Simple Tools for Monetary Policy with DSGE Models

. . . a practical guide for survival

Czech National Bank, Forecasting Dept.

Czech National Bank Seminar, 24.–26. Nov 2008

Outline of the Talk

- What we do and why...
- How we do it
- Demo if possible...

Warning:
Sadly, no economics talk left for me this time...
but we calculate decompositions to focus on economics

M. Andrle, O. Kamenik, J. Vlcek & T. Hledik:
Putting in Use the New Structural Model of the CNB, 2007–2008

M. Andrle: Simple Tools for Analysis of DSGE Models, 2008

CNB’s model-based forecasting process

Stages of the forecast:

(i) Model-consistent filtering
(ii) Baseline scenario
(iii) Alternative scenarios & risk analysis
(iv) Explaining deviations from a previous forecast
(v) “Inflation targeting performance evaluation”

What we found out:

(i) Understanding ”standard” IRFs is not enough
(ii) Shocks to initial cond & anticipated shocks needed
(iii) Tools to understand filtering process needed
(iv) Need for flexible tools to decompose simulation dynamics
(v) Linearity is your friend. . . but you can’t rely on it

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What we (learned to) do...

Model-consistent filtering:

1. **shock decomposition** (shocks → observed data)
2. **filter comparison** (change in data → change in shocks)
   (i) step 1: data revisions & NTF update (range unchanged)
   (ii) step 2: effects of new data (shift in time)
3. **filter decomposition** (shocks ← observed data)

Baseline forecast & scenario analysis

1. **simulation dynamics decomposition wrt steady-state**
2. **decomposition of scenaria differences**
3. **decomposition of current to previous forecast**

"Inflation targeting evaluation"

1. **what would be our forcast in T-6q given T info set**

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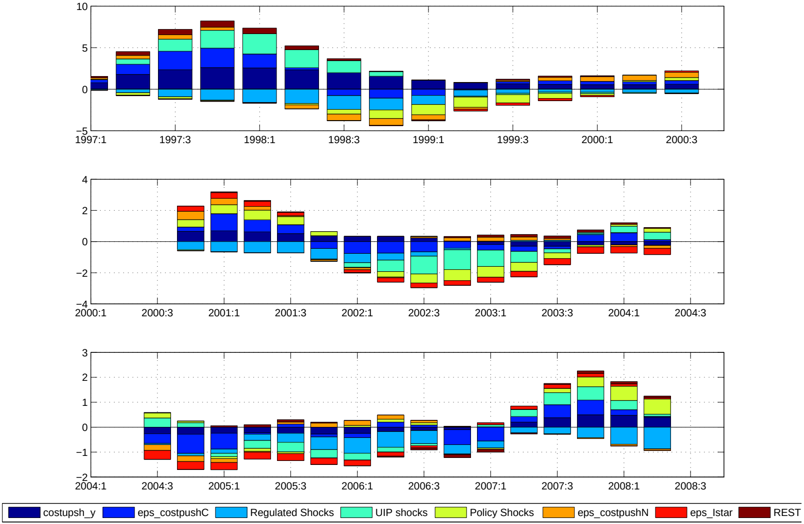
Shock Decomposition (shocks → observed data)



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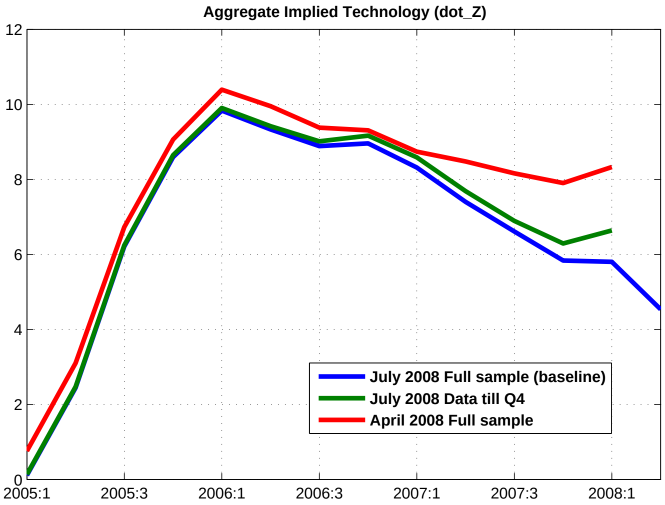
Filter Comparison



