Macroeconomic model and stability analysis

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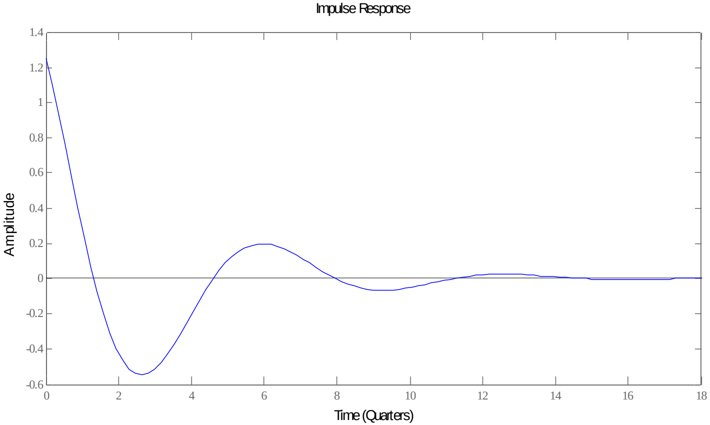
Stability analysis

- New approach to evaluation of macroeconomic models
- Help tool for decision of a monetary authority
- Interconnection of the macroeconomic theory with the theory of the dynamic systems

Example of wrong response of a macroeconomic system on an economic shock

- Dynamically stable solution but oscillative
- Economically inadmissible system



Solution:

1. Derivation of the transfer function ... $$G(z) = \frac{1}{\Delta(z)} F(z)$$

2. Deduction of the zeros ⋯ Roots of numerator polynomials *F(z)*

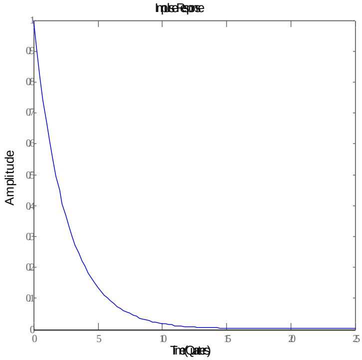
3. Deduction of the poles ⋯ Roots of denomirator polynomials Δ(z) = eigenvalues of the system

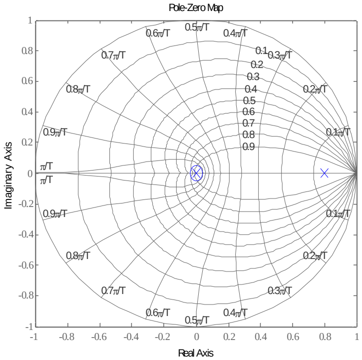
Influence of the poles on the dynamic response of the macroeconomic system

- 3 examples of various dynamic systems with different response to a shock
- Dependence on the poles of the system, especially on the imaginary part of the poles

Example 1

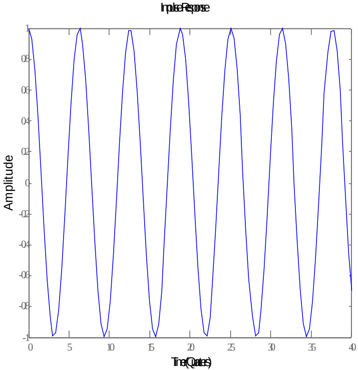
- Dynamic system with poles without imaginary part
- No oscillation of the dynamic system to a shock

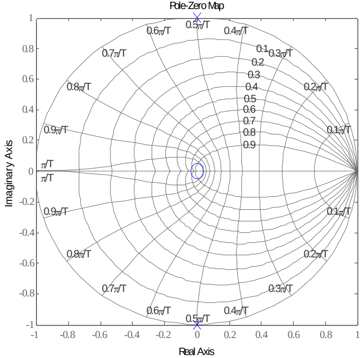




Example 2

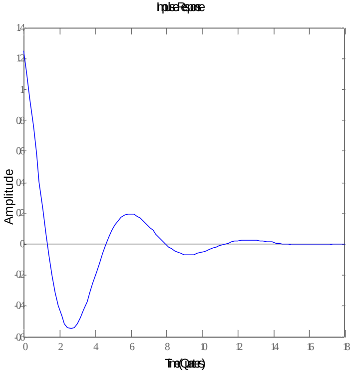
- Dynamic system with poles with imaginary part only
- Just oscillation of the dynamic system on a shock
- Does not converge to zero!!!

