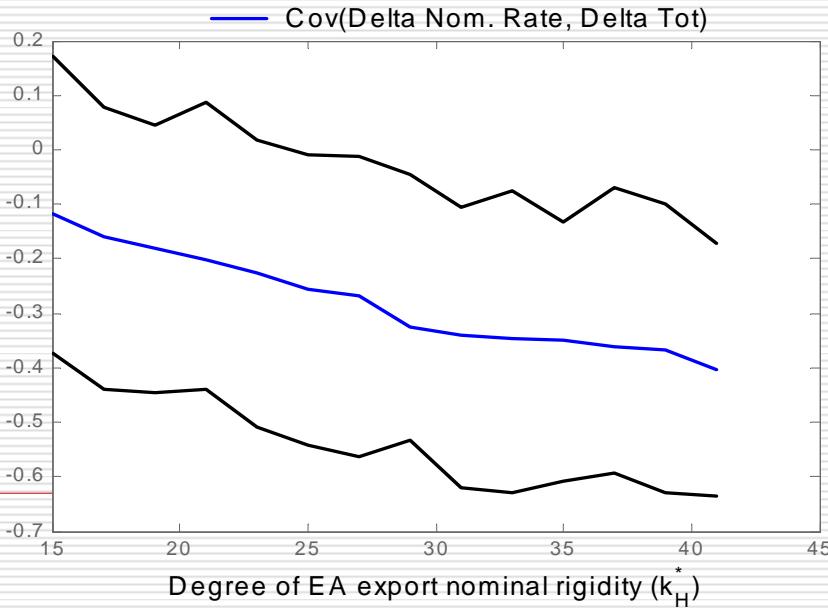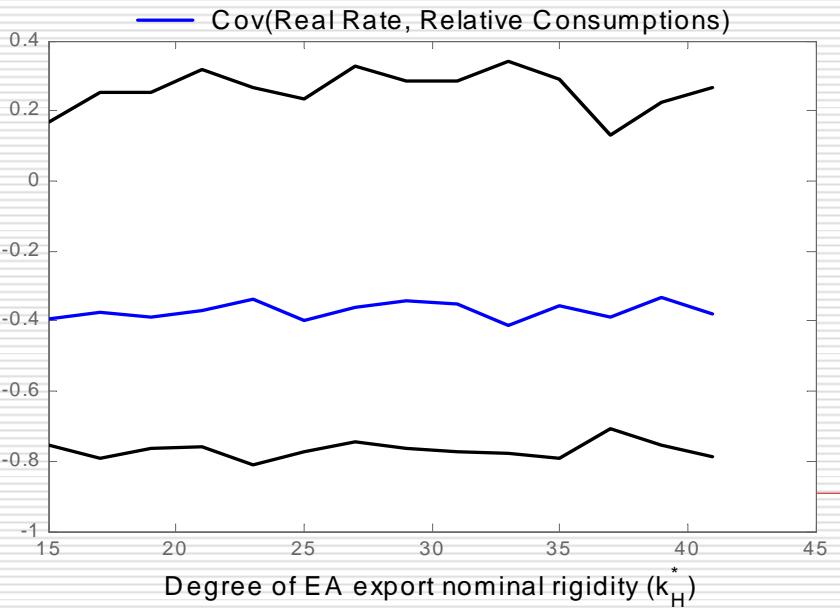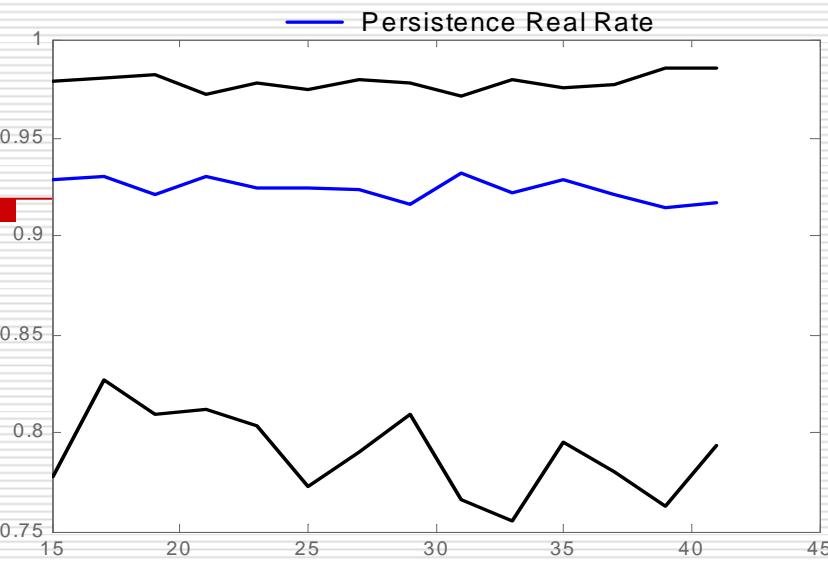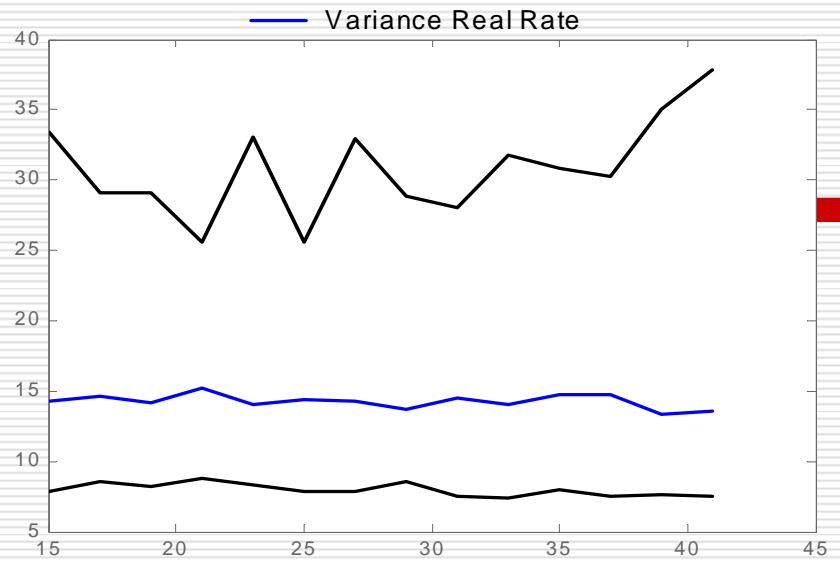
- ☐ In particular:
    - ■ we select a moment we are interested in
    - ■ we re-calculate it varying each unidentified parameter over the range where the posterior is flat …
    - ■ … while drawing the remaining parameters from the posterior

