2011

Interactions between Czech and Slovak economies in DSGE model

Veronika Beláková
Masaryk University, ESF
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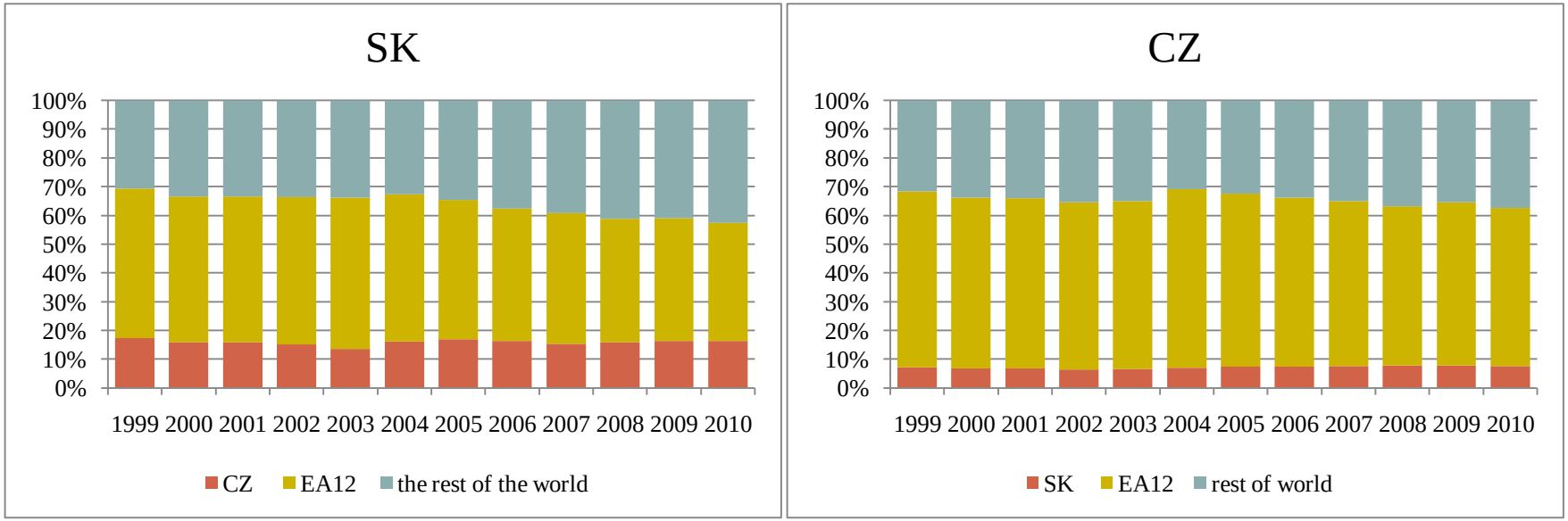
Motivation

Fig. 1: Foreign trade turnover (territorial structure)



