INSTITUTE FOR CAPACITY DEVELOPMENT

W-5: Transmission Mechanisms in the Open Economy

JANUARY 23, 2026

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Course on Monetary and Fiscal Policy Analysis with DSGE Models (OT26.08)

Outline

A. Overview of the Dynare code of the baseline model for small open economies
   - Log-linear version of the model
   - Calibration

B. Analysis of the transmission mechanisms for different shocks
   - We use the CPI Inflation Targeting Rule as the benchmark model

C. Role of monetary and exchange rate policies in the transmission of shocks
   - Compare responses under alternative policy regimes: (i) CPI Inflation Targeting; (ii) Exchange Rate Peg; (iii) Domestic Inflation Targeting, (iv) Full stabilization of domestic inflation

D. Role of FXI as complement of monetary policy
   - Conditions for using FXI: (i) Shallow FX markets; (ii) Non-fundamental risk premium shock

E. Pricing assumption: Producer Currency Pricing vs Local Currency Pricing

A. The Dynare code of the baseline model for small open economies

- Open model file nk_1soe1.mod in Matlab editor

```
/*
 * This file implements a NK Model for an Open Economy.
 * This version incorporate the case of incomplete market and
 * in endogenous risk premium depending on foreign debt to
 * generate stationarity
 * Pau Rabanal (September 2025)
 * Endogenous risk premim: Psi_t = (1 + psi_bstar*Bstar)
 * It includes interest rate smoothing in the Taylor-type rules
 * Different cases for the monetary/exchange rate policy
 * CITR: CPI Inflation Targeting (1)
 */

/*
 * Dynare is free software: you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation, either version 3 of the License, or
 * (at your option) any later version.
 *
 * Dynare is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
 * GNU General Public License for more details.
```

- Open model file nk_1soe1.mod in Matlab editor (cont.)

```
@#define DITR   = 0
@#define CITR   = 1
@#define PEG    = 0
@#define DITR_F = 0

% define string for saving different policies
@#if DITR == 1
    case_title='domestic inflation-based Taylor rule (DITR)';
@#else
    @#if CITR ==1
         case_title='CPI inflation-based Taylor rule (CITR)';
    @#else
        @#if PEG ==1
             case_title='exchange rate peg (PEG)';
        @#else
            @#if DITR_F ==1
                 case_title='Full stabilization dom. inflation';
            @#else
                error('One case must be set to 1')
```

This part defines the implemented policy regime

Model variables are named similarly as in the presentation

- Variables: $c_t;\ c_{H,t}; c_{F,t}; (p_{H,t} - p_t); rer_t; i_t; \pi_t; \pi_{H,t}; l_t; rw_t; y_t; mc_t;$

$a_t; g_t; z_t; c_t^*; \varphi_t; \gamma_{H,t};\ \Delta e_t; B_t^*; c_{H,t}^*; i_t^*; \pi_t^*; tb_t$

Endogenous variables

```
52  var c ch cf prh rer rnom pic pih lab rw y mchr a g z cstar varphi gammaH dep bstar chstar istar pistar tb;
53  varexo e_a e_g e_z e_cstar e_istar e_pistar e_varphi e_gammaH;
```

- Exogenous processes:

$$a_t = \rho_a a_{t-1} + \varepsilon_{a,t}$$

$$g_t = \rho_g g_{t-1} + \varepsilon_{g,t}$$

$$z_t = \rho_z z_{t-1} + \varepsilon_{z,t}$$

$$c_t^* = \rho_{c*} c_{t-1}^* + \varepsilon_{c*,t}$$

$$i_t^* = \rho_{i*} i_{t-1}^* + \varepsilon_{i*,t}$$

$$\pi_t^* = \rho_{\pi*} \pi_{t-1}^* + \varepsilon_{\pi*,t}$$

$$\varphi_t = \rho_\varphi \varphi_{t-1} + \varepsilon_{\varphi,t}$$

$$\gamma_{H,t} = \rho_{\gamma H} \gamma_{H,t-1} + \varepsilon_{\gamma H,t}$$

Shocks

Calibration

- Quarterly frequency
- As before in the basic close economy NK model:

$$\sigma = 1; \beta = 0.995; \theta = 0.75 \ (\rightarrow \kappa = 0.0846);$$

- Monetary policy:

$$\phi_i = 0.85; \phi_\pi = 1.5; \phi_y = 0$$

- Open economy features:

$$\eta_c = \eta^* = 0.5; \alpha_c = 0.3; \psi_{B*} = 0.001$$

  - Trade balance at the steady state = 0

- Persistence of shocks: see lines 71-78

B. Analysis of the transmission mechanisms for different shocks

Analyzing the effects of different shocks

- Matlab code W5_1.m solves the model nk_1soe1.mod and plots the responses of key variables to shocks in **domestic demand, foreign demand, domestic cost-push, domestic monetary policy (MP), and domestic productivity – in that order.**

- Figures are programmed in Matlab

- Run W5_1.m in Matlab, either in Command Window >> W5_1 or in Matlab editor

Part B.1: Analyze effects of a domestic demand shock

- See first figure generated.

