An Open Economy Model for the Monetary Policy Analysis and Forecasting

Jaromír Tonner, Jiří Polanský, Osvald Vašíček

Department of Economics
Faculty of Economics and Administration
Masaryk University

Oct. 22 - 23, 2010, Brno, Czech Republic.

Outline

- Introduction
- Model
- Model Estimation
- Model Behaviour
- Model Applications
- Conclusions

Introduction

- There are two antagonistic goals in modelling economic reality:
  - to have a simple model in order to interpret its dynamics (SIMPLICITY), but
  - there are always some observed facts we would like to incorporate (COMPREHENSIVENESS).
- We are anywhere between..
- The objective of the talk is to simply explain our framework for forecasting and monetary policy analysis.

Model - General Characteristics

- The model follows some recent developments in construction dynamic models
- Nominal frictions enrich the RBC dynamics
- Structural model with forward looking rational expectations
- Model is consistent with stock-flow national accounting
- Model contains the balanced growth path concept (not a reduced-form gap model)
- 11 sectors (households, 2 intermediate goods production sectors, 4 final goods production sectors, central monetary policy authority, central fiscal policy authority, forex dealers, rest of the world)
- GE SOE models for the Czech economy (tailor-made for the Czech economy)
- Inflation targeting regime - forward-looking monetary policy rule

Model - Parameters

The model is tailor-made for the Czech economy via

- Parameters setting
- Additional mechanisms as exogenous processes
- Time - variant parameters
- Expected time - variant parameters

Model structure

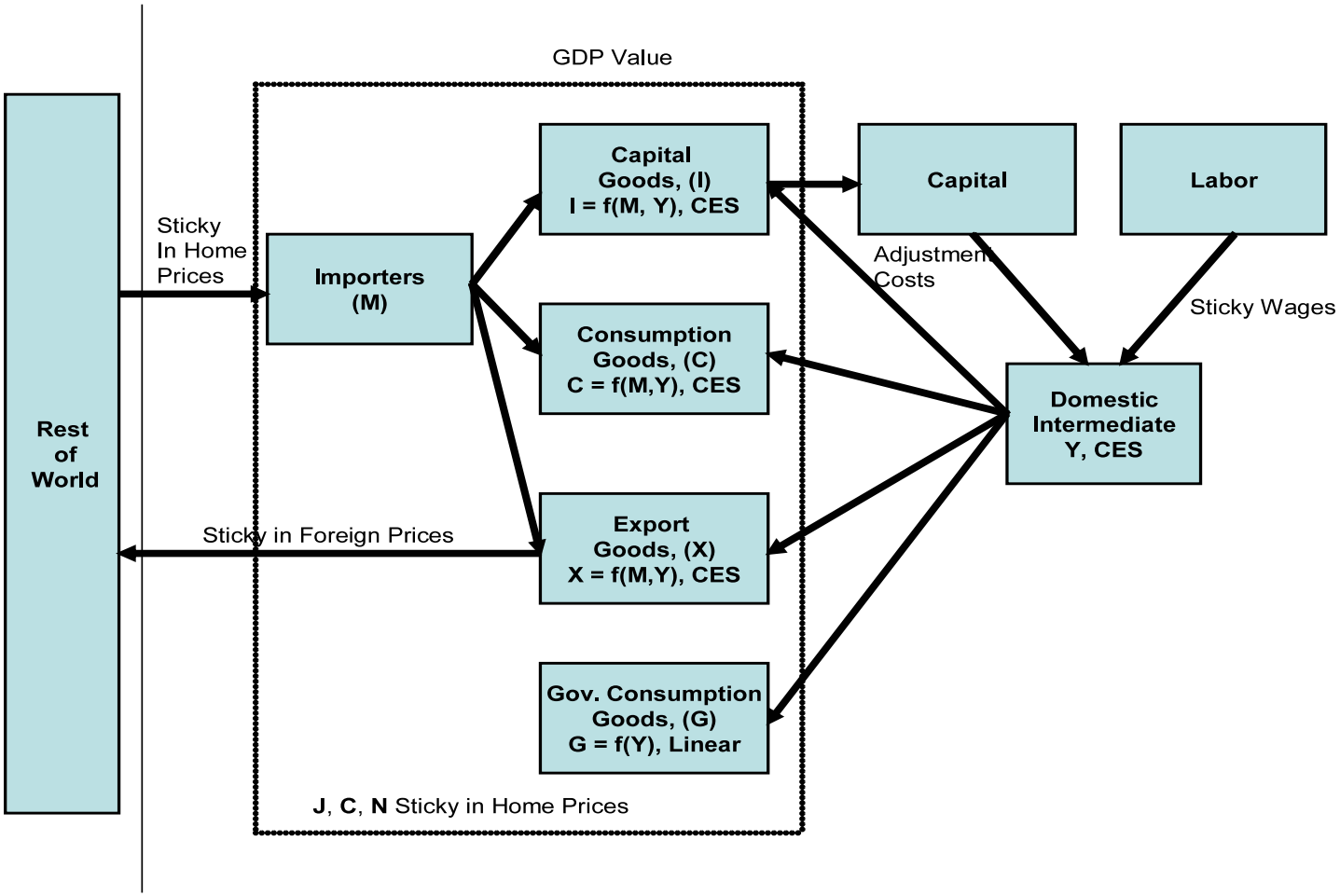


Figure: Structure of the Model

Added processes - households

- Regulated prices technology $a\dot{R}_t$
- Time-variant parameter κ_t^{euler}
- Time-varying parameters (a premium $prem_t$, κ_t^{forex}, and κ_t^{euler}) and an uncovered interest parity (UIP) shock ξ_t^{uip}

Added processes - production

- Export sector uses the intermediate import goods as one of its input
- Adjustment costs set to be zero for consumption, investment and export sectors
- We modified the export sector (two inputs)

Added processes - policy

- We modified a monetary policy rule and added relating equations. The motivation here is to get the model closer to the official monetary policy rule of the CNB.
- We modified a fiscal policy rule. It is not straightforward to model fiscal policy properly in a representative-agents type monetary DSGE model since agents are optimizing on the infinite future. Our second reason is that it is much simpler to obtain an analytical steady state through the modified setting.

Added processes - others

- Incorporation of the regulated prices technology to model a regulated prices sector.
- Incorporation of the export specific technology to incorporate Ballasha-Samuelson effect.
- Incorporation of the government specific technology to capture the government sector.
- Incorporation of the trade openness technology for the necessity of this technology for the Czech economy modelling.

Table: Estimated Parameters

Parameter		Prior	Dist	Post	Interval
Preferences					
Habits	h	0.900	gamma	0.9409	(0.9326 , 0.9513)
Labour supply coef.	ψ	8.832	gamma	8.8138	(8.7144 , 8.9094)
Frisch elasticity	γ	1.250	gamma	1.2556	(1.2330 , 1.2820)
Wedges					
Euler	κ^{euler}	1.0119	-	-	-
Forex	κ^{forex}	1.0034	-	-	-
Adjustment costs					
Investment	κ	20.000	gamma	20.1364	(20.0852 , 20.2006)
Capital utilization	$\gamma 2$	0.280	gamma	0.3229	(0.3054 , 0.3445)
Risk premium	Γ_{b_W}	0.800	beta	0.8027	(0.7564 , 0.8553)
Elasticities of substitution					
Domestic goods	ϵ	5.000	gamma	5.0035	(4.9562 , 5.0508)
Import goods	ϵ_M	9.000	gamma	9.0690	(9.0415 , 9.1017)
Export goods	ϵ_x	9.400	gamma	9.2646	(9.1852 , 9.3299)
World goods	ϵ_W	0.860	gamma	0.6938	(0.6090 , 0.7686)
Consumption goods	ϵ_c	7.600	gamma	7.6614	(7.6166 , 7.7022)
Investment goods	ϵ_i	7.600	gamma	7.5723	(7.5363 , 7.6029)
Labour types	η	7.000	gamma	7.0235	(7.0055 , 7.0428)

Table: Estimated Parameters

Parameter		Prior	Dist	Post	Interval
Price and wage setting					
Calvo dom. prices	θ_p	0.500	norm	0.6719	(0.6197 , 0.7600)
Calvo exp. prices	θ_x	0.080	gamma	0.2386	(0.1962 , 0.2814)
Calvo imp. prices	θ_M	0.750	norm	0.7309	(0.7046 , 0.7586)
Calvo wages	θ_w	0.380	norm	0.4519	(0.4302 , 0.4744)
Index. dom. prices	χ	0.750	gamma	0.7111	(0.6509 , 0.7688)
Index. imp. prices	χ_M	0.500	gamma	0.4519	(0.4187 , 0.4828)
Index. exp. prices	χ_x	0.350	gamma	0.3600	(0.3157 , 0.4191)
Index. wages	χ_w	0.920	gamma	0.9529	(0.9176 , 0.9859)
Monetary policy					
Taylor rule (int. rates)	γ_R	0.960	gamma	0.9544	(0.9389 , 0.9716)
Taylor rule (output gap)	γ_y	0.220	gamma	0.2233	(0.2109 , 0.2363)
Taylor rule (inflation)	γ_Π	1.150	gamma	1.1458	(1.1307 , 1.1600)
Home bias					
Home bias in consump.	n_c	0.280	beta	0.3453	(0.2878 , 0.4080)
Home bias in invest.	n_i	0.120	beta	0.3297	(0.2913 , 0.3608)
Home bias in export	n_x	0.550	-	-	-
Growth rates					
Invest. spec. tech.	Λ_μ	1.000	norm	1.0000	(0.9998 , 1.0002)
General tech.	Λ_A	1.009	norm	1.0090	(1.0088 , 1.0092)
Population	Λ_L	1.000	norm	1.0000	(0.9998 , 1.0001)
ER appreciation	$\dot{ex}$	0.994	norm	0.9942	(0.9940 , 0.9944)
Openness tech.	α_O	1.0035	-	-	-
Export spec. tech.	α_X	1.0058	-	-	-

Table: Estimated Parameters

Parameter		Prior	Dist	Post	Interval
AR coefs of shocks					
Intertemp. preferences.	ρ_d	0.550	beta	0.5370	(0.5163 , 0.5675)
Hours preferences.	ρ_φ	0.400	-	-	-
Public consumption	ρ_g	0.750	beta	0.7758	(0.7107 , 0.8488)
Foreign prices	ρ_{π_W}	0.300	beta	0.2992	(0.2839 , 0.3161)
Foreign demand	ρ_{y_W}	0.750	beta	0.7680	(0.7489 , 0.7884)
World interest rate	ρ_{R_W}	0.825	beta	0.8365	(0.8060 , 0.8600)
Foreign debt	ρ_{b_W}	0.450	beta	0.4061	(0.3605 , 0.4439)
Regulated prices	ρ_{aR}	0.300	-	-	-
General tech.	ρ_A	0.750	-	-	-
Export specific tech.	ρ_{aX}	0.200	-	-	-
Wedge euler	ρ_{euler}	0.500	-	-	-
Wedge forex	ρ_{forex}	0.600	-	-	-
Standard devs of shocks					
Invest. spec. tech.	σ_μ	0.045	invg	0.2048	(0.1747 , 0.2324)
General tech.	σ_A	0.010	invg	0.0078	(0.0045 , 0.0110)
Intertemp. preferences	σ_d	0.250	invg	0.1831	(0.1634 , 0.2087)
Hours preferences	σ_φ	0.001	invg	0.0009	(0.0002 , 0.0015)
Monetary policy	σ_m	0.008	invg	0.0033	(0.0027 , 0.0038)
Foreign prices	σ_{π_W}	0.010	invg	0.0097	(0.0082 , 0.0112)
Foreign demand	σ_{y_W}	0.310	invg	0.1681	(0.1456 , 0.1883)
World interest rate	σ_{R_W}	0.003	invg	0.0012	(0.0010 , 0.0014)