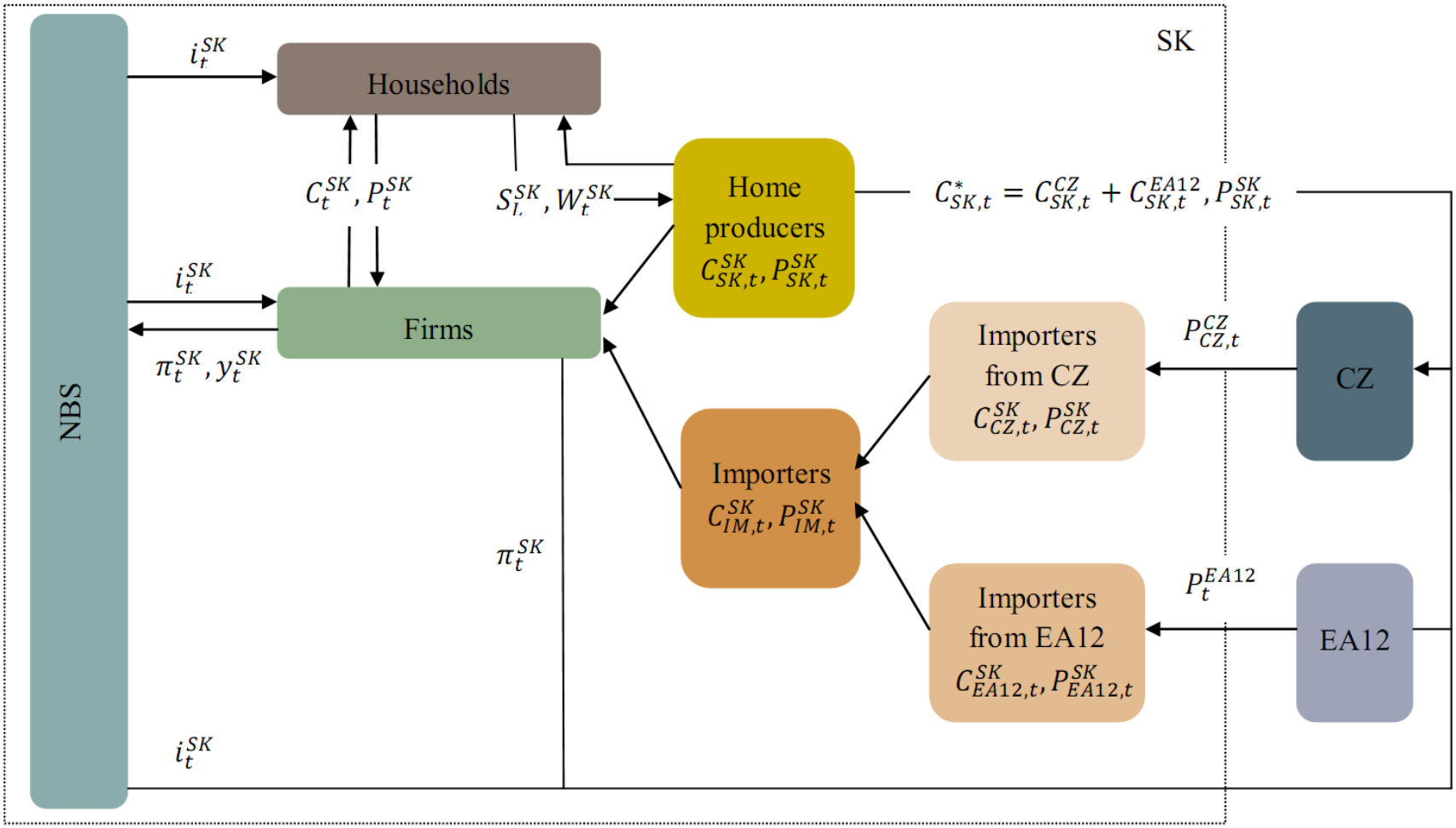
Source: Eurostat database, author's calculations

- SK average: 16% (25%)
- CZ average: 7% (11%)

Aim of presentation

- to what extent exist interactions between Czech and Slovak economies

Model


SK
NBS
i_t^{SK}
Households
C_t^{SK}, P_t^{SK}
S_L^{SK}, W_t^{SK}
Home producers
$C_{SK,t}^{SK}, P_{SK,t}^{SK}$
$C_{SK,t}^{*} = C_{SK,t}^{CZ} + C_{SK,t}^{EA12}, P_{SK,t}^{SK}$
i_t^{SK}
Firms
π_t^{SK}, y_t^{SK}
Importers from CZ
$C_{CZ,t}^{SK}, P_{CZ,t}^{SK}$
$P_{CZ,t}^{CZ}$
CZ
Importers
$C_{IM,t}^{SK}, P_{IM,t}^{SK}$
π_t^{SK}
Importers from EA12
$C_{EA12,t}^{SK}, P_{EA12,t}^{SK}$
P_t^{EA12}
EA12
i_t^{SK}

Model (2)

- Galí, Monacelli (2005), Justiniano, Preston (2004)

Households

- optimize their utility function subject to budget constraint

$$E_t[V(B_{t+s}^{SK})] = E_t \sum_{s=0}^{\infty} \beta^s \exp\left(v_{g,t+s}^{SK}\right) \left(\frac{(C_t^{SK} - h_1 C_{t-1}^{SK})^{1-\sigma_1}}{1-\sigma_1} - \frac{(N_t^{SK})^{1+\phi_1}}{1+\phi_1} \right) \quad (1)$$

$$\text{s.t. } P_{t+s}^{SK} C_{t+s}^{SK} + E_t\left\{Q_{t+s,t+s+1}^{SK} B_{t+s+1}^{SK}\right\} = B_{t+s}^{SK} + W_{t+s}^{SK} N_{t+s}^{SK} + T_{t+s}^{SK} \quad s = 0,1,2,\ldots \quad (2)$$

