Extended DSGE Model of the Czech Economy

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Moderní nástroje pro finanční analýzu a modelování

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Outline

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DSGE Modelling in General...

- Forecast model scenario for quarterly Macroeconomic Forecast
- Simulations for strategic documents (Convergence Programme, Fiscal Outlook) and ad hoc analysis

≫ HUBERT - Dynamic Stochastic General Equilibrium model.

- We began from a small simple model (households, firms, government, central bank, foreign sector)
- two extensions were made:
  1. households and fiscal block
  2. domestic demand (consumption and investments)
     net export (exports and imports)

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Building Blocks of the Model

Households

- Infinitely lived agents;
- Habit formation for smoother consumption;
- Savers and Spenders.

Firms

- Cobb-Douglas production function, CES aggregation ;
- Price takers assumption;
- Calvo pricing.

Governmental authorities

- Monetary policy: Taylor rule;
- Fiscal policy: aggregated revenues and expenditures, fiscal rule focused on debt stability.

Foreign sector

- Approximated by EA aggregate;
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Households - main equations:

$$E_t \sum_{n=0}^{\infty} \beta^n U_{j,t+n} = E_t \sum_{n=0}^{\infty} \beta^n \left[\log\left(C^R_{j,t+n} - H_{j,t+n}\right) - \frac{(N^R_{j,t+n})^{1+\psi_N}}{1+\psi_N} \right] \quad (1)$$

$$(1+\tau^c_t)P^C_t C^R_{j,t} + P^I_t I_{j,t} + P_t a(u_{j,t})K^s_{j,t} + \frac{1}{R_t} B_{j,t+1} + \frac{1}{R^*_t + \zeta_t} S_t B^*_{j,t+1} = \\ = B_{j,t} + S_t B^*_{j,t} + (1-\tau^k_t)[R^k_t u_{j,t} K^s_{j,t} + Q_t] + (1-\tau^w_t) W_t N^R_{j,t} \quad (2)$$

$$(1+\tau^c_t)P^C_t C^N_{j,t} = (1-\tau^w_t) W_t N^N_{j,t} + \tau^b_t W_b (N^N_{j,t} - L^N_{j,t}) + TR_t \quad (3)$$

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Governme

- Moneta
- Fiscal p revenue fiscal ru stability

Firms - main equations:

$$Y_{it} = z_t^{1-\eta} K_{it}^{\eta} L_{it}^{1-\eta} \tag{1a}$$

$$Y_t = \left[\int_0^1 Y_{it}^{(\theta-1)/\theta} di \right]^{\theta/(\theta-1)} \tag{1b}$$

$$P_t^{1-\theta} = \xi_p P_{t-1}^{1-\theta} + (1-\xi_p) \left(P_t^{new} \right)^{1-\theta} \tag{1c}$$

$$(W_t)^{1-\theta_W} = \alpha_R \left[\xi_w \left(W_{t-1} \right)^{1-\theta_W} + (1-\xi_w) \left(W_t^{new} \right)^{1-\theta_W} \right] + (1-\alpha_R) \left(W_{t-1} \right)^{1-\theta_W} \tag{1d}$$

Building Blocks of the Model

Governmental authorities - main equations:

$$GR_t = \tau_t^c \left(P_t^C C_t + G_t\right) + \tau_t^w W_t L_t + \tau_t^k \left(R_t^k K_t + Q_t\right) \quad (1a)$$

$$GE_t = G_t^C + \tau_t^b W_t L_t + G_t^O \quad (1b)$$

$$GE_t - GR_t = \frac{1}{R_t} B_{t+1} - B_t \quad (1c)$$

$$\hat{R}_t = (1 - \phi_r)[\lambda_\pi \hat{\pi}_t + \lambda_y \hat{y}_t] + \phi_r \hat{R}_{t-1} \quad (1d)$$

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Building Blocks of the Model

Household

- Infinitely
- Habit fo
  consum
- Savers

Foreign sector - main equations:

$$M_t = C_t^m + I_t^m \tag{1a}$$

$$X_t = C_t^{m*} + I_t^{m*} \tag{1b}$$

$$F_t = \Phi^* F_{t-1} + \epsilon_t^*, \; where F_t = [C_t^{m*}, I_t^{m*}, P_t^*, R_t^*]'. \tag{1c}$$

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Model parameters

Initial values of selected parameters

Parameters	Value	Calibrated	Estimated from		
			data	regression	ss
α_r, s_R	0.32, 1.55		✓		
β	0.99	✓			
δ	0.01				✓
η	0.53	✓			✓
θ_c, θ_{c*}, θ_i, θ_{i*}	0.2–0.3				✓
κ	11			✓	
μ_{cm}, μ_{im}	0.22, 0.32		✓		
μ_z	1.05	✓	✓		
ξ_p, ξ_w	0.9, 0.2	✓			
ϕ_r, λ_π, λ_y	0.5,1.5,0.5	✓		✓	
ω_{rkz}	12.72			✓	