- Discuss how **domestic demand shocks** are transmitted in the baseline model

Part B.2: Analyze effects of a foreign demand shock

- See second figure generated.

- Discuss how **foreign demand shocks** are transmitted in the baseline model

Part B.3: Analyze effects of a domestic cost-push shock

- See third figure generated.

- Discuss how **domestic cost-push shocks** are transmitted in the baseline model

Part B.4: Analyze effects of a domestic MP shock

- See fourth figure generated.

- Discuss how **domestic MP shocks** are transmitted in the baseline model

Part B.5: Analyze effects of a productivity shock

- See fifth figure generated.

- Discuss how **domestic productivity shocks** are transmitted in the baseline model

C. Role of monetary and exchange rate policies in the transmission of shocks

Describing alternative policy regimes

- Recall that the transmission of shocks depends on the policy regime in place.

- We discuss four alternative policy regimes during the lecture:
  - CPI Inflation Targeting Rule (CITR) – This is the baseline model.
  - Domestic Inflation Targeting Rule (DITR)
  - Exchange Rate Peg (PEG)
  - Full Stabilization of Domestic Inflation – This corresponds to the optimal policy in Gali and Monacelli (2005).

Implementation of alternative regimes in Dynare

- Baseline model (nk_1soe1.mod), CPI Inflation Targeting rule (CITR): $i_t = \phi_i i_{t-1} + (1-\phi_i)\left(\phi_\pi \pi_t + \phi_y y_t\right) + z_t$

We analyze three additional regimes and models:

- Model nk_1soe2.mod has a Domestic Inflation Targeting rule (DITR):

$$i_t = \phi_i i_{t-1} + (1-\phi_i)\left(\phi_\pi \pi_{H,t} + \phi_y y_t\right) + z_t$$

- Model nk_1soe3.mod has an exchange rate peg (PEG):

$$\Delta e_t = 0$$

- Model nk_1soe4.mod has a full stabilization of Domestic Inflation (DITR_F)

$$\pi_{H,t} = 0$$

Compare responses to shocks across regimes

- The MATLAB code W5_2.m solves the first three models (nk_1soe1.mod, nk_1soe2.mod, and nk_1soe3.mod). It then plots the responses of key variables to shocks in **domestic demand, foreign demand, domestic cost-push,** and **domestic productivity** across different policy regimes.

- Figures are generated in Matlab

- Run W5_2.m in Matlab, either in Command Window >> W5_2 or in Matlab editor

Part C.1: Compare responses to a domestic demand shock

- See first figure generated.

- Discuss how **domestic demand shocks** are transmitted differently across regimes

Part C.2: Compare responses to a foreign demand shock

- See second figure generated.

- Discuss how **foreign demand shocks** are transmitted differently across regimes

Part C.3: Compare responses to a domestic cost-push shock

- See third figure generated.

- Discuss how **domestic cost-push shocks** are transmitted differently across regimes

Part C.4: Compare responses to a productivity shock

- See fourth figure generated.

- Discuss how **productivity shocks** are transmitted differently across regimes

Part C: Natural Equilibrium in Dynare

- We do not include the output gap explicitly in the model because GDP (denoted as "y" in the code) is measured as output relative to the deterministic steady state.
- However, the output gap should be defined as the log deviation of GDP from its corresponding level under price flexibility.

- In contrast to the case of Gali and Monacelli (2005)—under complete markets, where there is an analytical solution for the output gap—here we must solve numerically for the allocation under price flexibility due to the presence of incomplete markets. This is implemented using the Dynare file nk_1soe_nat.mod, where all variables ending in "_nat" denote the natural equilibrium (i.e., the flexible-price allocation).