- considering a habit formation (a real rigidity)
- could decide if they consume home produced or imported good

$$C_t^{SK} \equiv \left[(1-\alpha_1)^{\frac{1}{\eta_1}} \left(C_{SK,t}^{SK}\right)^{\frac{\eta_1-1}{\eta_1}} \alpha_1^{\frac{1}{\eta_1}} \left(C_{F,t}^{SK}\right)^{\frac{\eta_1-1}{\eta_1}} \right]^{\frac{\eta_1}{\eta_1-1}} \quad (3)$$

- they distinguish between goods imported from CZ and EA12

$$C_{F,t}^{SK} \equiv \left[\tau_1^{\frac{1}{\gamma_1}} \left(C_{S2,t}^{SK}\right)^{\frac{\gamma_1-1}{\gamma_1}} + (1-\tau_1)^{\frac{1}{\gamma_1}} \left(C_{FS,t}^{SK}\right)^{\frac{\gamma_1-1}{\gamma_1}} \right]^{\frac{\gamma_1}{\gamma_1-1}} \quad (4)$$

Model (3)

Firms

- home producers and home importers trade at monopolistically competitive markets -> they are price makers
- they maximize the net present value of their profit subject to their demand function -> they get the price that they set

$$\max_{\bar{P}^{SK}_{SK,t}} E_t \sum_{s=0}^{\infty} (\theta_{SK,1})^s \, Q^{SK}_{t,t+s} Y^{SK}_{t+s}(i) \left[P^{SK}_{SK,t+s}(i) - P^{SK}_{SK,t+s} MC^{SK}_{SK,t+s} \right]$$
$$s.t. \quad Y^{SK}_{t+s}(i) = \left(\frac{P^{SK}_{SK,t+s}(i)}{P^{SK}_{SK,t+s}} \right)^{-\varepsilon} Y^{SK}_{t+s} \tag{5}$$

- Calvo price-setting – only a part of firms set their prices optimally

$$P^{SK}_{SK,t} \equiv \left[(1-\theta_{SK,1}) (\bar{P}^{SK}_{SK,t})^{1-\varepsilon} + \theta_{SK,1} \left(P^{SK}_{SK,t-1} \left(\frac{P^{SK}_{SK,t-1}}{P^{SK}_{SK,t-2}} \right)^{\delta_{SK,1}} \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \tag{6}$$

- the part of non-optimizing firms adjust their price according to previous inflation rate

Model (4)

Monetary policy

- MP targets inflation according to a Taylor rule

$$r_t^{SK} = \rho_1 r_{t-1}^{SK} + (1-\rho_1)\left(\gamma_{\pi,1}\pi_t^{SK} + \gamma_{y,1}y_t^{SK}\right) + \varepsilon_{M,t}^{SK} \qquad (7)$$

Other assumptions

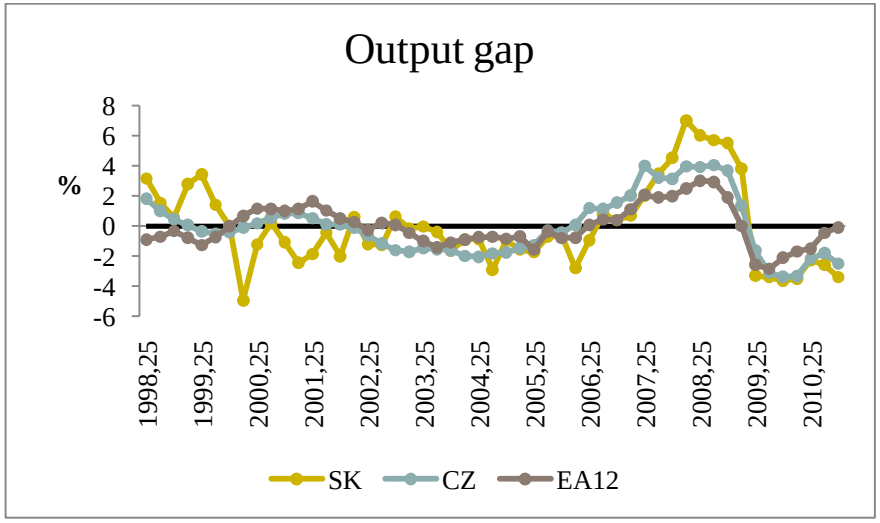
- complete international financial markets
- perfect competitive labour market
- the exogenous foreign sector is defined by AR(1) processes
- assumption of small open economies means that openness of foreign sector is near zero and the terms of trade of foreign sector is asymptotically one