Model estimation

Table: Estimated Parameters

Parameter		Prior	Dist	Post	Interval
Premium	σ_{prem}	0.400	invg	0.3140	(0.2454 , 0.3652)
Openness	σ_{aO}	0.095	invg	0.0609	(0.0448 , 0.0749)
Regulated prices	σ_{aR}	0.012	invg	0.0111	(0.0089 , 0.0133)
Government specific	σ_{aG}	0.038	invg	0.0269	(0.0199 , 0.0337)
Population	σ_L	0.0001	-	-	-
Government	σ_g	0.0001	-	-	-
Export specific	σ_{aX}	0.0001	-	-	-
Target	σ_{target}	0.0100	-	-	-
UIP	σ_{uip}	0.0001	-	-	-
Wedge forex	σ_{forex}	0.0100	-	-	-
Wedge euler	σ_{euler}	0.0100	-	-	-
Std of measurement errors					
Exchange rate	σ_{EX}	0.001	invg	0.0009	(0.0002 , 0.0016)
Domestic interest rate	σ_R	0.001	invg	0.0009	(0.0002 , 0.0016)
Foreign interest rate	σ_{RW}	0.001	invg	0.0008	(0.0002 , 0.0016)
Domestic inflation	σ_{CPI}	0.100	invg	0.0900	(0.0657 , 0.1128)
Foreign inflation	σ_{PIW}	0.100	invg	0.0643	(0.0295 , 0.1045)
Import prices inflation	σ_{PM}	2.000	invg	2.0983	(2.0442 , 2.1381)
Export prices inflation	σ_{PX}	3.000	invg	3.2641	(3.1952 , 3.3376)
Investment prices inflation	σ_{PI}	4.000	invg	4.0216	(3.9240 , 4.0849)
Population	σ_L	10.000	invg	9.3616	(9.3189 , 9.4103)
Consumption	σ_C	5.000	invg	5.3204	(5.2871 , 5.3603)
Investment	σ_I	4.000	invg	4.1811	(4.1423 , 4.2135)
Export	σ_X	10.000	invg	9.9154	(9.8412 , 9.9854)
Import	σ_M	10.000	invg	9.9734	(9.8564 , 10.0801)
Foreign demand	σ_{YW}	10.000	invg	10.0867	(10.0176 , 10.1802)
Nominal wages	σ_W	1.000	invg	0.8639	(0.8339 , 0.8987)
Government spending	σ_G	5.000	invg	5.1637	(5.1101 , 5.2234)