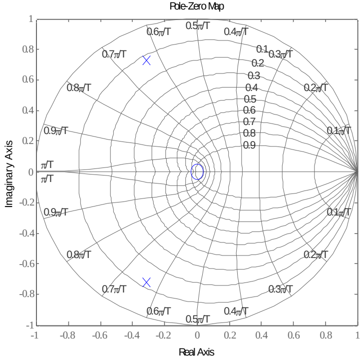




Example 3

- Dynamic system with poles containing imaginary and real part
- Oscillation of the dynamic system on a shock
- Converges to zero





Monetary application of the stability analysis

New Keynesian macroeconomic model of the small open Czech economy containing:

- IS curve
- Phillips curve
- Taylor policy rule
- Consumer price index equation
- Exchange rate equations
- Import price inflation rate equation
- Rational expectations

The Baseline Framework

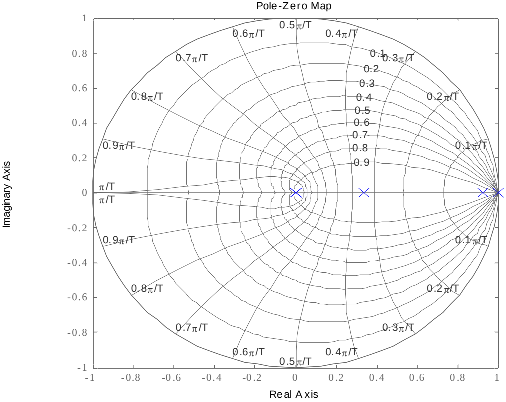
$$
\begin{aligned}
y\_gap_t &= -1/\sigma\left[i_t/4 - E_t\left(\pi^n_{t+1}\right) - r\_eq_t/4\right] + \\
&\quad + \kappa\alpha y\_gap_{t-1} + \kappa(1-\alpha)E_t\left(y\_gap_{t+1}\right) + \\
&\quad + \eta_1 \Delta lz\_gap_t + \eta_2 y\_gap^f_t + \omega^{y-gap}_t && (1) \\
\pi^n_t &= \lambda_0 y\_gap_t + \lambda_1 y\_gap_{t-1} + \psi_1 E_t\left(\pi^n_{t+1}\right) + \psi_2 \pi^M_t + \\
&\quad + (1-\psi_1-\psi_2)\pi^n_{t-1} + \omega^{\pi^n}_t && (2) \\
i_t/4 &= i\_eq_t/4 + \gamma_{\pi^n}\left(\pi^n_t - \bar{\pi}^n_t\right) + \gamma_{y\_gap} y\_gap_t + \omega^i_t && (3) \\
\pi_t &= \delta\pi^n_t + (1-\delta)\pi^r_t + \omega^\pi_t && (4) \\
ls_t &= E_t\left(ls_{t+1}\right) + \left(i_t - i^f_t - prem_t\right)/4 + \omega^{ls}_t && (5) \\
lz_t &= lz_{t-1} + \Delta ls_t - \pi^f_t + \pi^n_t + \omega^{lz}_t && (6) \\
lz\_gap_t &= lz_t - lz\_eq_t && (7) \\
\pi^M_t &= -\Delta ls_t + \pi^f_t + \omega^{\pi^M}_t && (8) \\
i\_eq_t/4 &= r\_eq_t/4 + \pi^n_t + \omega^{i-eq}_t && (9)
\end{aligned}
$$