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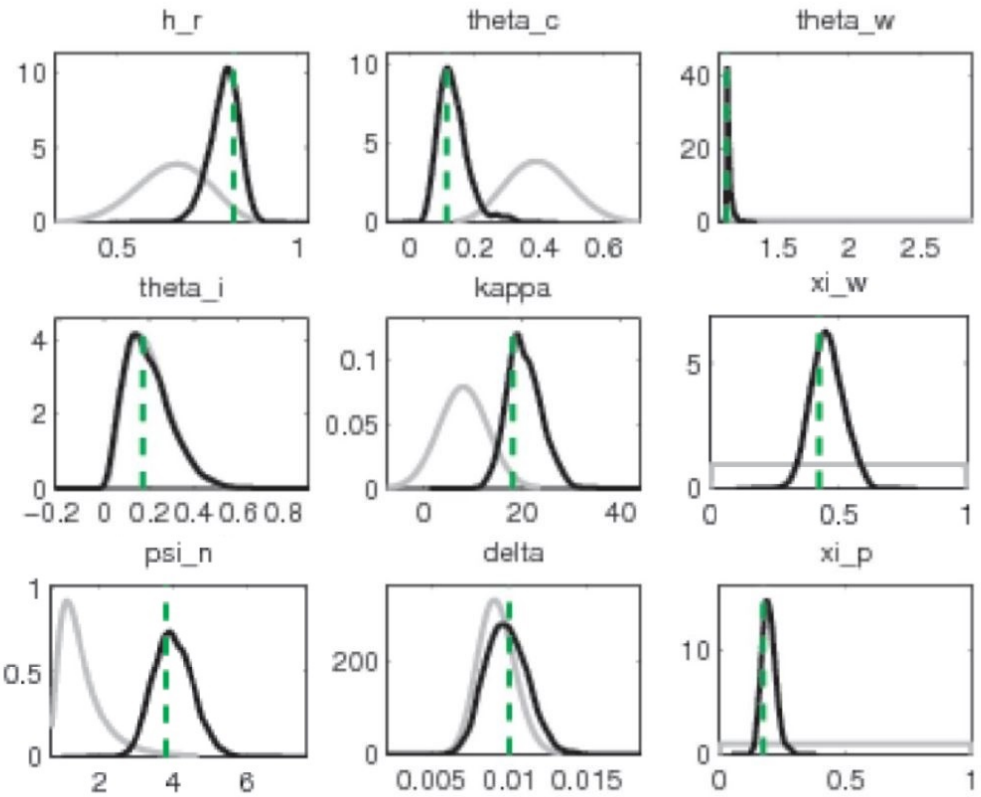
Results

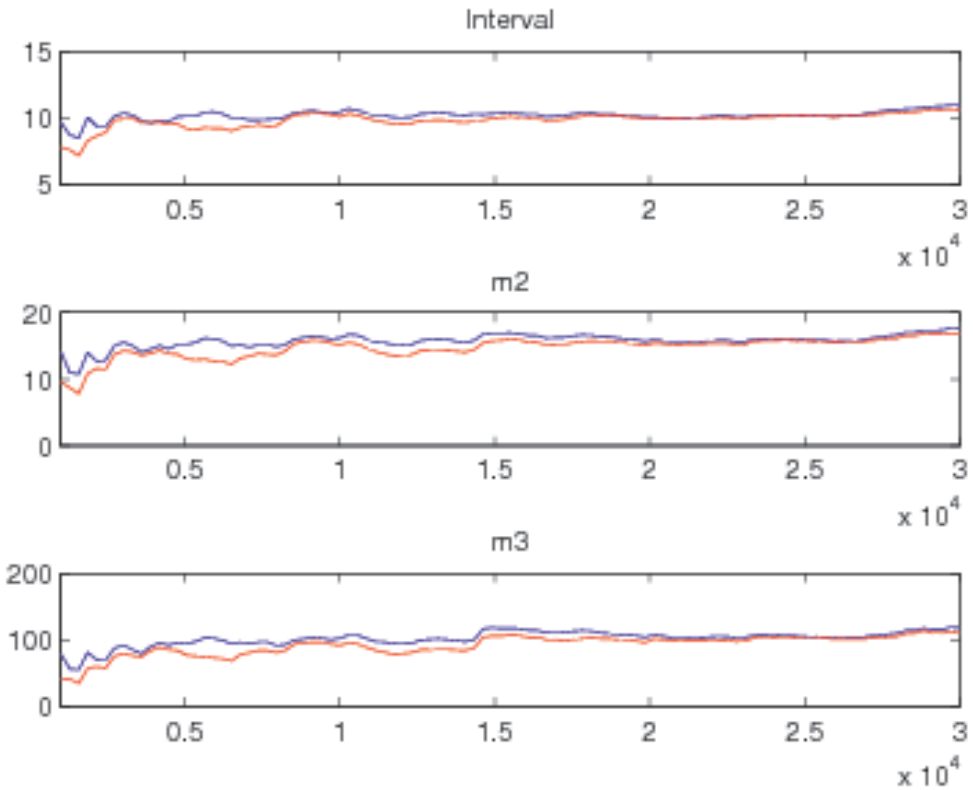
Preliminary estimation results of selected parameters