Model Behaviour

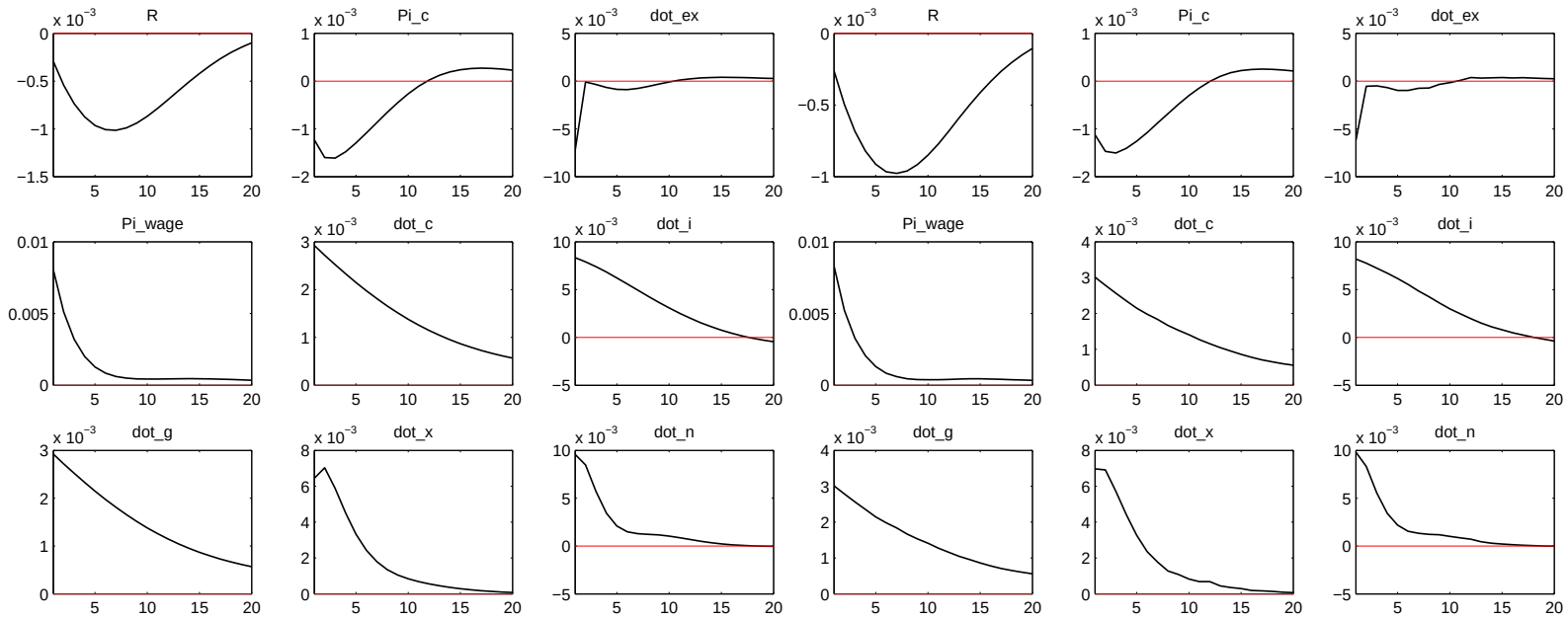


Figure: Technology shock

Model Behaviour

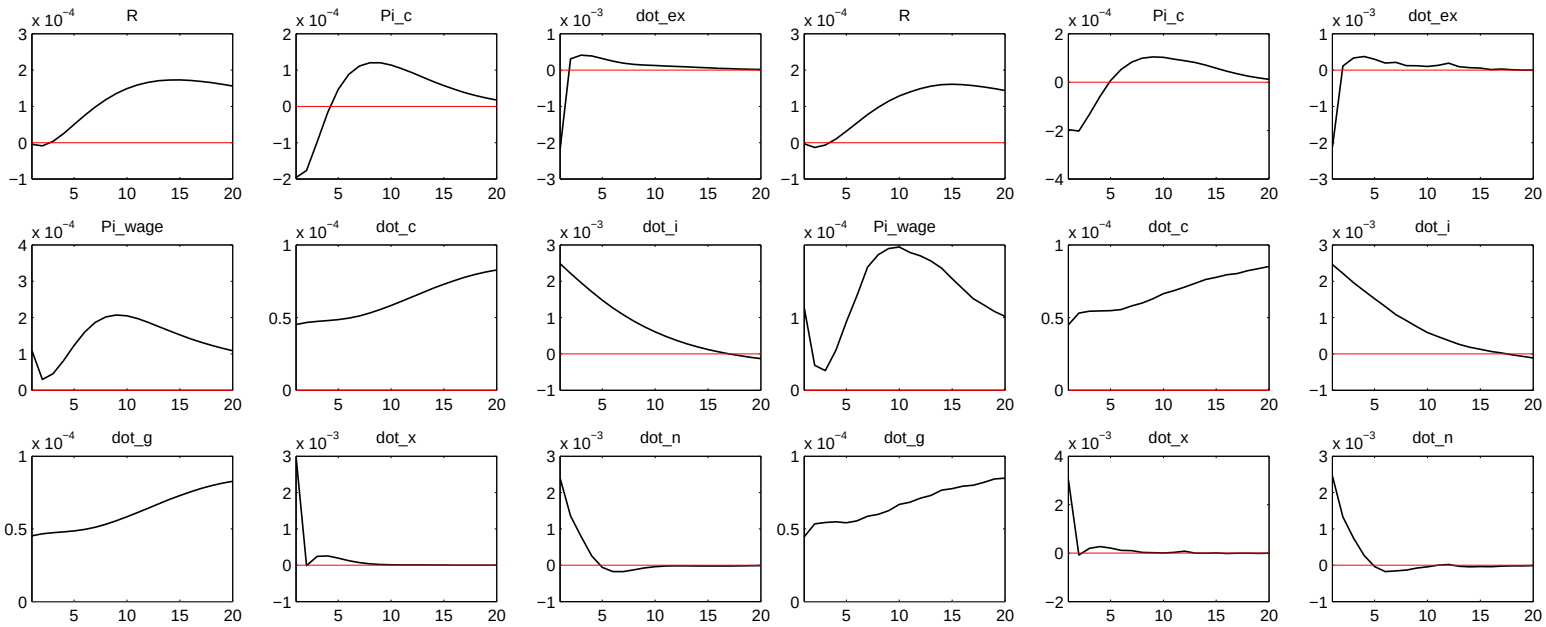


Figure: Investment specific technology shock

Model Behaviour

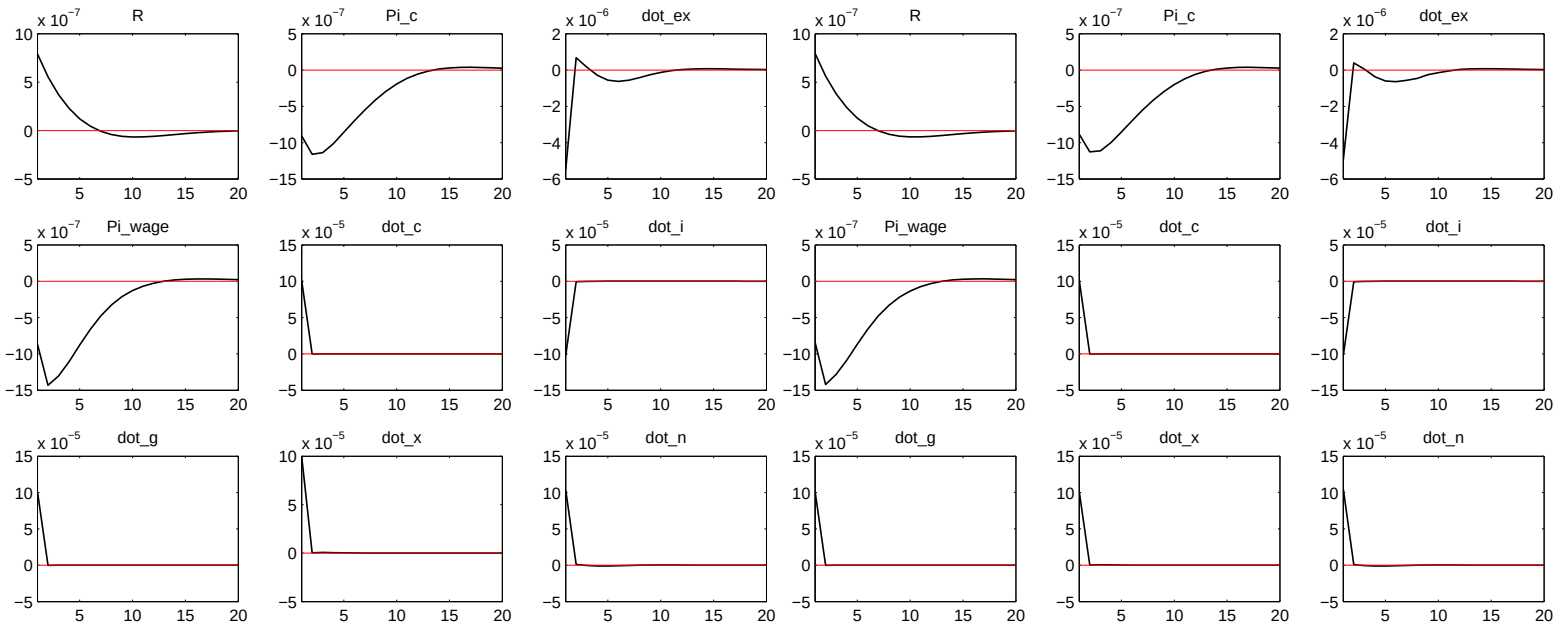


Figure: Population shock

Model Behaviour

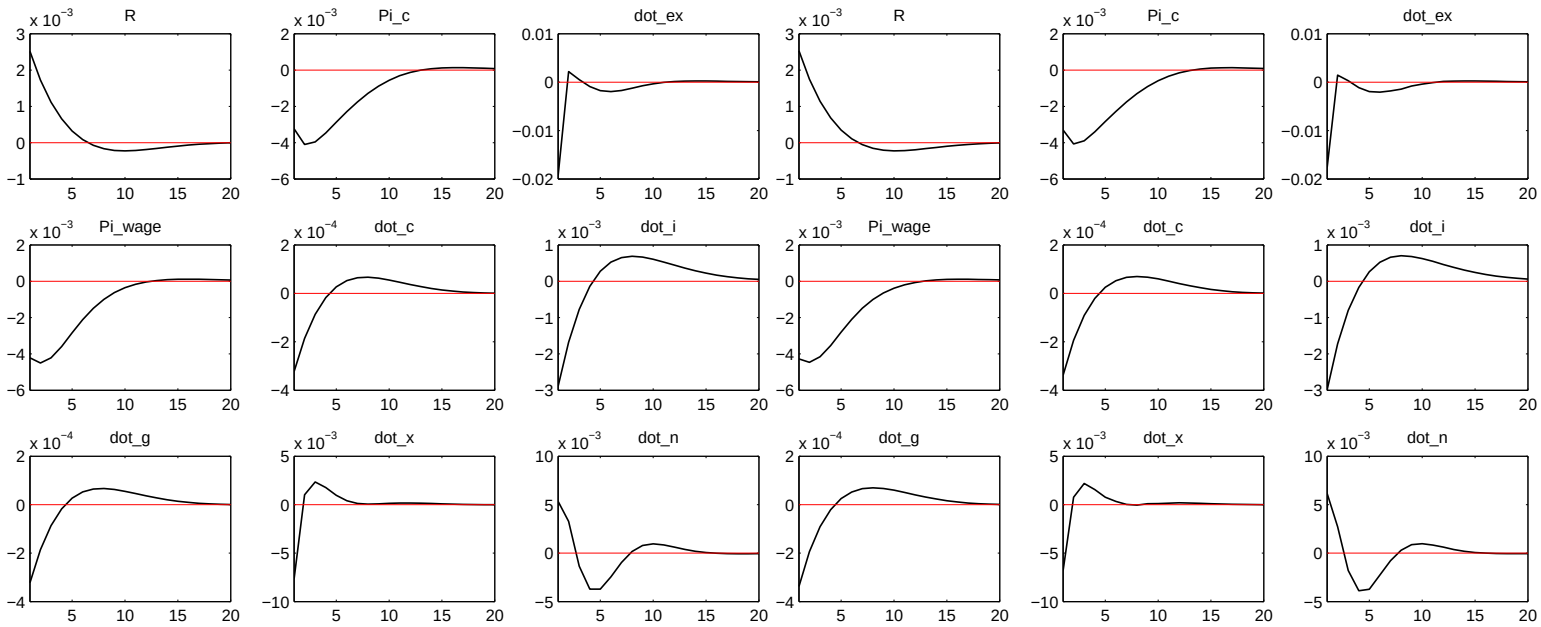


Figure: Monetary policy shock