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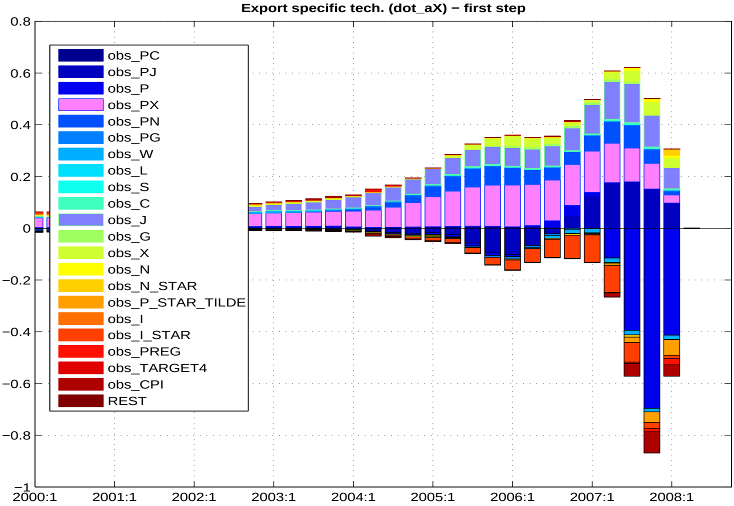
Filter Decomposition (shocks ← obs. data)

. . . similar logic for step 1 & step 2



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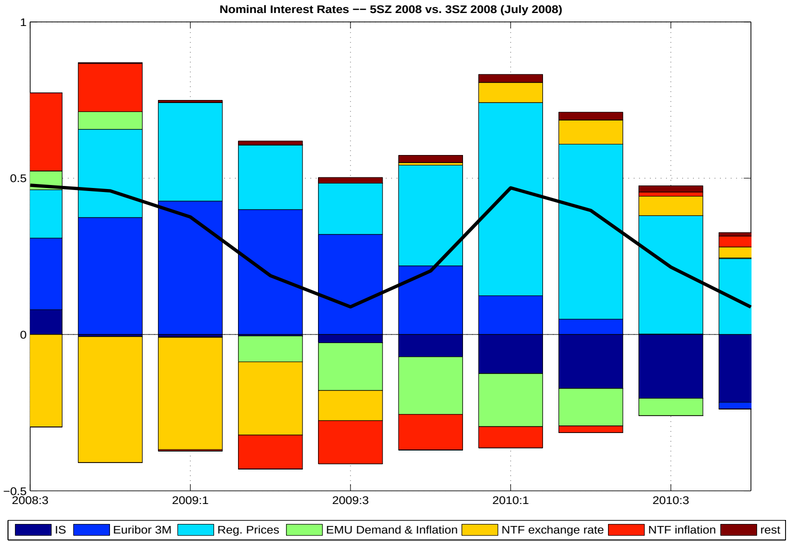
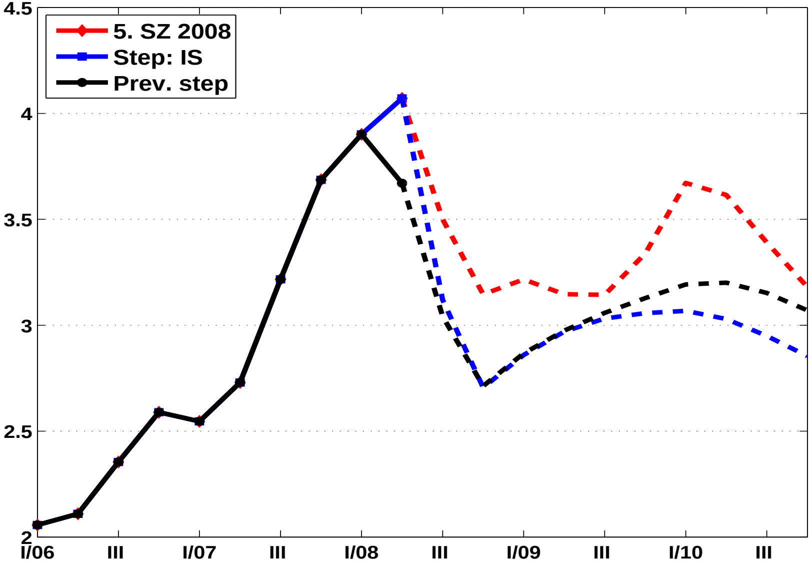
Simulation Dynamics Decomposition (Generic Fig.)