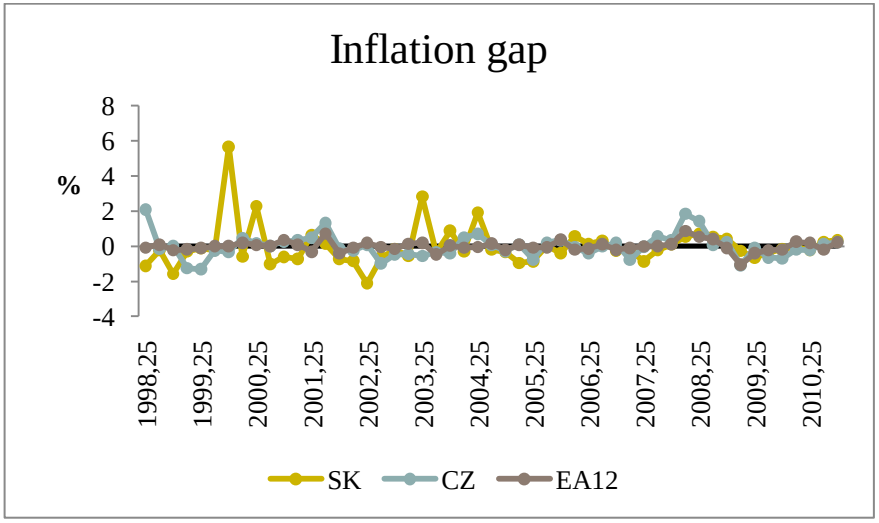
Shocks

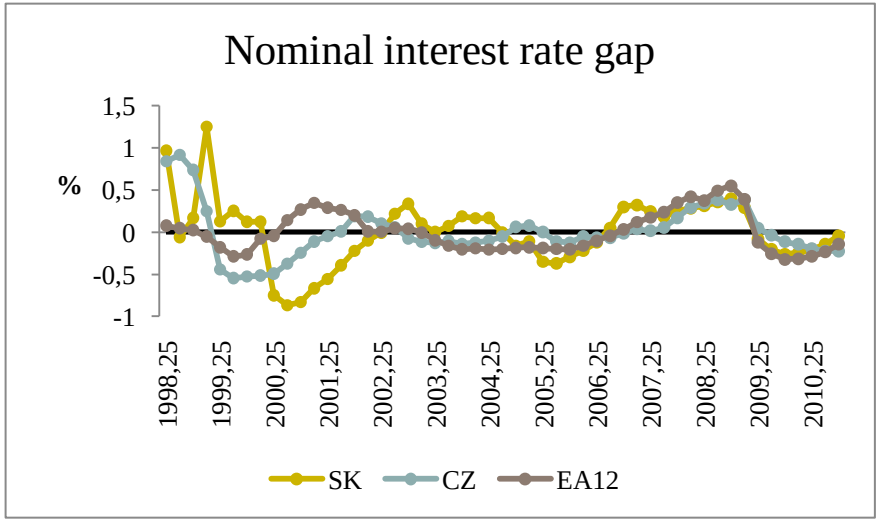
- Preference shocks, technology shocks, monetary policy shocks and real exchange rate shocks

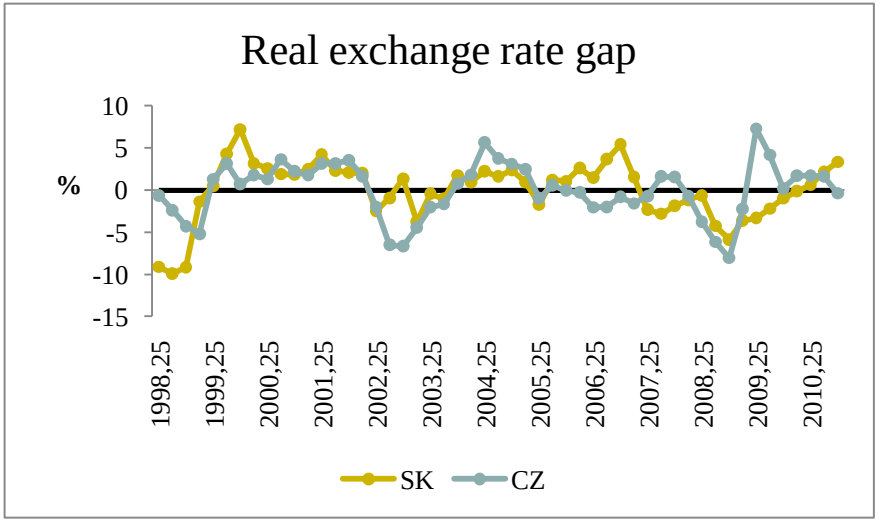
=> log-linearization around the steady state

Data









Source: Eurostat database, author's calculations

Data (2)