Model Behaviour

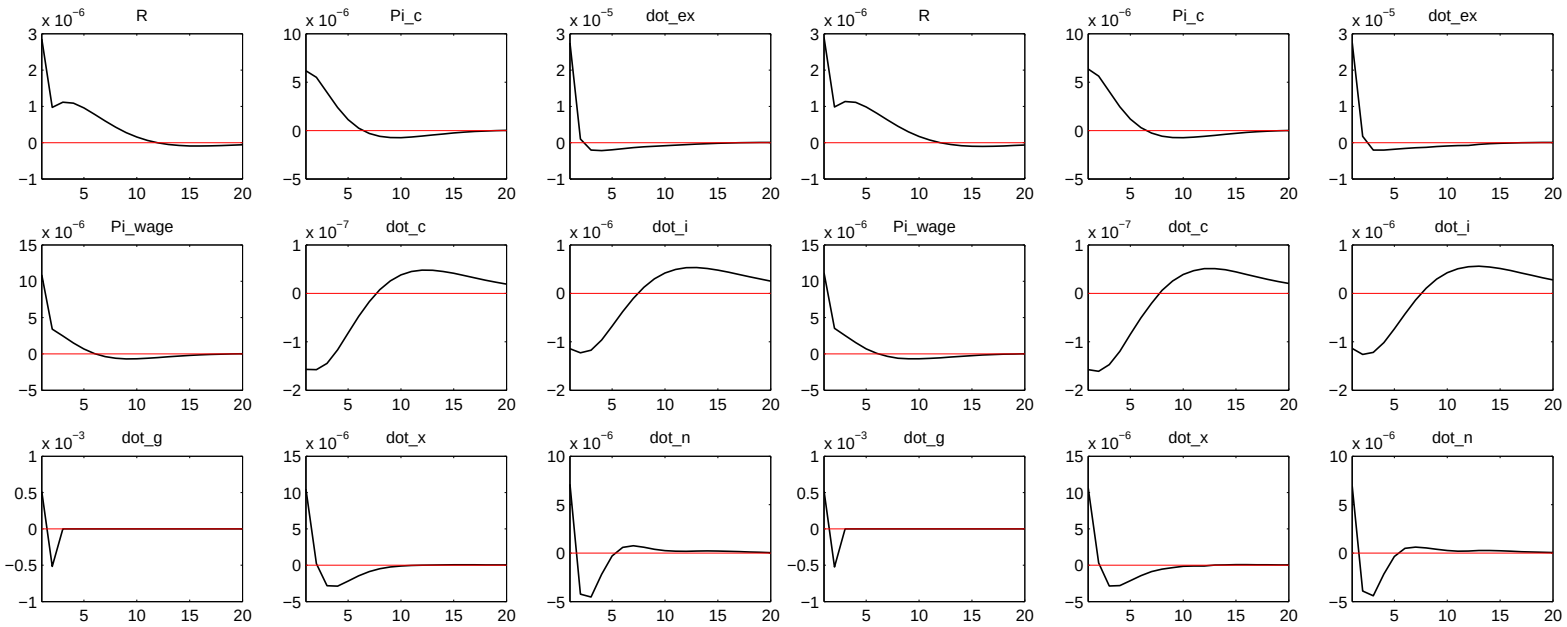


Figure: Government real consumption shock

Model Behaviour

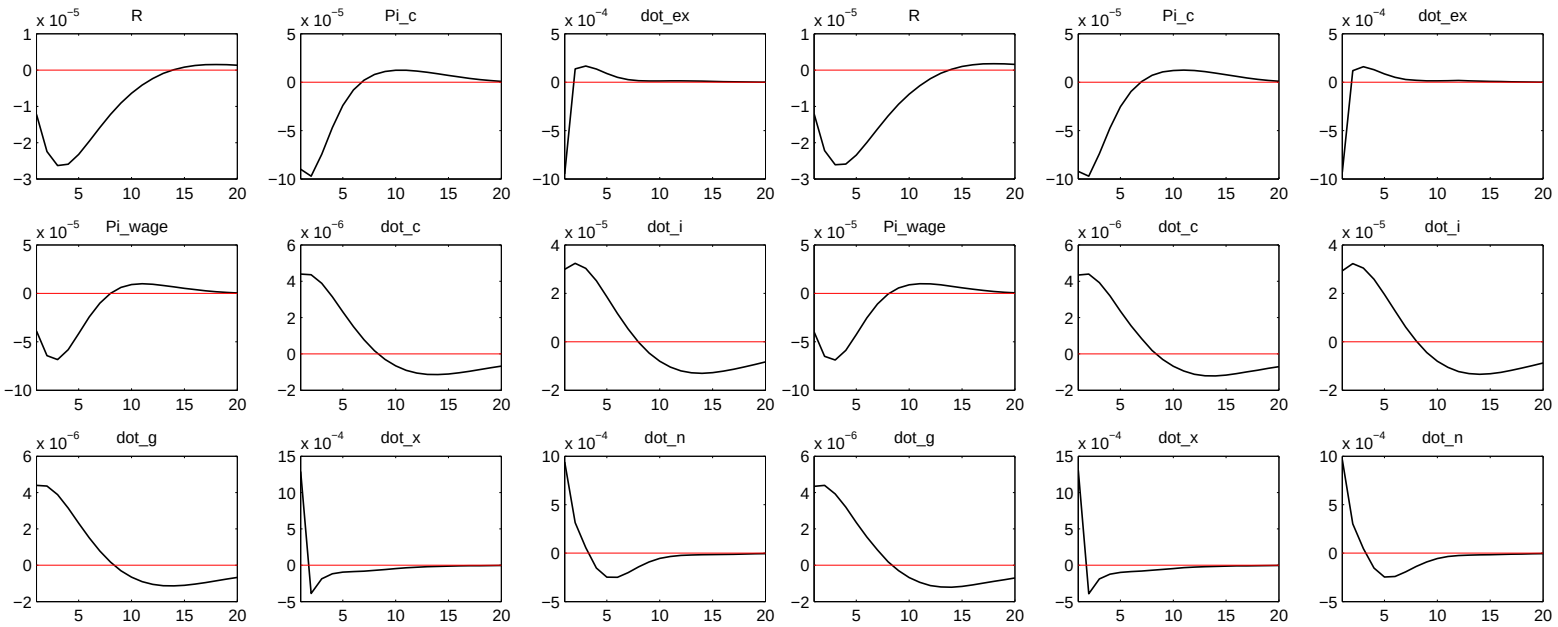


Figure: Foreign demand shock

Model Behaviour

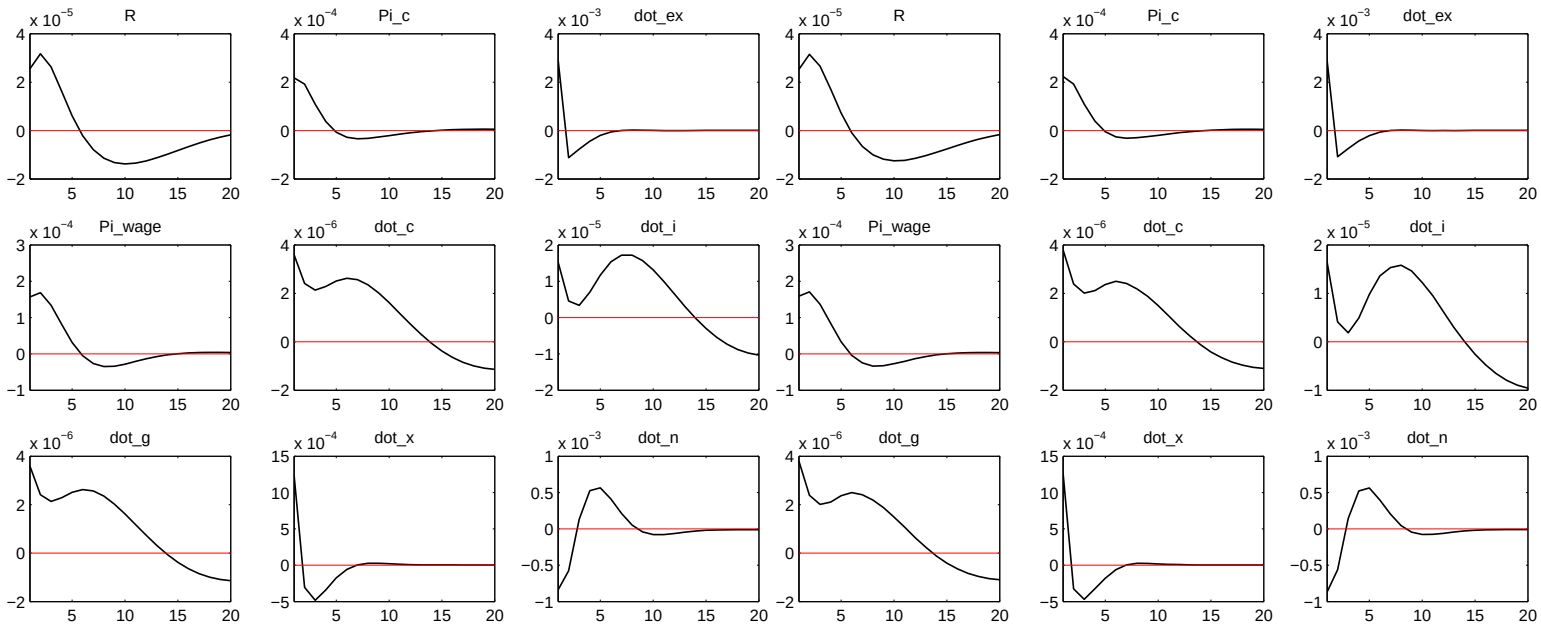


Figure: Foreign interest rate shock

Model Behaviour

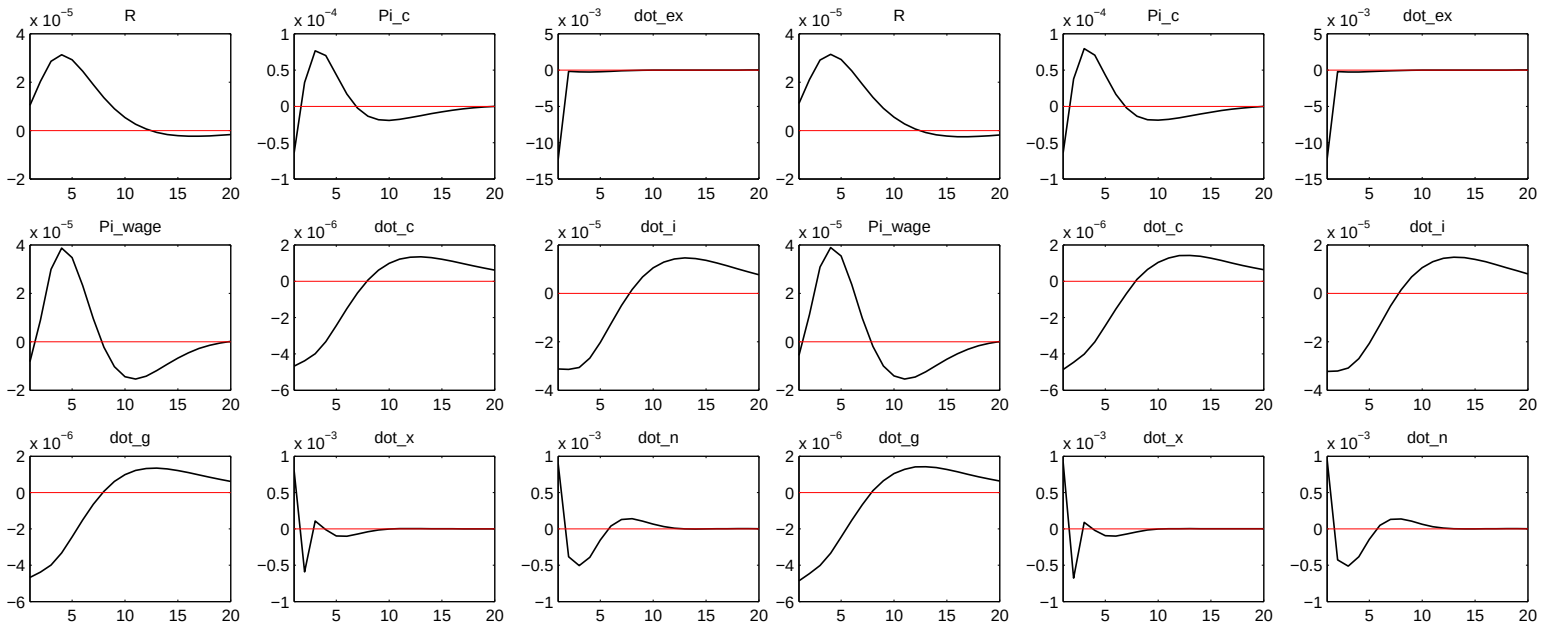