. . . and derivatives linked to it



e.g.

automatic generation of step decomposition for MPC members

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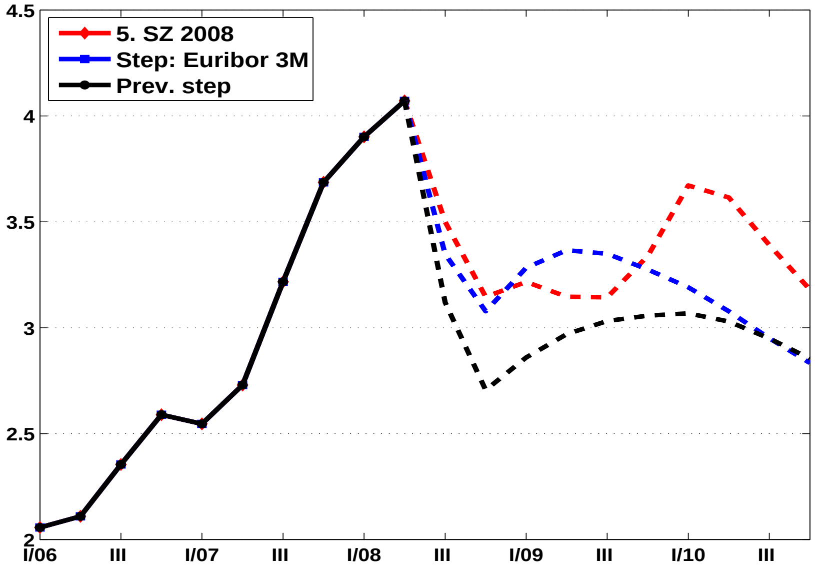
. . . and derivatives linked to it



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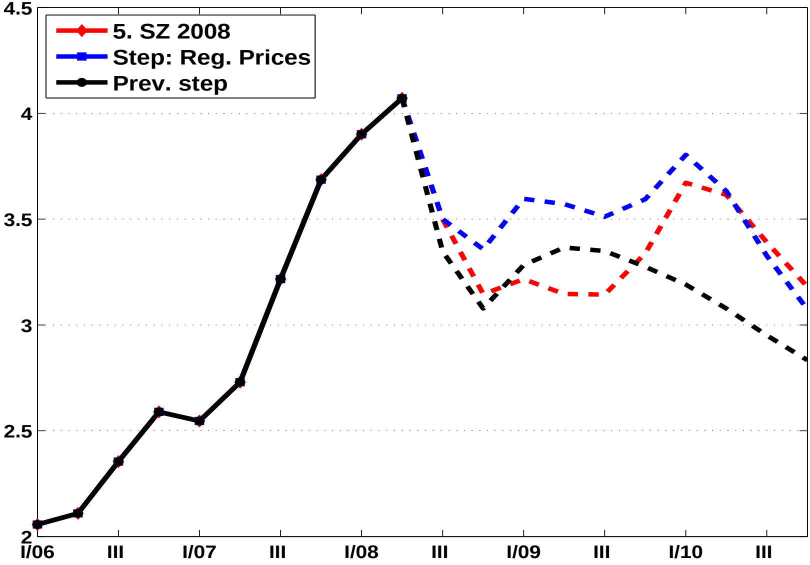
...and derivatives linked to it



How we do it. . . (i)

All things presented above are very easy to do, if. . .

1. your models are **always linear**
2. you don't allow **both for anticipated & unanticipated shocks**
3. you don't want to decompose w.r.t **hard-tunes** but only **soft-tunes**
4. you don't require your reports to span the space of differences
5. flexibility & extendability is not an issue
6. . . .

Lesson learned – make things enough general and abstract. . .

How we do it... (ii)

Basic framework for decompositions:

$$X = F(m_1, Y) \quad (1)$$
$$XF = \tilde{F}(m_2, X, E), \quad (2)$$

where

Y – (n_mes $\times$ T_1) matrix of observed data
X – (n_trans $\times$ T_1) matrix of transition data
XF – (n_trns $\times$ T_2) matrix of simulated trans. data

$F(.)$ – the filtering function
$\tilde{F}(.)$ – the simulation function

m_1 – the model for filtering
m_2 – forecasting/simulation function, often $m_1 \in m_2$

Importantly, for some exercise (e.g. inflation targeting eval.) we define a compound function

$$XF = G(.) = \tilde{F}(m_2, F(.), E) \equiv G(m_2, m_1, Y, E) \quad (3)$$

How we do it. . . (iii)

Why all these functions instead a standard linear state-space?

All decompositions are based on first-order approximation, i.e. on total differential of $F(.)$, $\tilde{F}(.)$ or $G(.)$ w.r.t all their arguments.