- Source: Eurostat Database
- time series of real output, HCPI inflation, 3M money market interest rate and real exchange rate from 1999Q1:2010Q3
- seasonally adjusted by X-12 ARIMA incorporated in IRIS (a Matlab toolbox)
- gap data – detrended by Hodrick-Prescott filter ($\lambda = 1600$)

Estimation

- Bayesian method – Metropolis-Hastings algorithm incorporated in Dynare (toolbox for Matlab)
- Calibrated parameters
  - → discount factor = 0.99
  - → openness of Slovak economy = 0.76
  - → openness of Czech economy = 0.65
- Prior setting
  - → Justiniano, Preston (2004), Liu (2006)
  - → Musil, Vašíček (2006), Remo (2007)
  - → Senaj, Výškrabka, Zeman (2010)

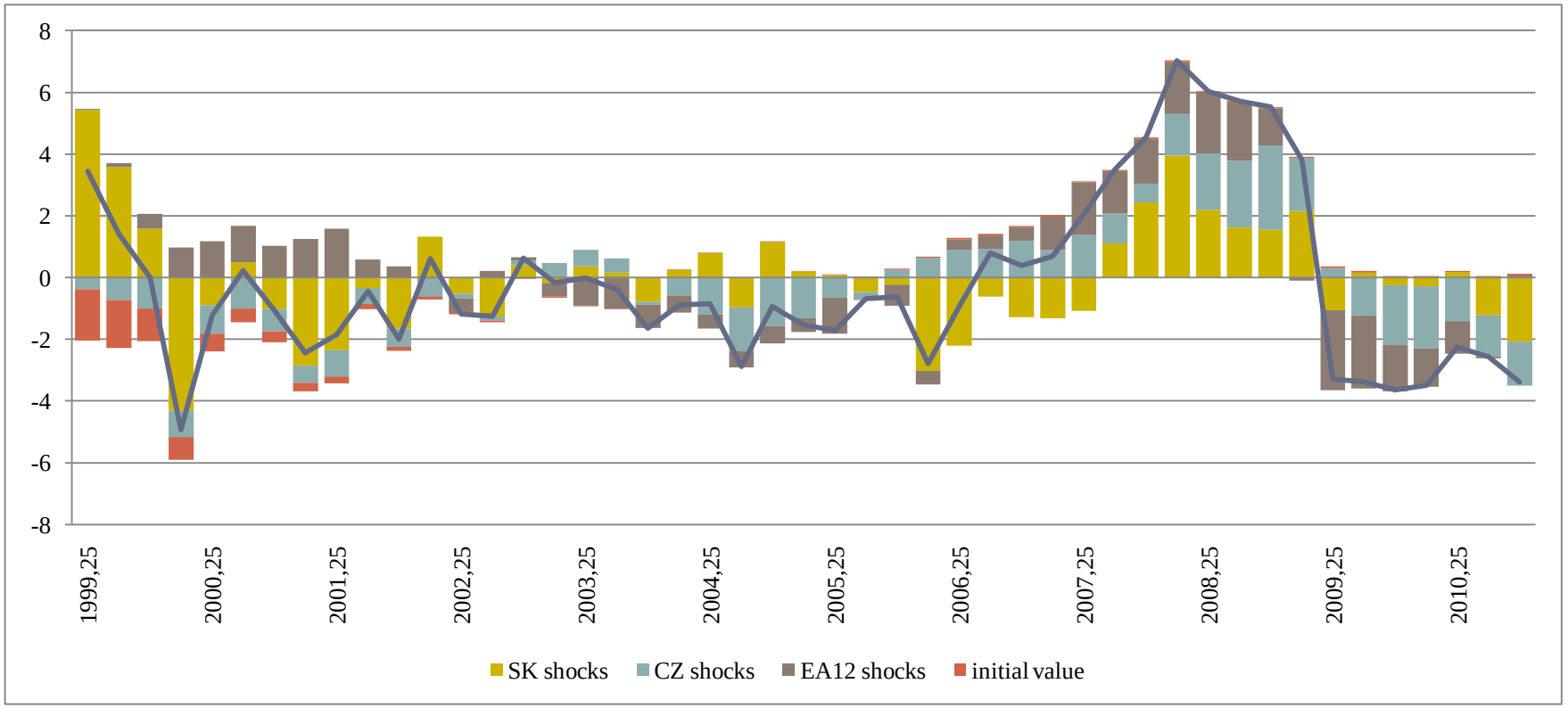
Estimated values of parameters

- the ratio of imports/exports come from/to second small open economy
  - → for SK: 24.2% (7%; 40%)
  - → for CZ: 2.7% (1%; 5%)