Results of parameter estimation

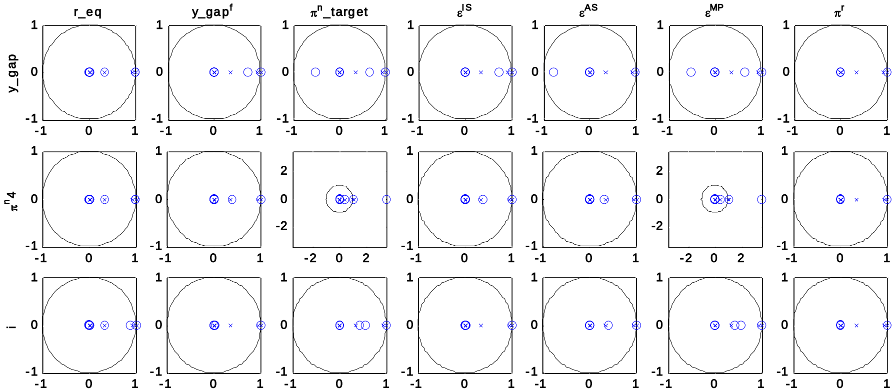
Equation No.	Parameter	Parameter estimation	T-Stat.	Standard deviation
(1)	σ	2.6315		
	κ	1.0000		
	α	0.4173	4.2554	0.0981
	η_1	0.1224	2.1779	0.0562
	η_2	0.2700	2.6324	0.1026
(2)	λ_0	-0.4407	10.2188	0.0431
	λ_1	0.1290	2.9470	0.0438
	ψ_1	0.2061	4.0986	0.0503
	ψ_2	0.1795	10.1470	0.0177
(3)	γ_π	1.2000		
	γ_{y_gap}	0.4000		
(4)	δ	0.7551	22.5589	0.0335

Poles of the baseline framework

- Poles of the baseline framework does not contain imaginary part

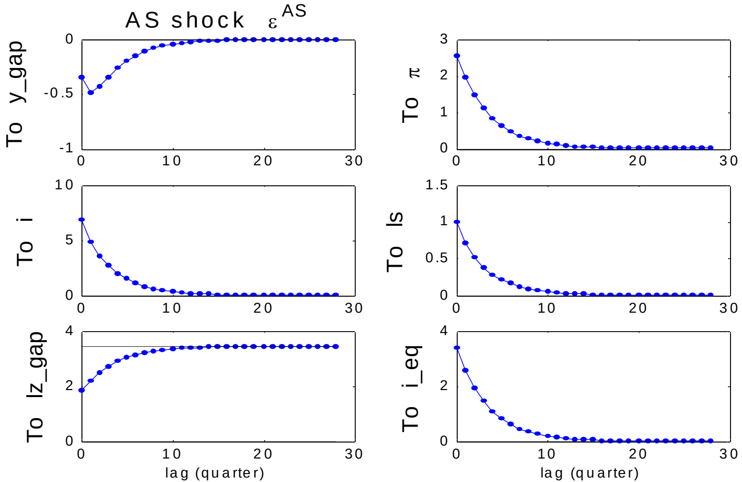


The particular I/O relations of the model



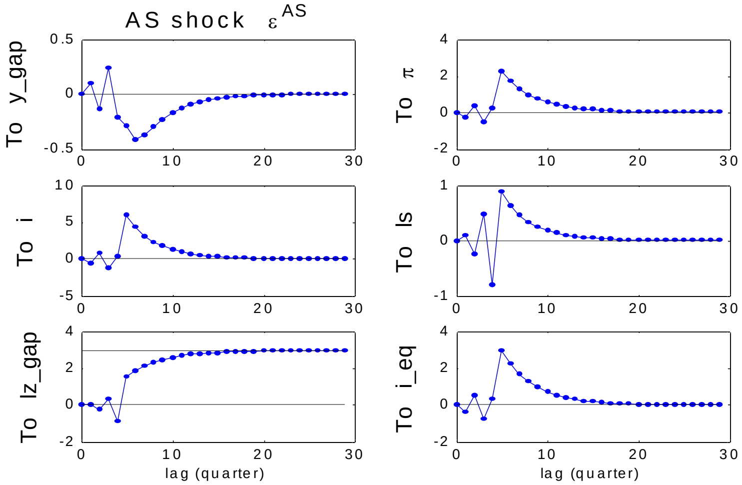
Unexpected aggregate supply shock

System converges to zero without oscillations.



Expected aggregate supply shock

System converges to zero after adjusting of the expectations without oscillations.



Summary

- Deeper analysis of the economic system behaviour using the impulse response
- Incorporation of the theory of the dynamic systems
- Possibility to create new conditions and restrictions for a monetary authority decision
- Successful stabilization of the real world economic system