- ☐ If the considered moment is roughly inveariant, than the lack of convergence does not affect the economic dimension we are interested in
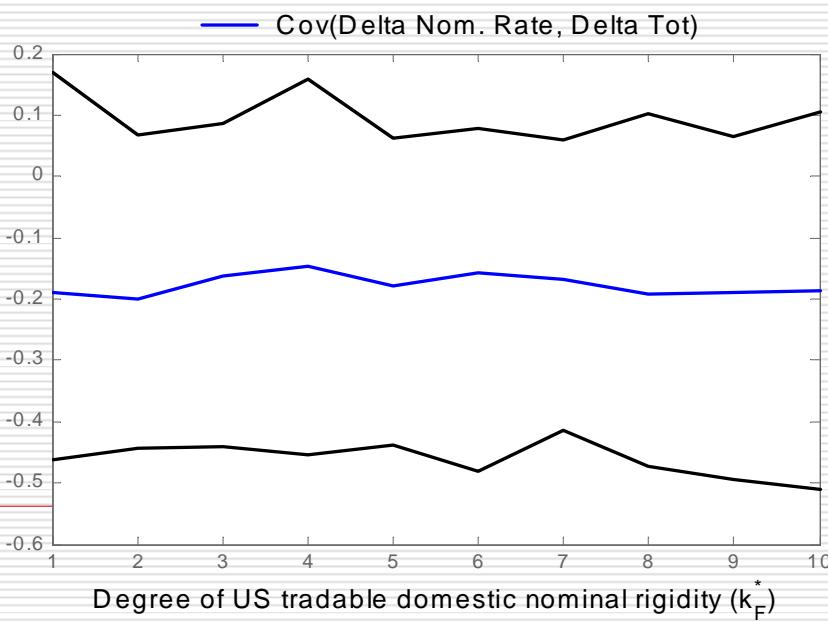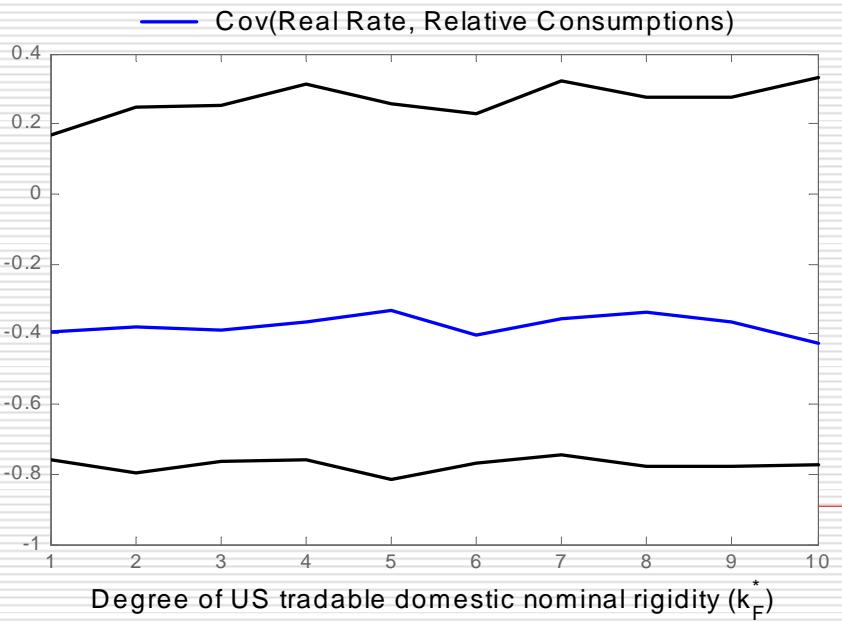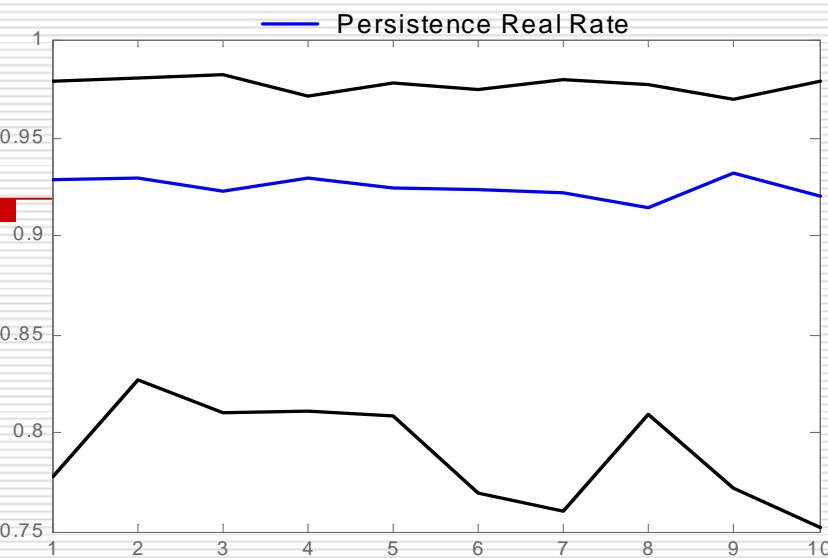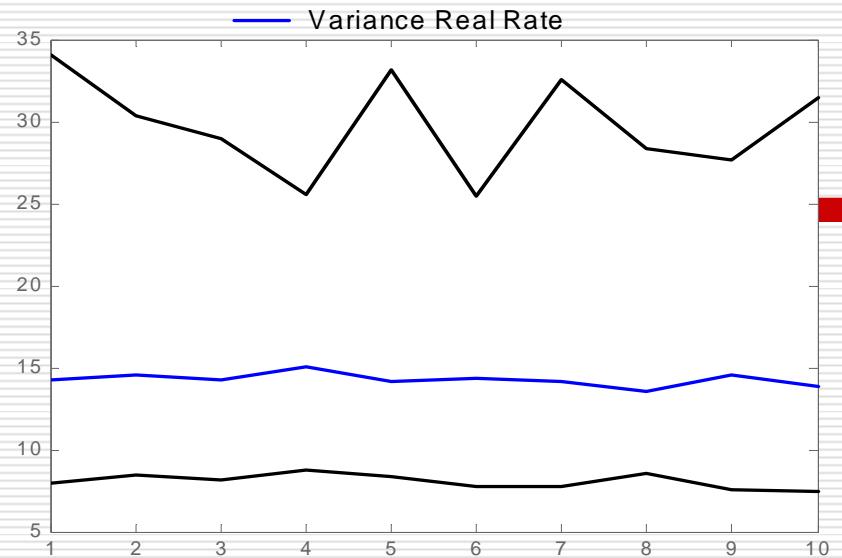
Main Moments of Euro-Dollar Exchange Rate
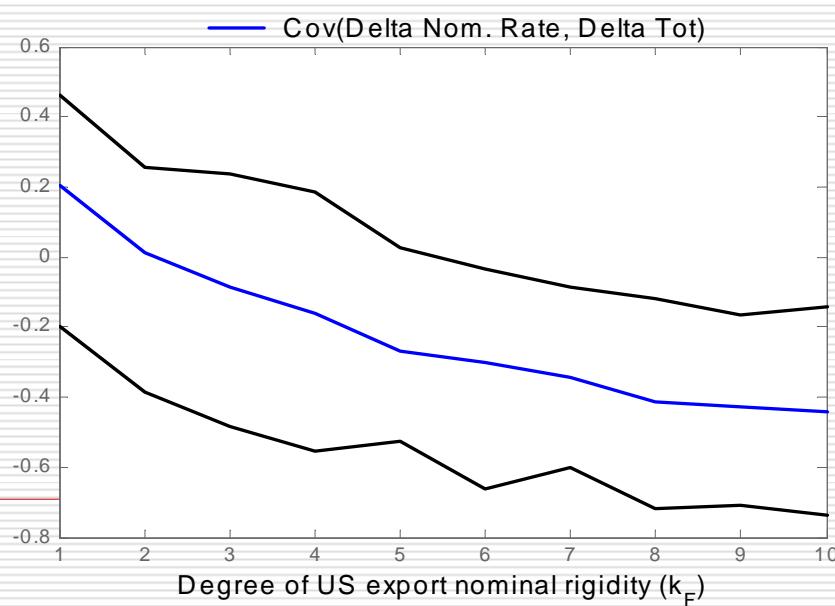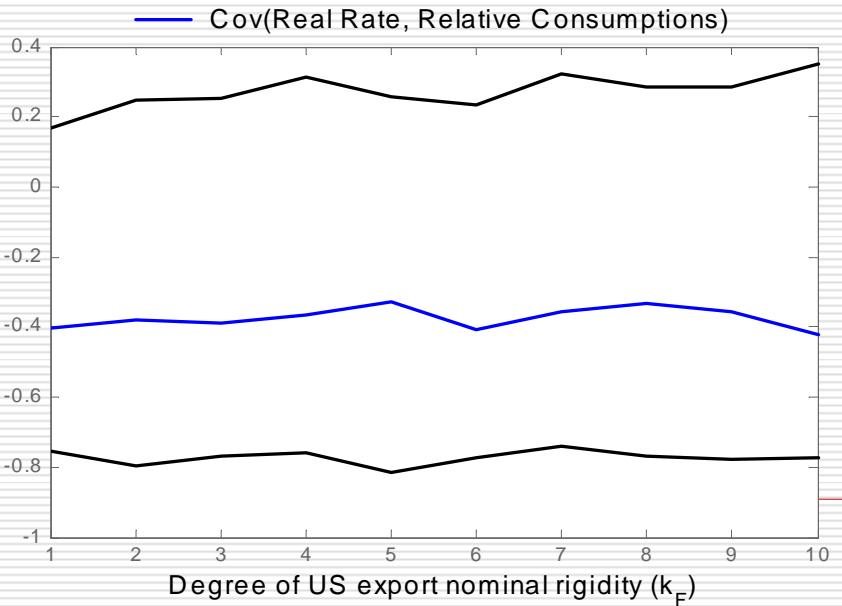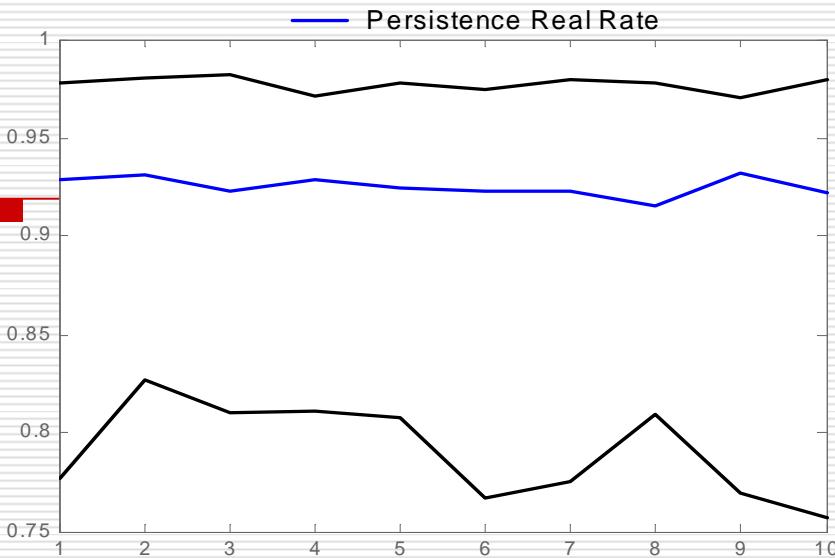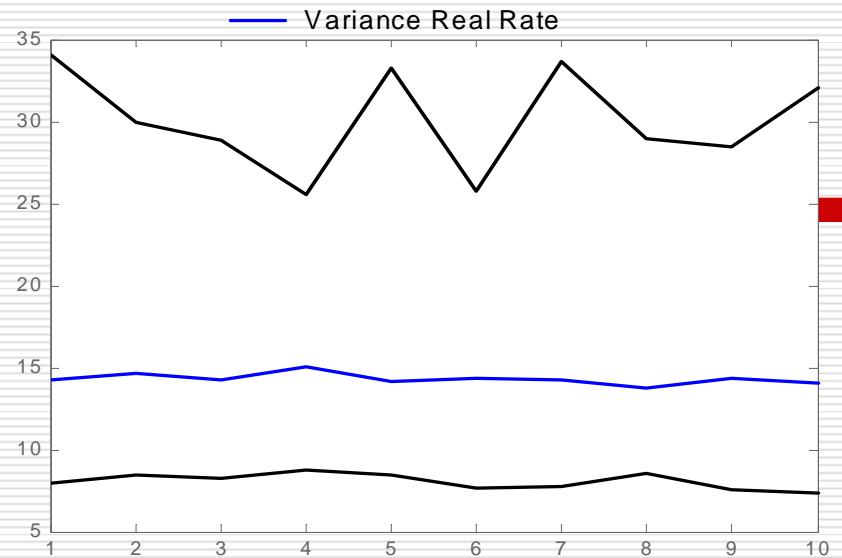
Variance Real Rate

Persistence Real Rate

Cov(Real Rate, Relative Consumptions)

Cov(Delta Nom. Rate, Delta Tot)

Degree of EA tradable domestic nominal rigidity (k_H)

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Main Moments of Euro-Dollar Exchange Rate

Variance Real Rate

Persistence Real Rate

Cov(Real Rate, Relative Consumptions)

Cov(Delta Nom. Rate, Delta Tot)

Degree of EA export nominal rigidity (k_H^*)

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Main Moments of Euro-Dollar Exchange Rate

Degree of US tradable domestic nominal rigidity (k_F^*)

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Main Moments of Euro-Dollar Exchange Rate

Final remarks

- ☐ It is essential to look at <u>statistical</u> measures to validate a model

- ☐ In presence of identification and convergence problems, we need to check how the <u>economic</u> conclusions change as the unidentified parameters vary

- ☐ This is particularly important for central bankers: policy simulations crucially depend on structural parameters