Figure: Foreign prices shock

Model Behaviour

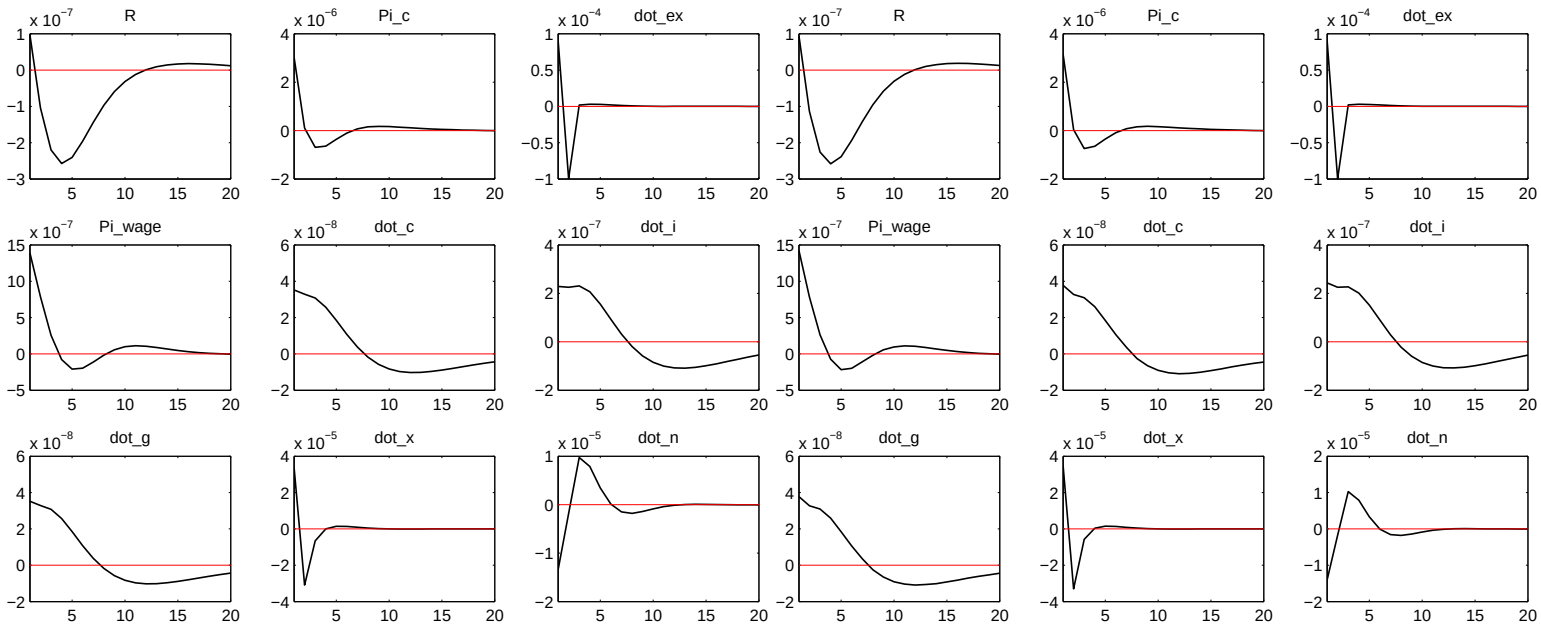


Figure: UIP shock

Model Behaviour

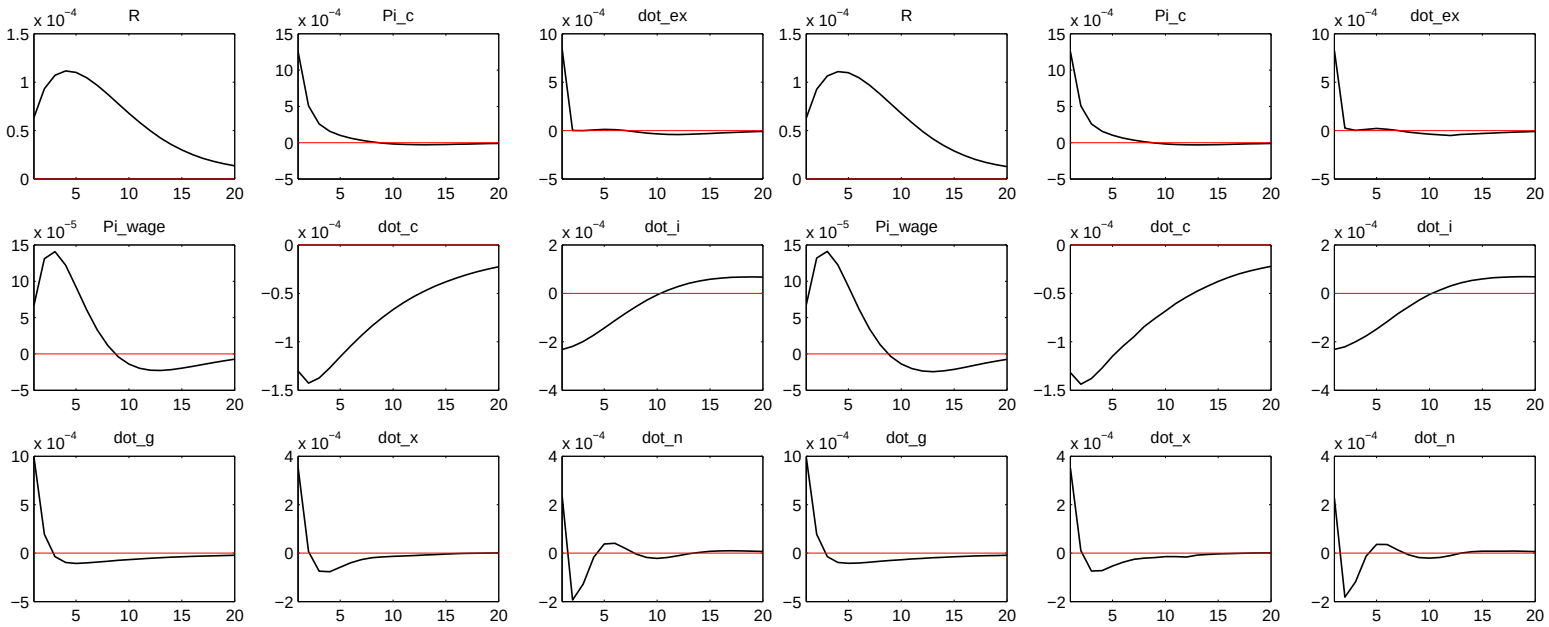


Figure: Regulated prices shock

Model Behaviour

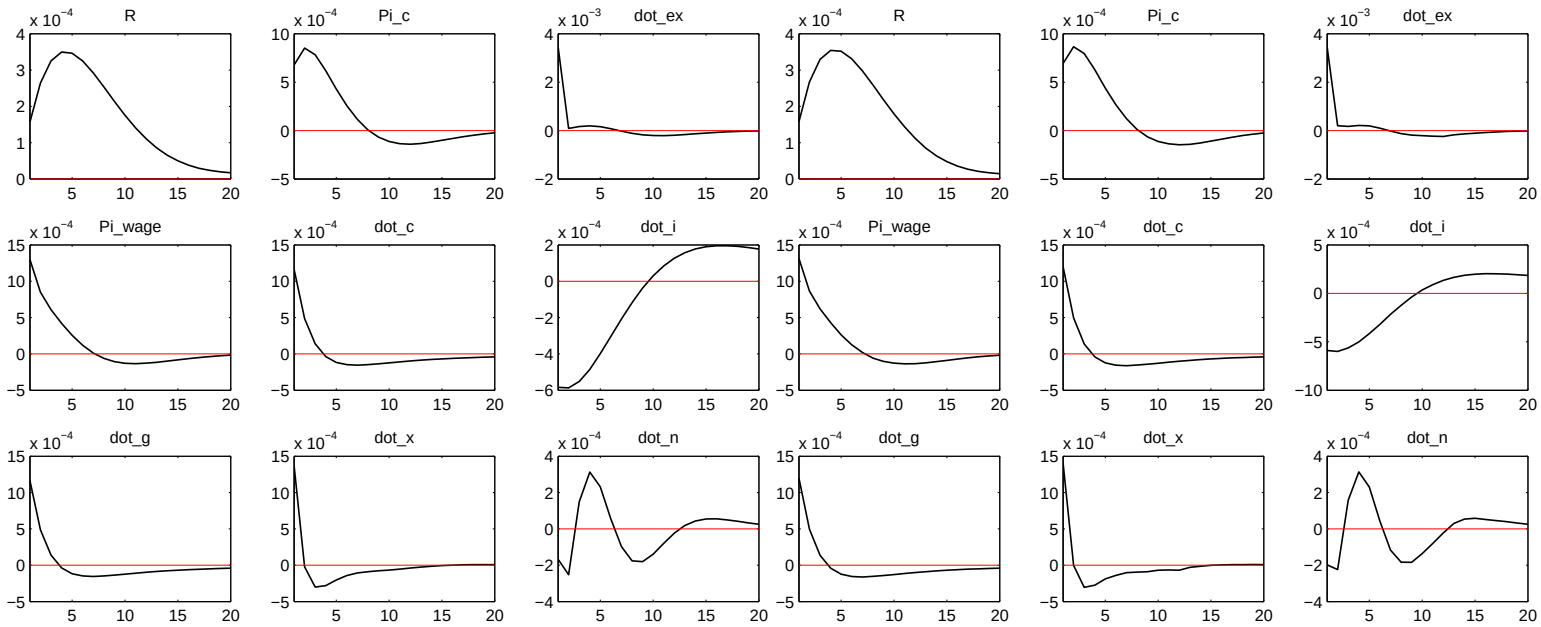


Figure: Preference shock

Model Behaviour

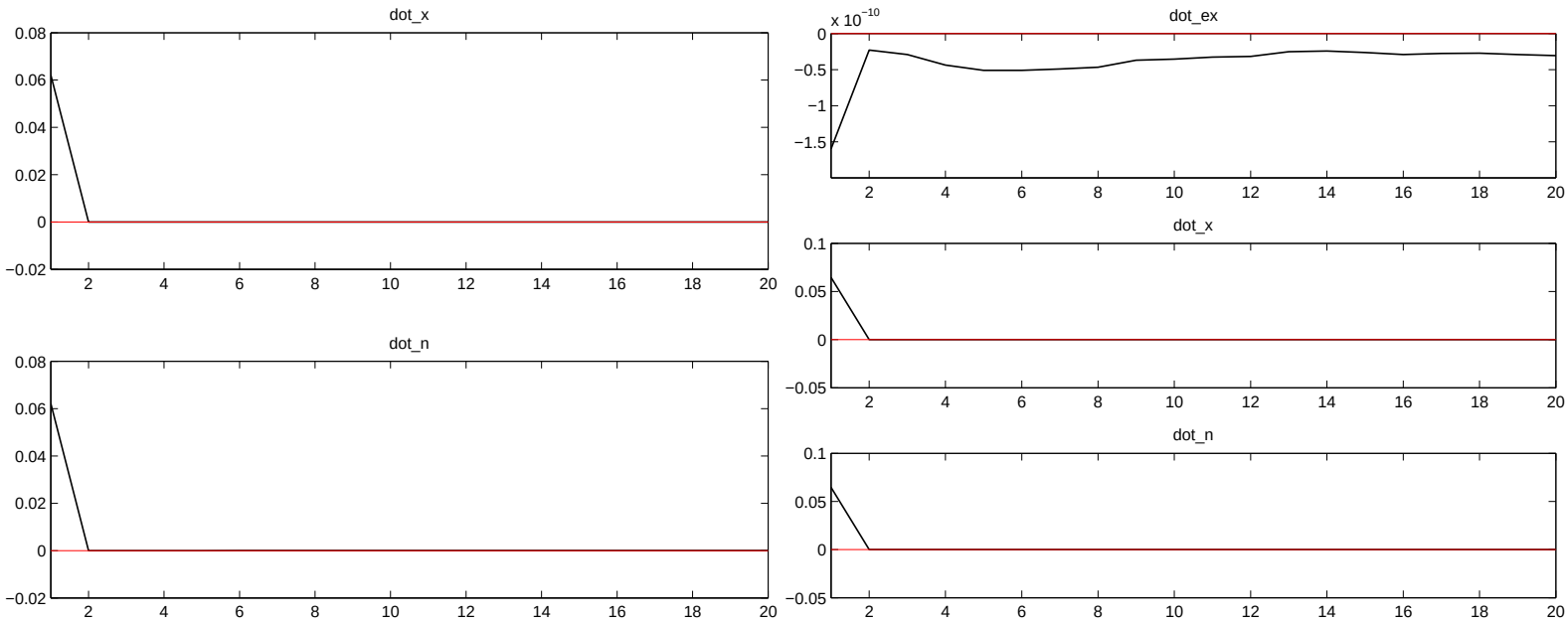