1. **filter decomposition** – uses filtering fn. $F(.)$
2. **simulation comparison** – uses simulation fn. $\tilde{F}(.)$
   2.1 $\tilde{F}(.)$ – in terms of init. conds & future exogs.
   2.2 $G(.)$ – in terms of all observed data & future exogs.
3. **infl. targeting evaluation** – $\tilde{F}(., \tilde{X}, .)$ or $G(.)$

It is a very flexible framework. It proved to be easy to adapt to new simulation & filtering function without change in the “decomposition” codes. . .

Some terminology:

soft-tunes: – anticipated and/or unanticipated structural shocks
hard-tunes: – endogenous variables fixed at a particular value using either anticipated or unanticipated shock. . .
filter-tune: – equality constraints by state-space augmentation.

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How we do it. . . (iv)

The forecasting function thus can be quite different

1. anticipated shocks
2. unanticipated shocks
3. mix of some anticipated and unanticipated shocks
4. hard tunes via anticipated or unanticipated shocks
5. . . .

We are not tied to a particular solution technique or software. . .

For purely anticipated or unanticipated hard-tunes, the backed-out soft-tunes give identical simulation.

However, the decomposition effects are different whether you decompose wrt hard-tunes (fixes) or implied soft-tunes (struct. shocks)

Example of hard-tune:

```
fcast_plan = exogenize(fcast_plan, 'dot_s', rng)
fcast_plan = endogenize(fcast_plan, 'eps_uip', rng)
```

How we do it. . . (v)

Our “atoms” are following:

1. variables
2. parameters/model change (we do not use it much. . .)

Variables are identified **uniquely** by

(i) **type:** ini — fix — res — obs
(ii) **period** (e.g. 2008q1)
(iii) **name**

Examples: Q-o-Q inflation (name: `dot_p`) can be both init.cond or fix, if hard-tunes are applied. . .

Exog. shock `eps_uip` is always only `res`, but for periods when it is endogenized (due to hard-tunes) we can decompose it. . .

How we do it. . . (iv)

Calculations separated from reporting. Reporting is fast and flexible then. If needed, the process is embarassingly parallel. . .

We decompose once, save the data & report in whatever aggregation we want.

Calculations

decompose a function into all nonzero differences

```
DEC = decomp(m, db1, db2, range, sim_plan, ...)
```

Reporting

```
out = decomp_report(DEC, groups, groups_names,...
decomp_list, 'format','ps', 'graph_per_page',1, ...
'colormap',[],'report_style', 'detailed', 'plot_range', prange)
```

Reporting types – specifying reporting groups

Reporting has three basic types:

(i) “firstroup” –report first N largest factors, put other into rest
(ii) “namelist” – specify groups of vars. by name only
(iii) “detailed” – specify groups in terms of “atoms”

Detailed reporting “language”:

`range__type__name`

Examples of group item entry:

`all__ini__all` – all initial conditions
`all__fix__istar` – foreign interest rate *fix* at all periods
`2008Q1:2008Q4__res__eps_uip` – particular range of struct. shock only
`2008Q1__fix__all` – all fixes valid at 2008Q1

Asking the model for entry `alll__all__all` prompts kind of nasty reply by the software. . .

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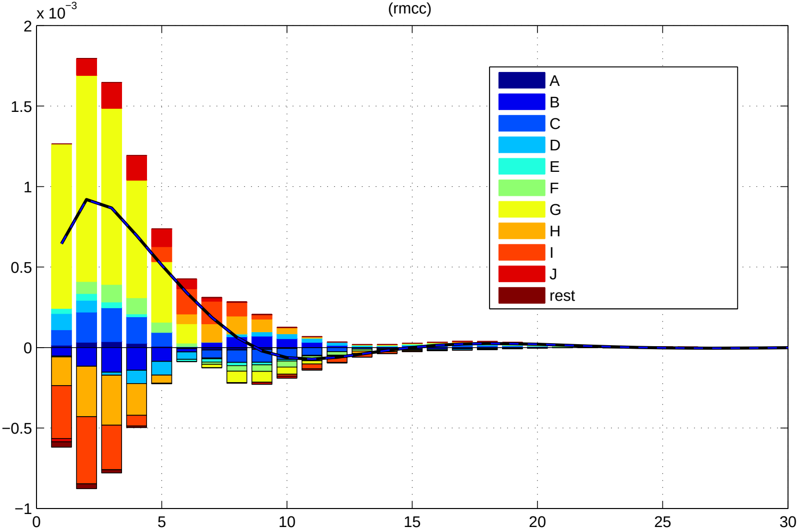
Reporting types – a generic graph



All ingredients of reports are saved for processing using other pieces of code. . .

Thank you for your attention. . .