  => hypothesis: Should Slovak policy makers take into account business cycle of the Czech Republic?
- Calvo parameters of importers from second small open economy
  - → SK importers from CZ : 0.776 (0.64; 0.92) = price contracts of imported goods last approximately 4,5 quarters
  - → CZ importers from SK : 0.703 (0.55; 0.86) = price contracts of imported goods last approximately 3,6 quarters
- Indexation of importers from second small open economy
  - → SK: 0.601 (0.43; 0.76)
  - → CZ: 0.603 (0.43; 0.76)

Shock decomposition

Fig 2: Shock decomposition of SK output gap

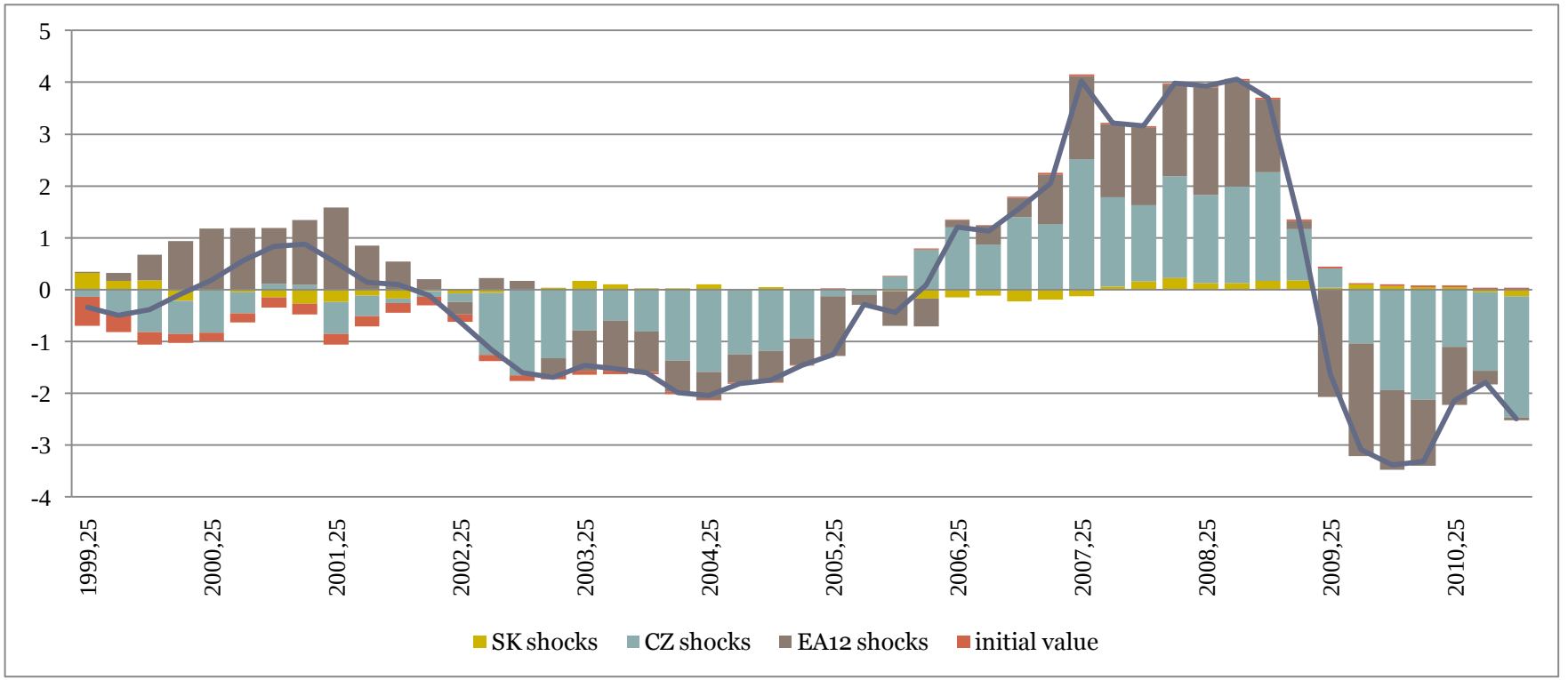


Source: author's calculations

- in-sample impacts of component shocks: SK 56%; CZ 22%; EA12 19%

Shock decomposition (2)