Figure: Export specific technology shock

Model Behaviour

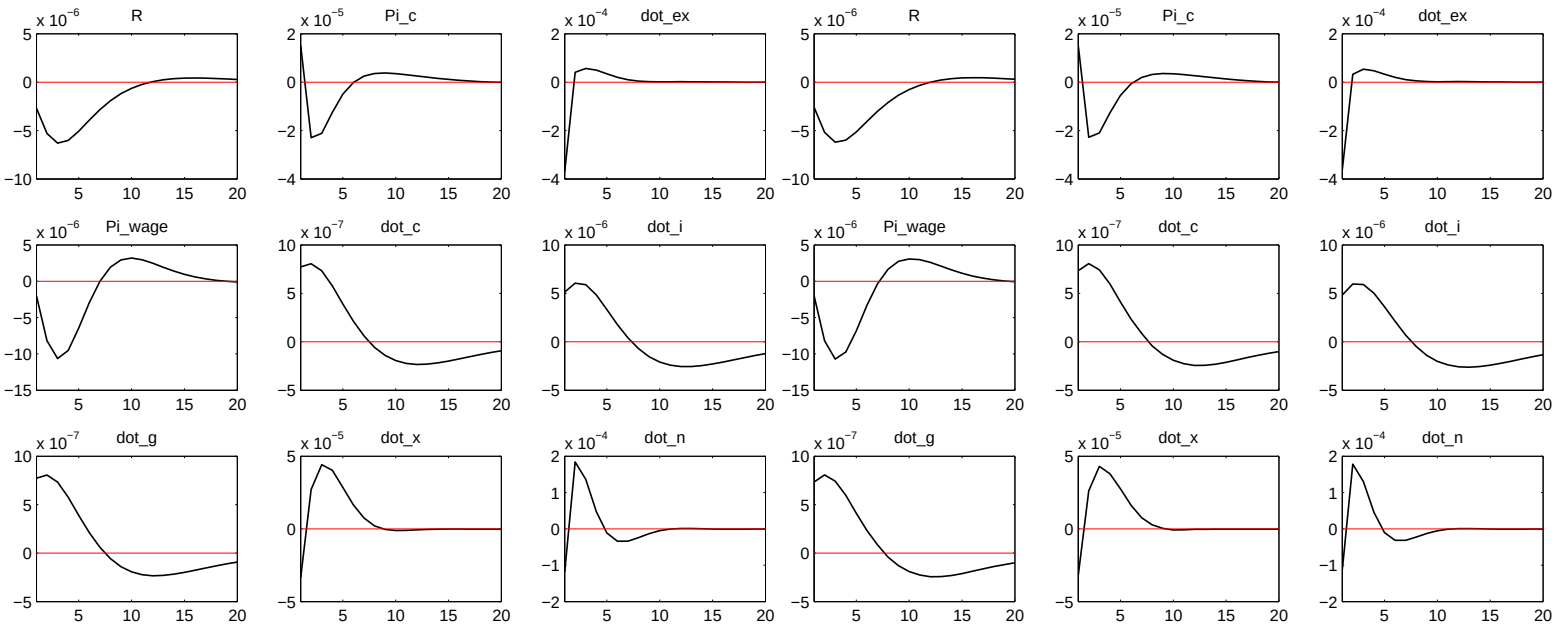


Figure: Export specific technology shock

Model Applications

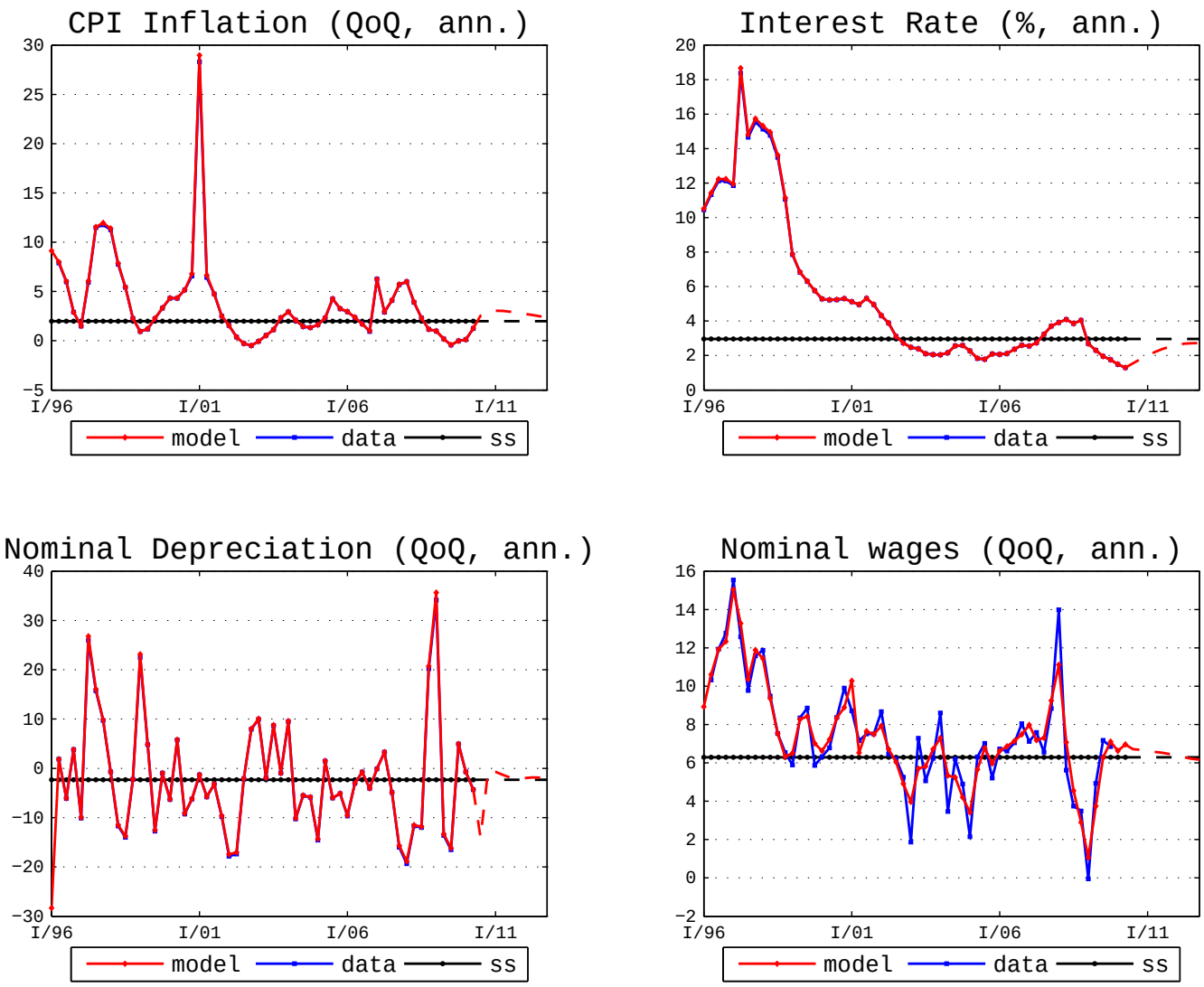


Figure: Filtration and Forecast

Model Applications

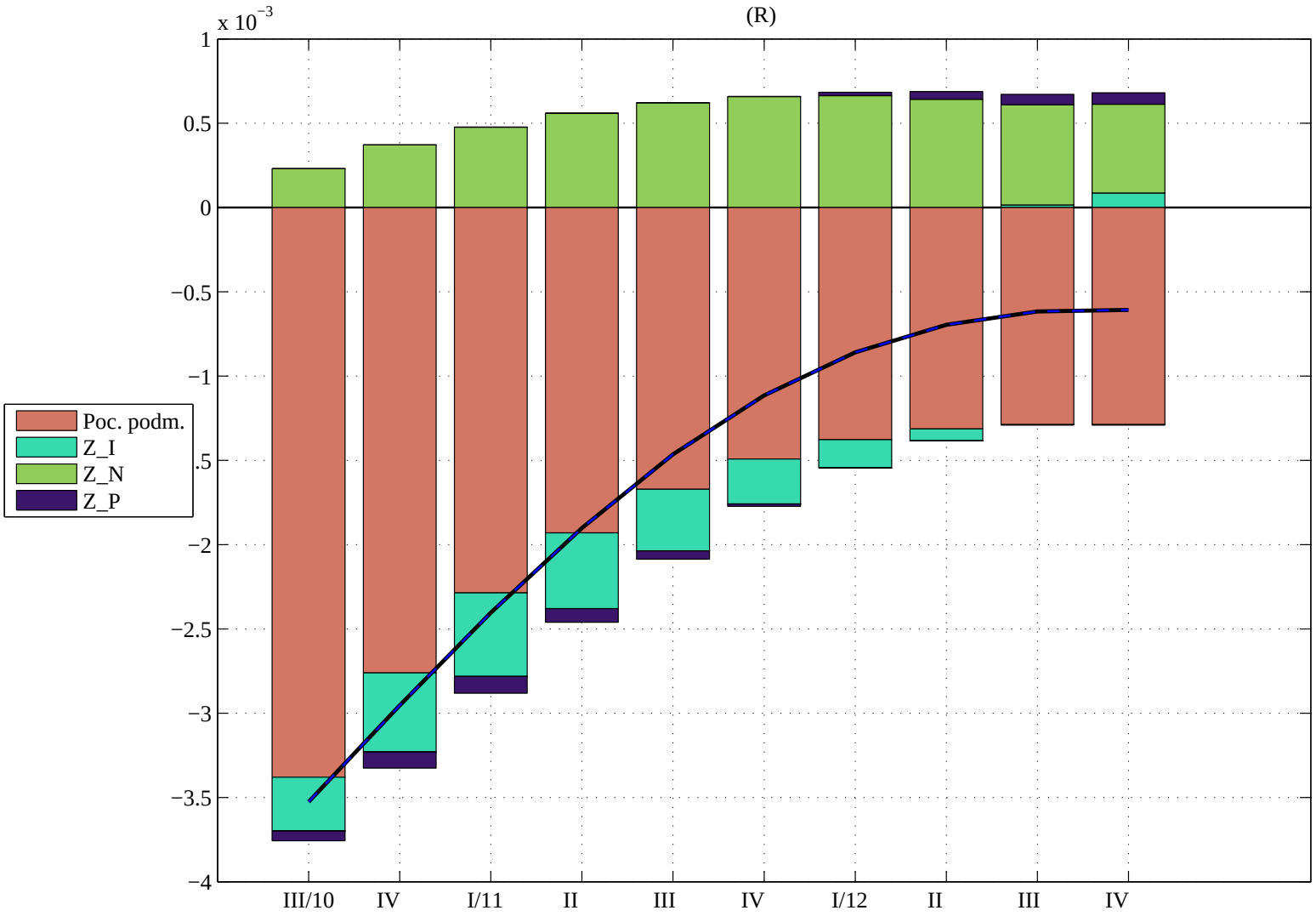


Figure: Decomposition of Interest Rate Forecast

Model Applications