Parameters		Prior distribution	Prior mean	Posterior mean
h_r	habit formation	beta	0.65	0.80
θ_c	domestic good e.s.	beta	0.40	0.13
θ_w	labor good e.s.	uniform	2.00	1.15
θ_i	investment good e.s.	beta	0.20	0.20
κ	inv. adjustment cost	normal	8.00	20.39
δ	depreciation rate	beta	0.01	0.01
ξ_p	Calvo prices	uniform	0.50	0.20
ξ_w	Calvo wages	uniform	0.50	0.46
ψ_n	Frisch elasticity	invgamma	1.55	3.99

Prior and posterior distribution of selected parameters



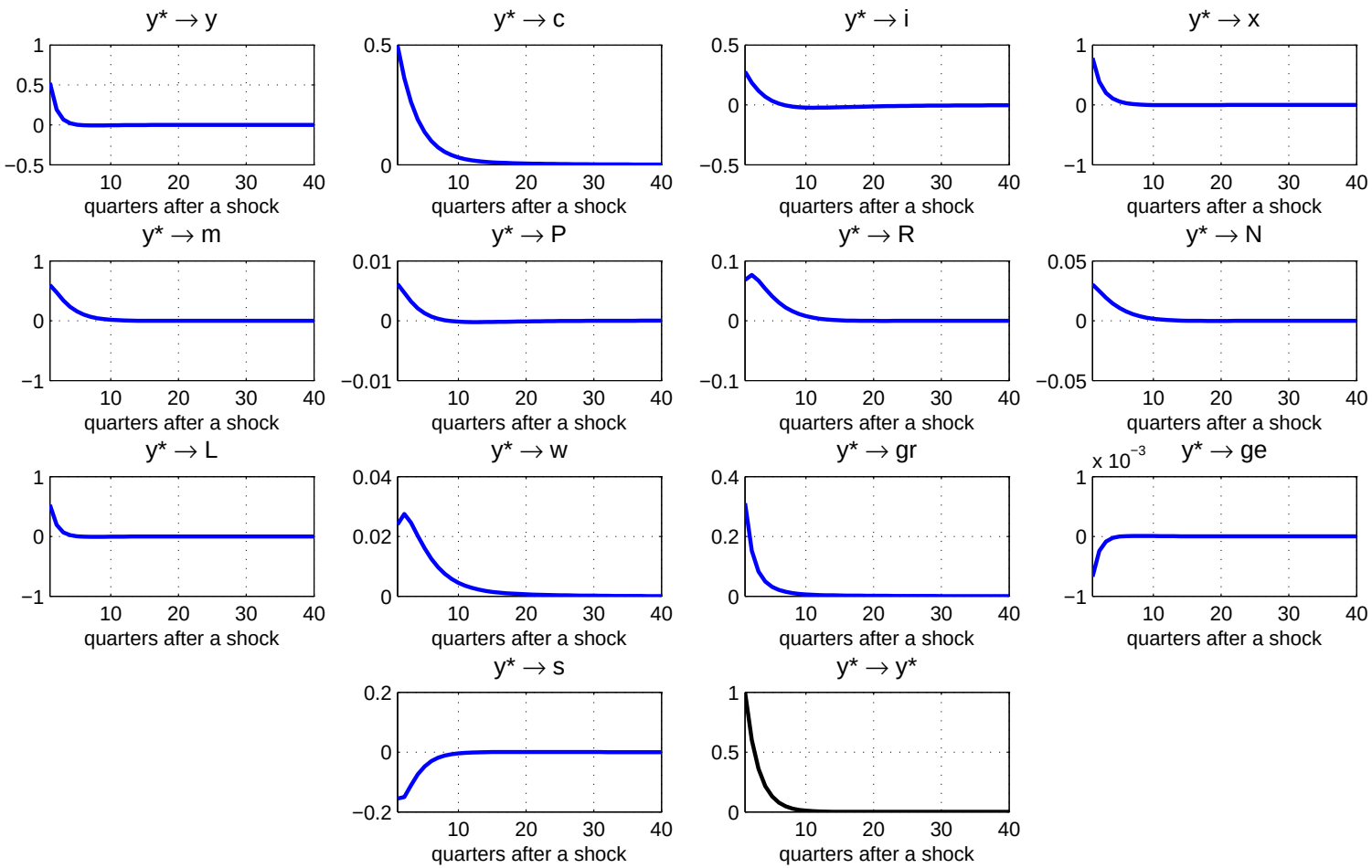
Multivariate convergence diagnostics



Outline

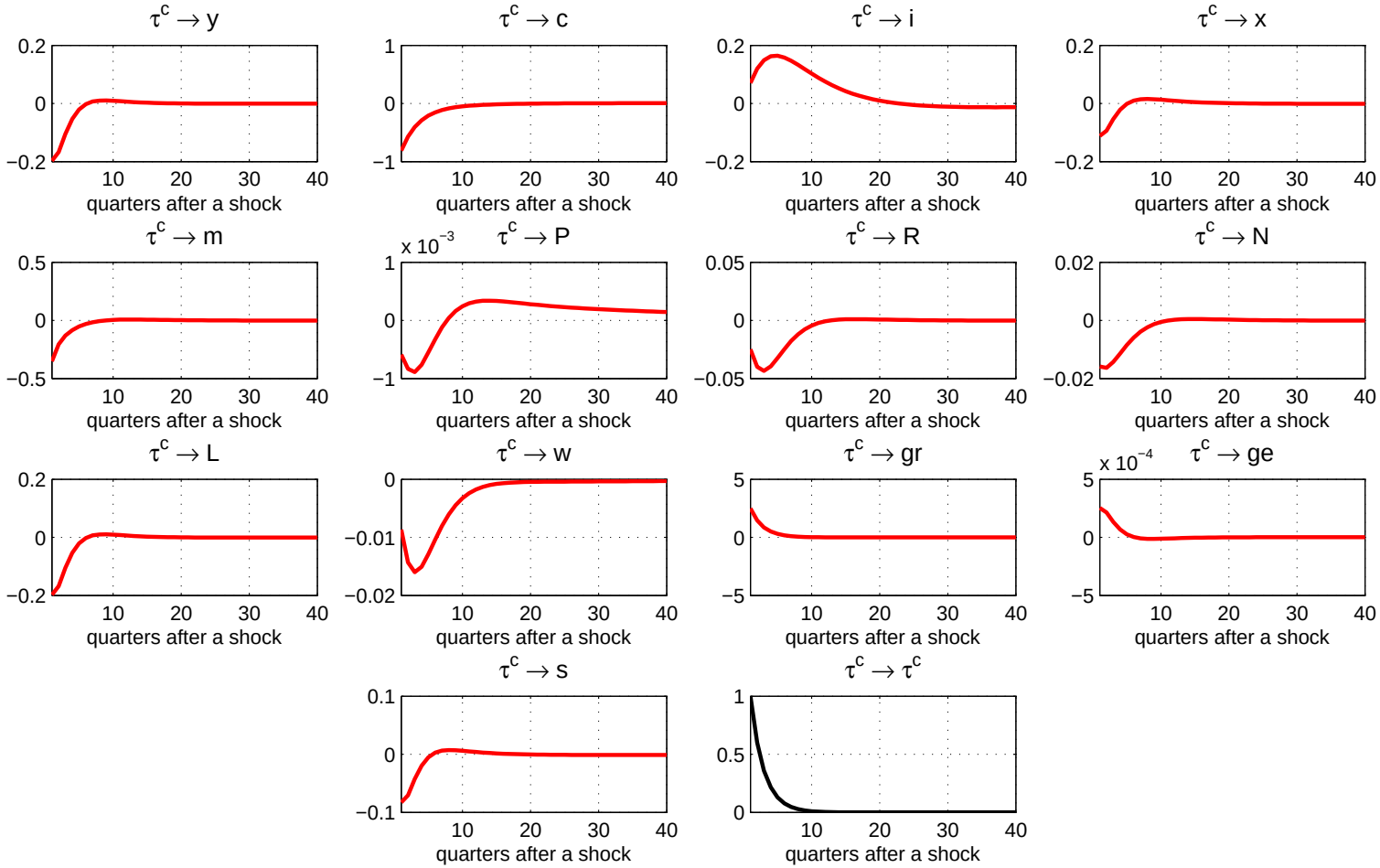
Macroeconomic shocks

Foreign demand shock



Fiscal shocks

Tax rate on consumption shock



Summary

- Started from a simple model...
- ...necessary extensions driven by demand.
- Recently focusing on estimations.

- Next steps
  - Not any further enlargements...
  - ...focus on improving outputs; case studies.
  - Solve labor market issues.

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Thank you for your attention...

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Aliyev, I. – Bobková, B. – Štork, Z. (2014)
Extended DSGE model of the Czech economy.
Ministry of Finance of the Czech Republic, Working Paper, 1/2014.