Fig 3: Shock decomposition of CZ output gap



Source: author's calculations

- in-sample impacts of component shocks: SK 1%; CZ 57%; EA12 42%

Variance decomposition

Variable: Slovak output gap:

term	SK shocks	CZ shocks	EA12 shocks
1	0.848	0.063	0.089
4	0.800	0.115	0.085
8	0.782	0.131	0.088
inf	0.778	0.133	0.089

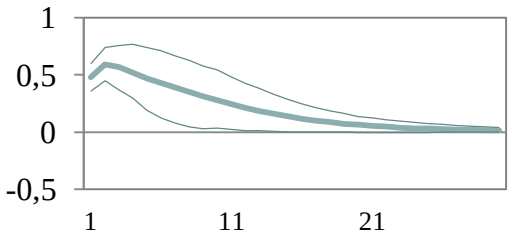
Variable: Czech output gap

term	SK shocks	CZ shocks	EA12 shocks
1	0.029	0.714	0.258
4	0.019	0.789	0.192
8	0.016	0.807	0.177
inf	0.015	0.812	0.173

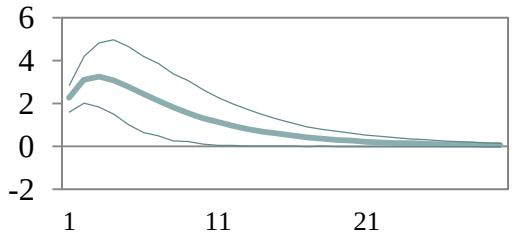
Source: author's calculations

IRFs of Czech preference shock ($\sigma_g^{CZ} = 8.9$)