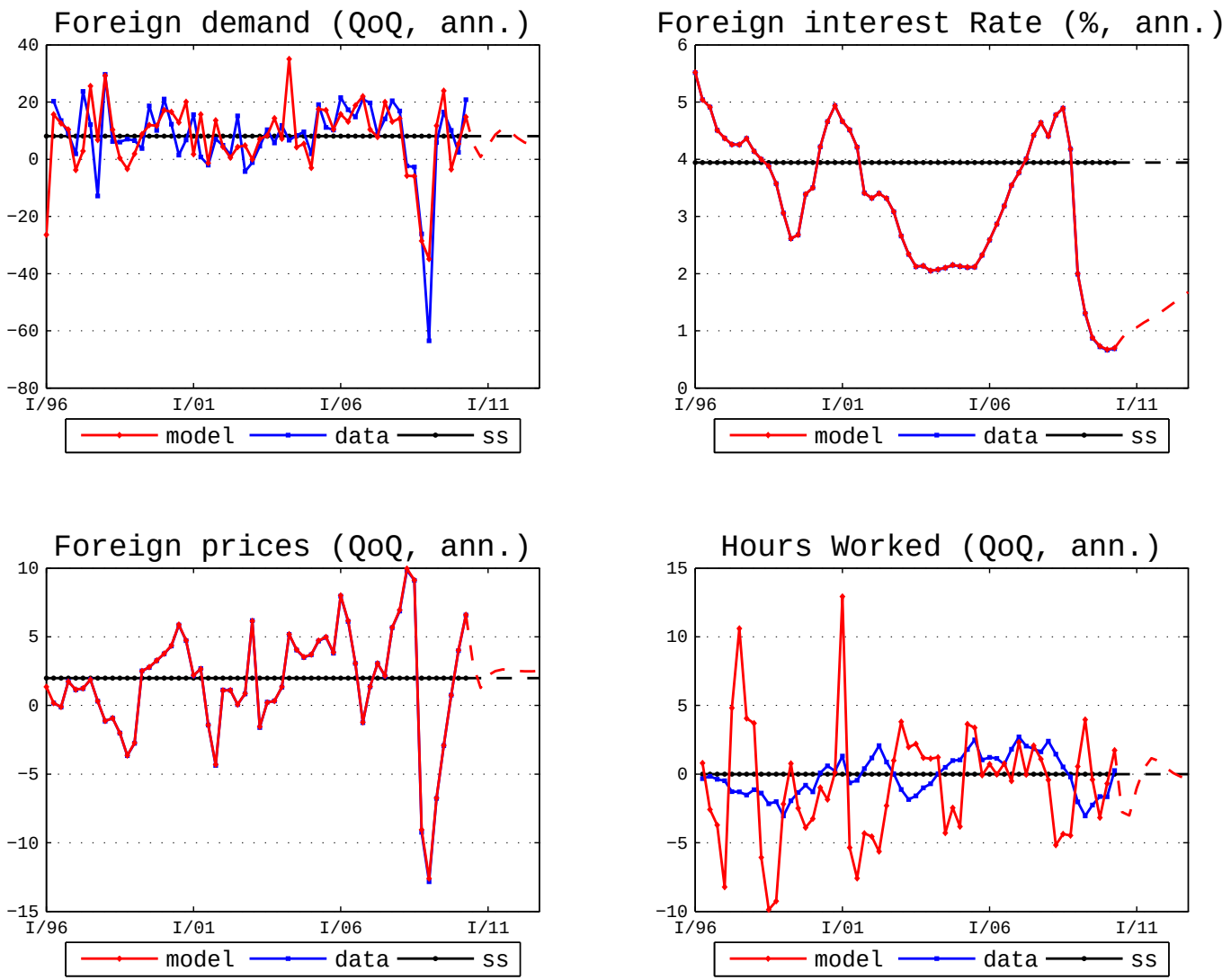


Figure: Filtration and Forecast

Model Applications

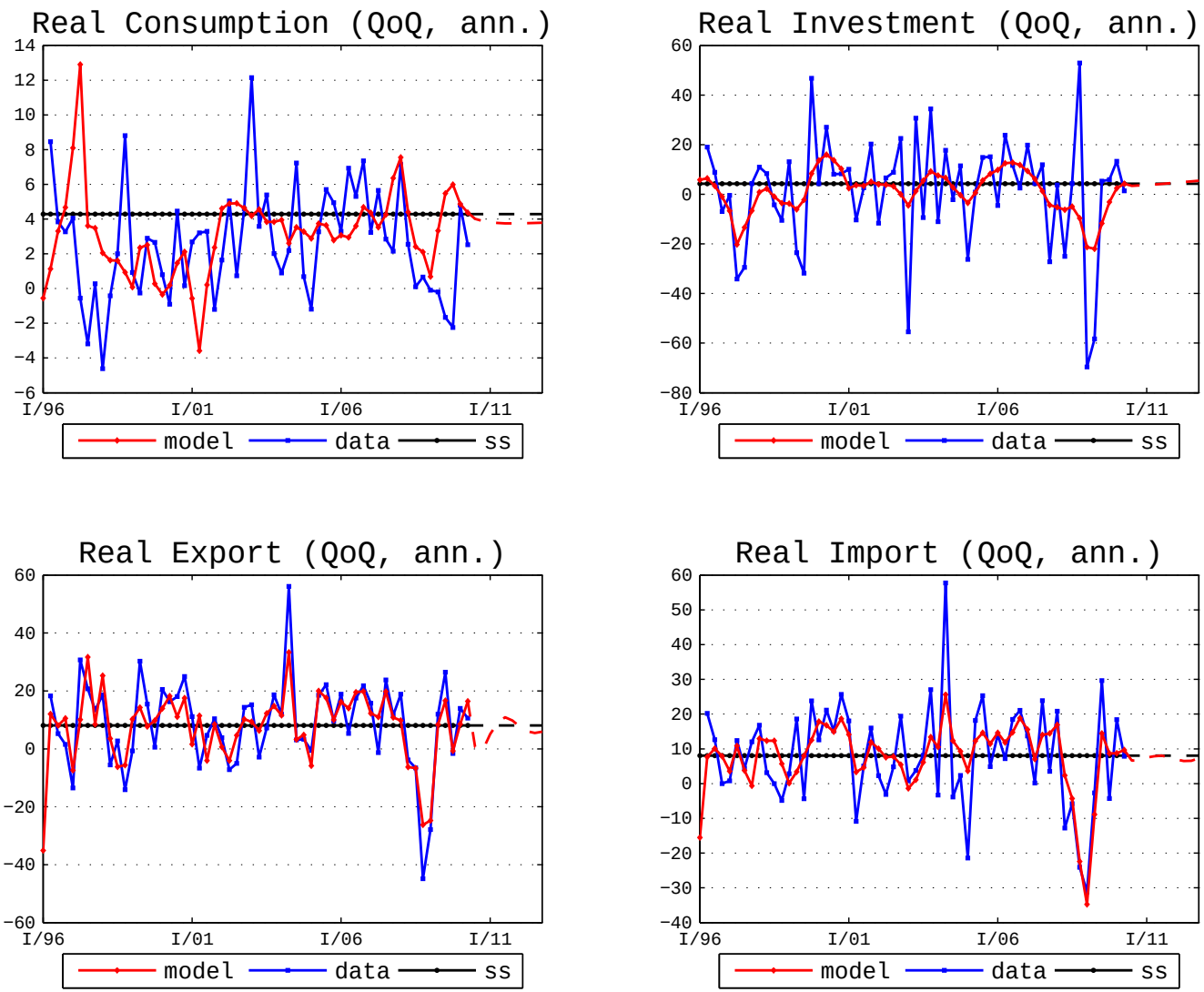


Figure: Filtration and Forecast

Model Applications

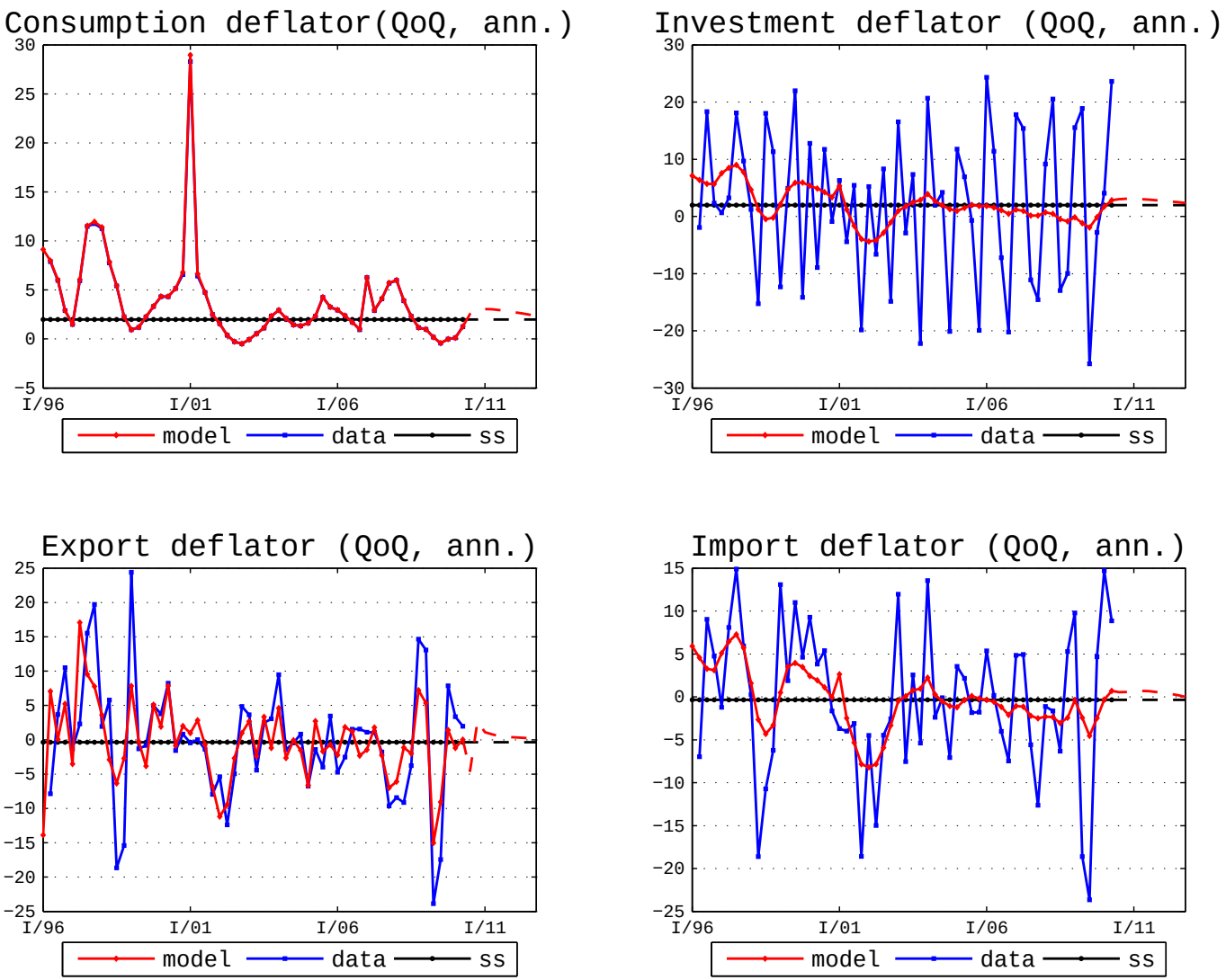


Figure: Filtration and Forecast

Model Applications

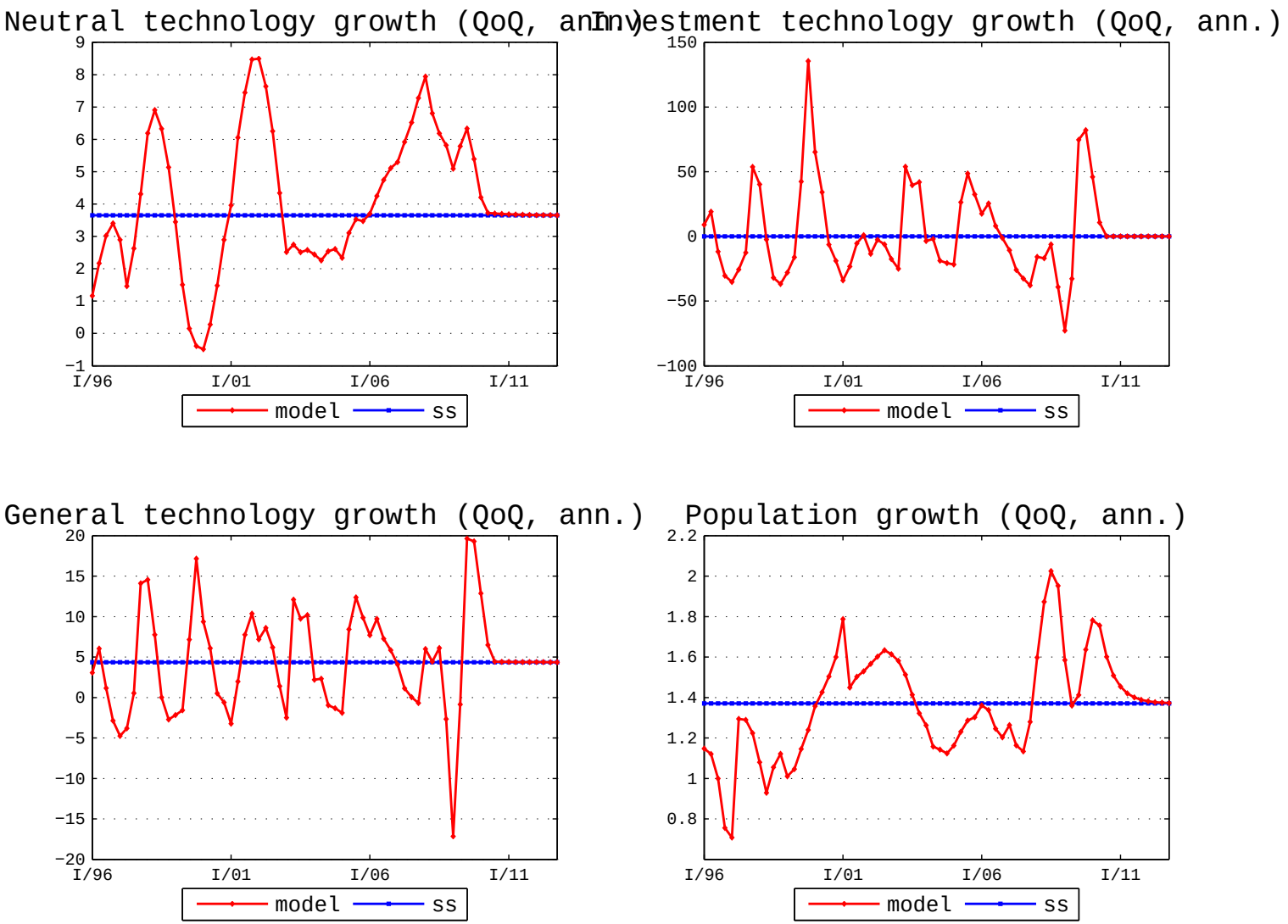
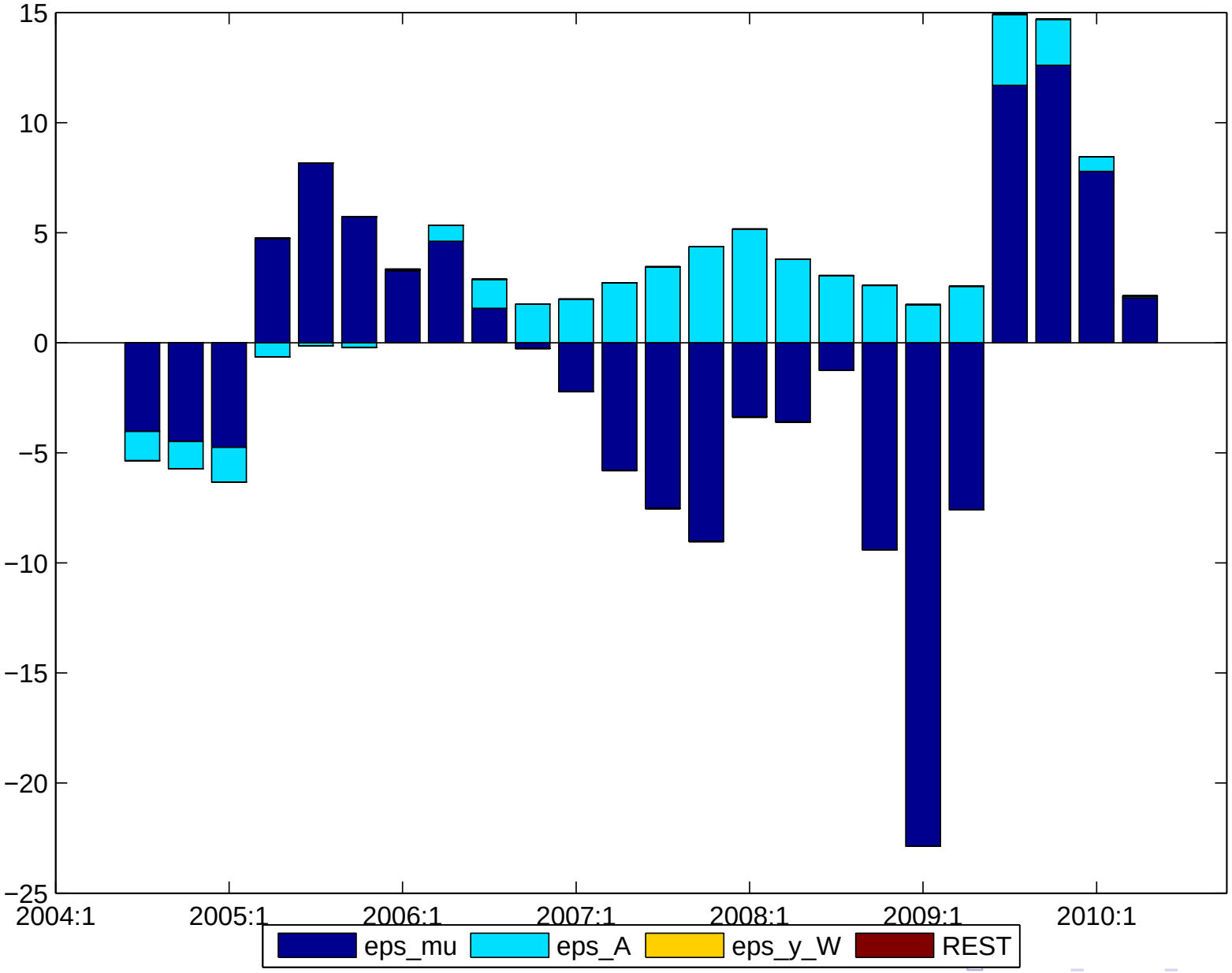