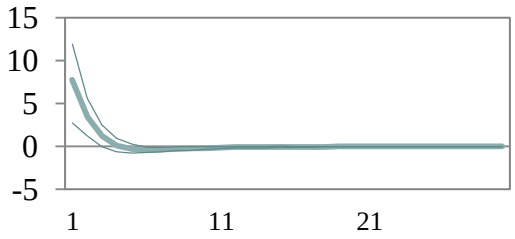
CZ output



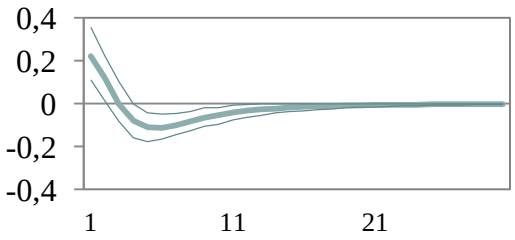
CZ consumption



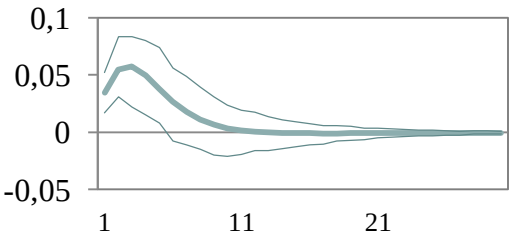
CZ real marginal costs



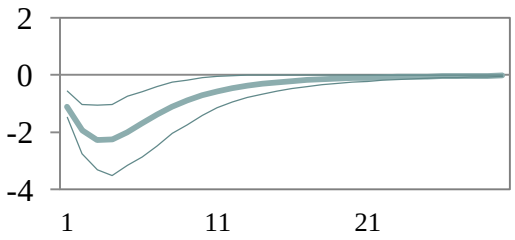
CZ inflation



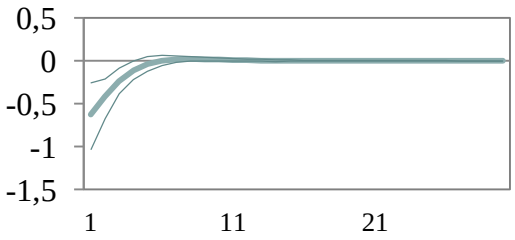
CZ interest rate



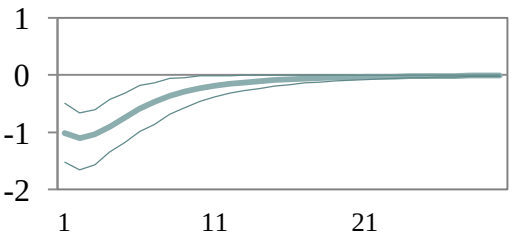
CZ the terms of trade



CZ the law of one price

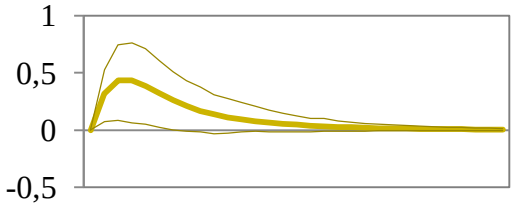


CZ real exchange rate

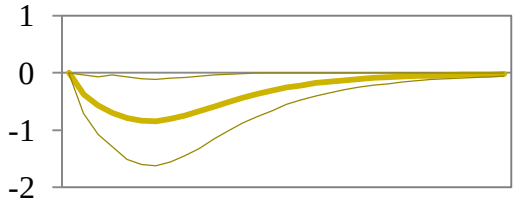


IRFs of Czech preference shock ($\sigma_g^{CZ} = 8.9$) - continue

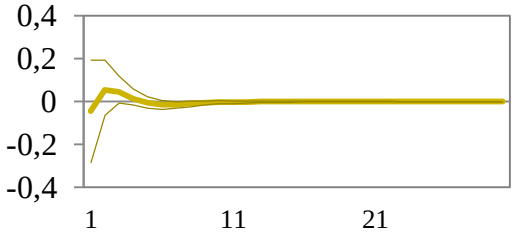
SK output



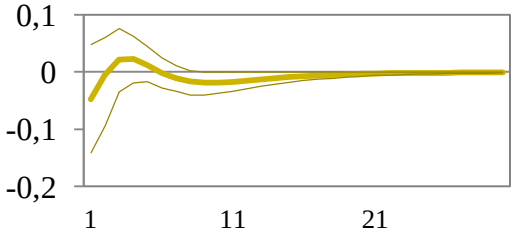
SK consumption



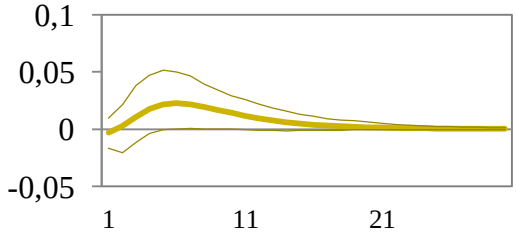
SK real marginal costs



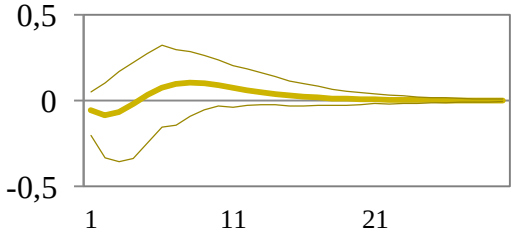
SK inflation



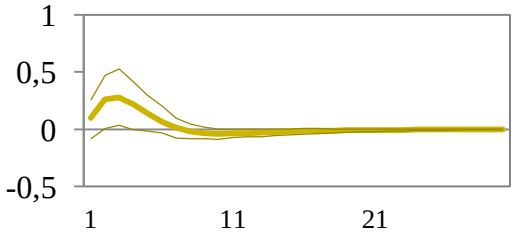
SK interest rate



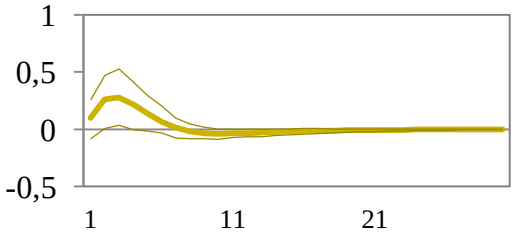
SK the terms of trade



SK the law of one price



SK real exchange rate



Test of hypothesis

- Should policy makers in Slovakia take into account the business cycle of Czech economy? Is business cycle of the Czech Republic affected by Slovak's one?
- Bayes factor

Model	SK↔CZ←EA12	SK←EA12; CZ←EA12	EA12→CZ←SK; SK←EA12	EA12→SK←CZ; CZ←EA12
Log Marginal Density	-540.949	-541.295	-542.039	-535.855
Bayes Ratio	1.000	0.707	0.336	162.954

=> the most probable model is when SK economy is affected by EA12 and CZ, but CZ is affected only by EA12

Conclusions

- there was presented the model of two small open economies with the exogenous foreign sector
- the estimation results indicate that 24% of Slovak imports are imported from the Czech Republic and only 3% of Czech imports are imported from Slovakia
- a relative large effect of Czech shocks on Slovak macroeconomic time series was presented also by shock decomposition and variance decomposition
- the most probable model conditional on data is the one where Slovak economy is affected by Czech and Euroarea-12 economies and Czech economy is affected only by economies of Euroarea-12

Thank you for your attention!

Veronika Beláková
belakova.nika@gmail.com