Figure: Filtration and Forecast

Model Applications



Model Applications

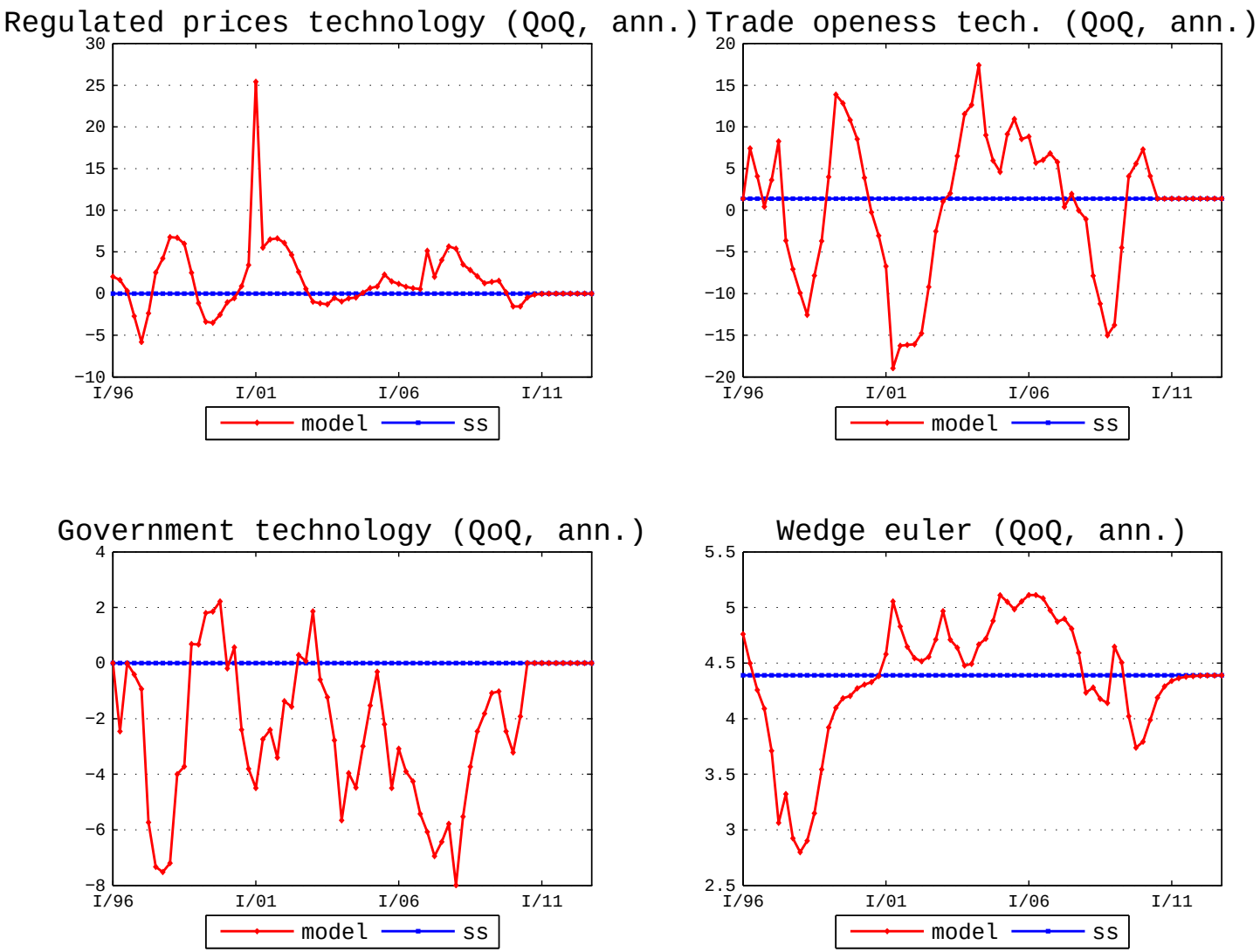


Figure: Filtration and Forecast

Model Applications

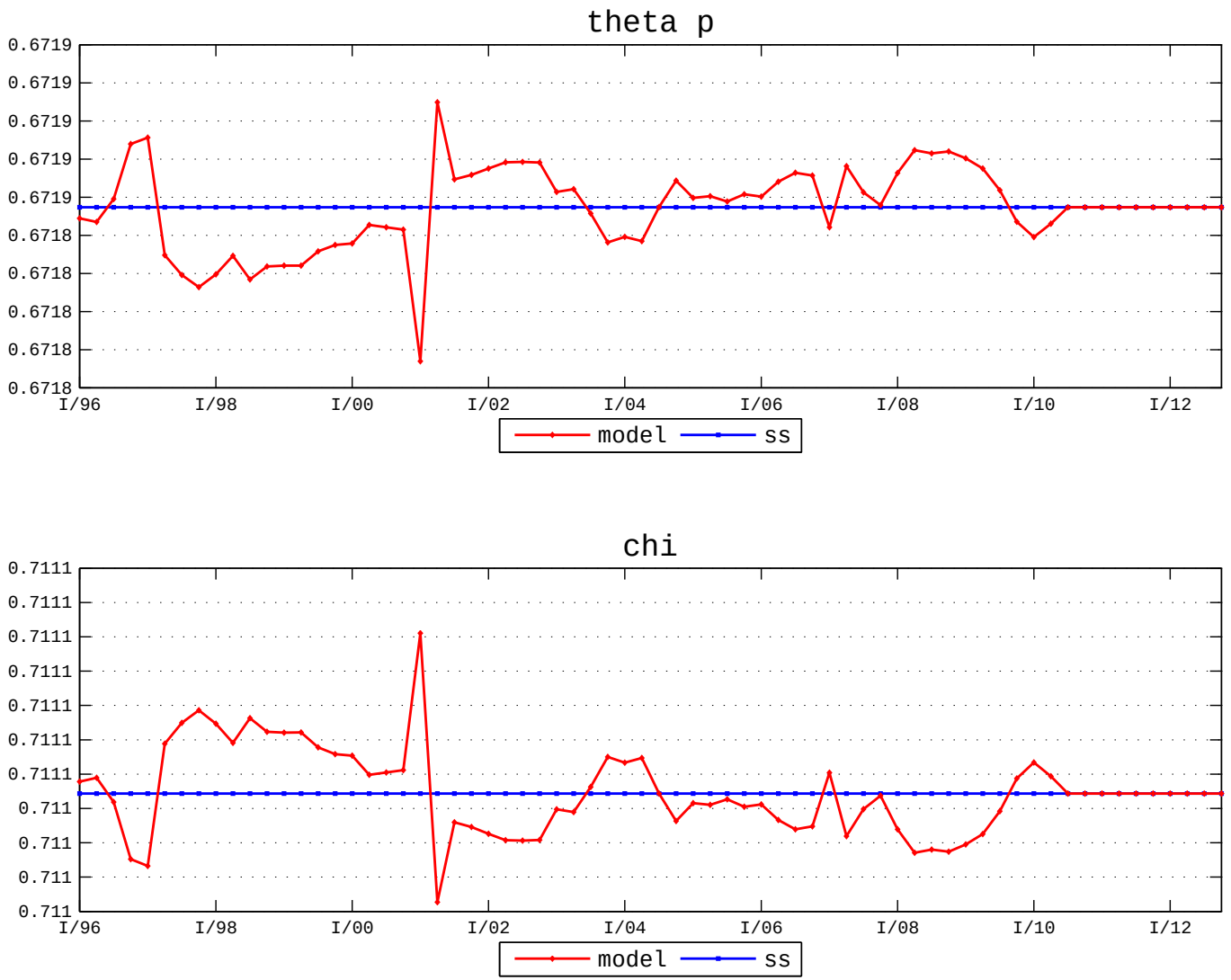


Figure: Filtration and Forecast

Model Applications

The first order approximation is

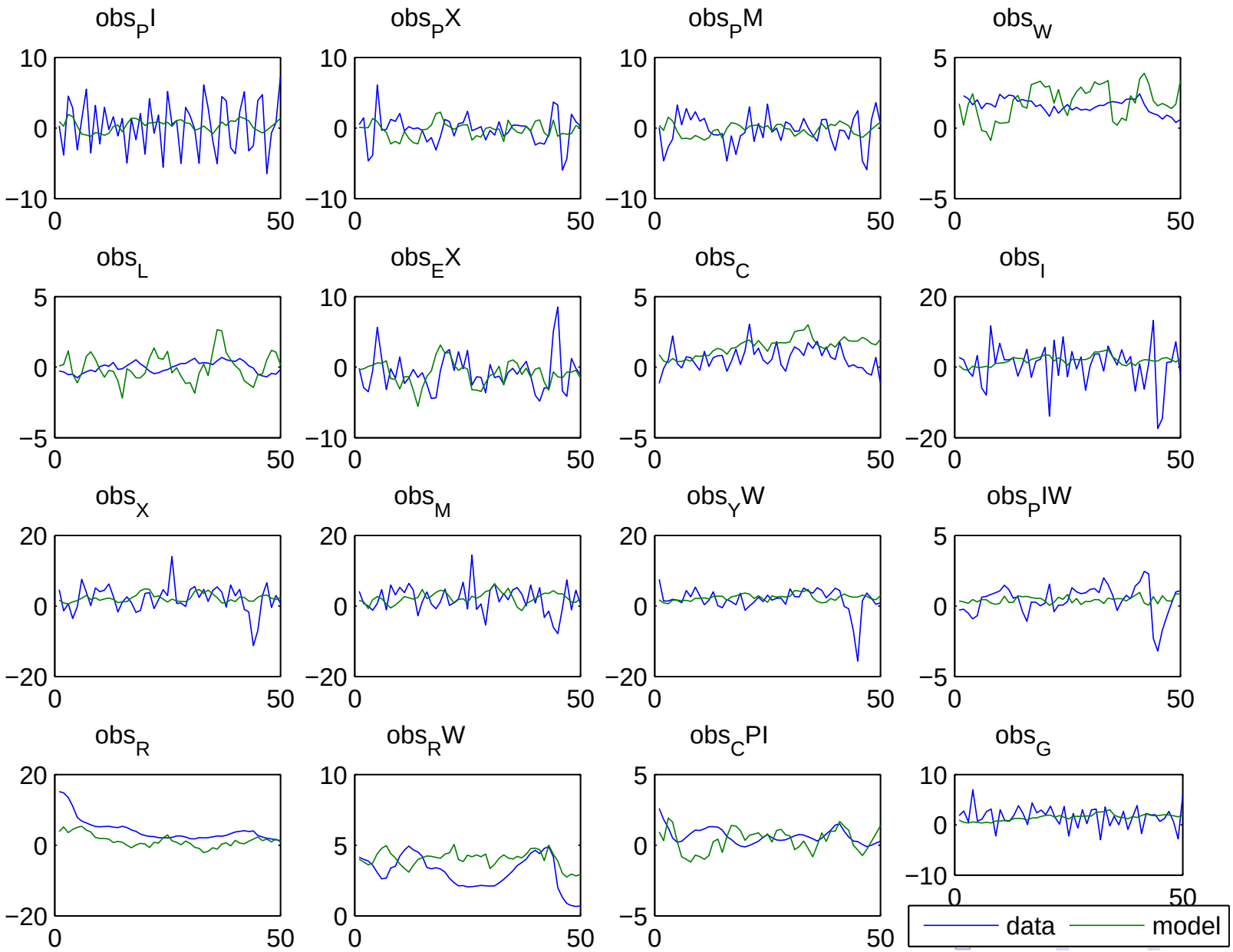
$$y_t = y_s + Ayh_{t-1} + Bu_t$$

where ys is the steady state value of y and $yh_t = y_t - ys$.
The second order approximation is

$$\begin{aligned} y_t = ys + 0.5\Delta^2 + Ayh_{t-1} + Bu_t + 0.5C(yh_{t-1} \otimes yh_{t-1}) \\ + 0.5D(u_t \otimes u_t) + E(yh_{t-1} \otimes u_t) \end{aligned}$$

where ys is the steady state value of y, $yh_t = y_t - ys$, and Δ^2 is the shift effect of the variance of future shocks.

Model Applications



Model Applications

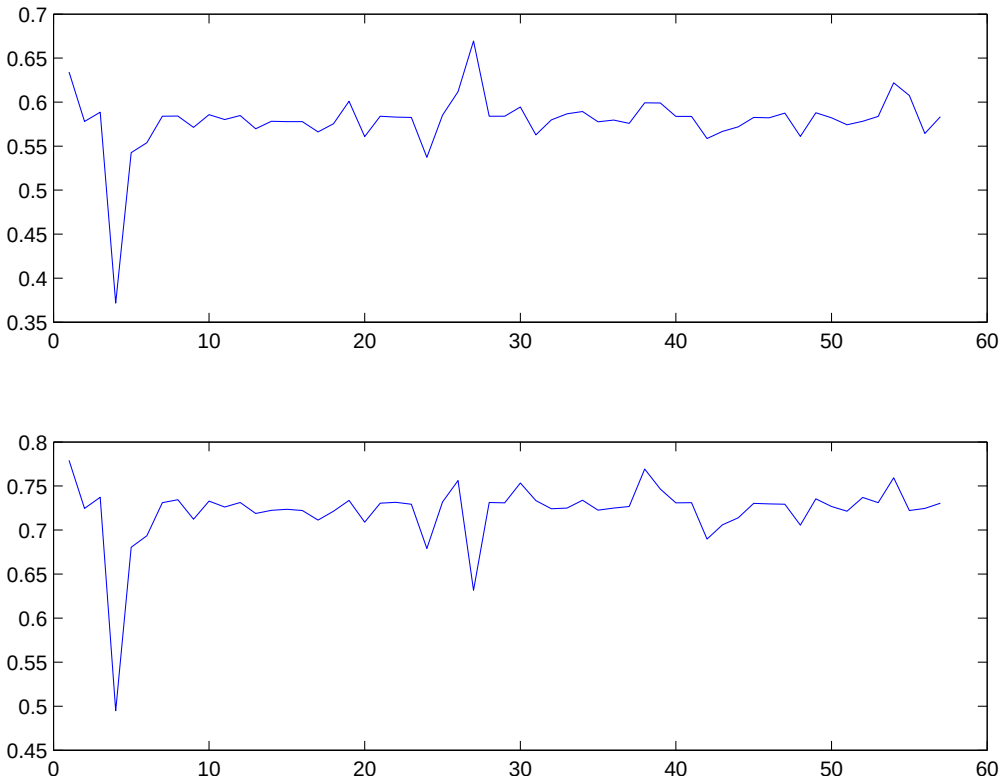


Figure: Nonlinear Parameter Filtration

Conclusions

This work should bring following benefits:

- Qualitative improvements of understanding influences of especially monetary authority on economic environment.
- A complex overview of existing methods and instruments for DSGE model identification with description of necessary advantages and disadvantages.
- New challenges which occur when time - variant parameters are introduced.

Closing

Thank you for your attention

Related papers of the authors are available on IS MUNI or:

jtonner@tiscali.cz