- We then compute the output gap as: y_gap = y – y_nat

We extend the model to include both the natural equilibrium and the output gap:

- nk_2soe1.mod is the code under CPI Inflation Targeting (CITR)
- nk_2soe2.mod is the code under Domestic Inflation Targeting (DITR)
- nk_2soe3.mod is the code under exchange rate peg (PEG)
- Nk_2soe4.mod is the code under full stabilization of domestic inflation (DITR_F)

Part C.5: Compute macroeconomic volatility

- The MATLAB code W5_3.m solves the four models (nk_2soe1.mod, nk_2soe2.mod, nk_2soe3.mod, and nk_2soe4.mod) and computes the standard deviation of key variables across policy regimes.

- Run W5_3.m in Matlab, either in Command Window >> W5_3 or in Matlab editor

- Discuss differences in standard deviation of variables across regimes.

- Propose a ranking for the regime in terms of macroeconomic stability

D. Role of FXI as complement of monetary policy

When using FXI as complement of MP?

- As discussed in the lecture, the responses of Emerging Economies to certain external shocks differ from those observed in Advanced Economies
  - Risk appetite shocks (e.g., a non-fundamental risk premium shock, as presented in the model)
  - FX markets are less well developed in Emerging Economies
- We consider an extended version of the baseline model under CPI Inflation Targeting (**CITR**) to include foreign exchange (FX) reserves:
  - nk_3soe1a.mod: Dynare code with a deep FX market
  - nk_3soe1b.mod: Dynare code with a shallow FX market

Part D.1: Analyzing the effect of FXI under deep and shallow FX markets

- Matlab code W5_4.m solves the two models (nk_3soe1a.mod and nk_3soe1b.mod). Then, it plots the responses to a transitory reduction of FX reserves.

- Run W5_4.m in Matlab, either in Command Window >> W5_4 or in Matlab editor

- Discuss differences in the responses of the main macroeconomic variables between deep and shallow FX markets.

Part D.2: Analyzing the role FXI under a shallow FX market in responses to a risk premium shock

- Matlab code W5_5.m solves the model under a shallow FX market (nk_3soe1b.mod). Then, it plots the responses to a risk premium shock not using FXI (**no FXI**) and selling FX reserves (**FXI**).
- Run W5_5.m in Matlab, either in Command Window >> W5_5 or in Matlab editor
- Discuss differences in the responses between the two cases analyzed: (i) No FXI; (ii) FXI
- What are the policy lessons derived from these exercises D.1 and D.2?

E. Pricing assumption: Producer Currency Pricing vs Local Currency Pricing

Pricing assumption

- The baseline model assumes that price rigidities exist only in domestic prices, and these rigidities are in the domestic currency. This case is referred to as **Producer Currency Pricing (PCP)**.
- However, retailers of imported goods can also face nominal rigidities when setting prices in the domestic currency. This corresponds to Local Currency Pricing (LCP) for imported goods.
- Similarly, exporters may face nominal rigidities in setting prices in foreign currency when selling abroad. This also corresponds to **Local Currency Pricing (LCP), but for exported goods**.

Two additional Phillips curves

- Imported prices for F goods sold locally:

$$\pi_{F,t} = \beta E_t \pi_{F,t+1} + \kappa_F \left(e_t + p_{,t}^* - p_{F,t} \right)$$

with $\kappa_F = (1 - \theta_F)(1 - \beta\theta_F)/\theta_F$, and where θ_F represents the degree of price rigidity for imported goods sold locally.

- Exported prices for H goods sold abroad:

$$\pi_{H,t}^* = \beta E_t \pi_{H,t+1}^* + \kappa_X \left(p_{H,t} - e_t - p_{H,t}^* \right)$$

with $\kappa_x = (1 - \theta_x)(1 - \beta\theta_x)/\theta_x$, and where θ_x represents the degree of price rigidities for exported goods sold abroad.

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Implementation in Dynare

The baseline model is extended to include the two additional Phillips curves under CPI Inflation Targeting rule (**CITR**)

- nk_4soe1a.mod: Dynare code with $\theta_F = \theta_x = 0.0001$. Why does this case correspond to a PCP situation?
- nk_4soe1b.mod: Dynare code with $\theta_F = 0.75; \theta_x = 0.0001$. Why does this other case correspond to an LCP situation for imported goods?
- nk_4soe1c.mod: Dynare code with $\theta_F = \theta_x = 0.75$. Why does this last case correspond to an LCP situation for imported and exported goods?

Comparing responses under different pricing assumptions

- Matlab code W5_6.m solves the three models (nk_4soe1a.mod, nk_4soe1b.mod, and nk_4soe1c.mod). Then, it plots the responses to shocks in **risk premium** and **domestic MP**.

- Run W5_6.m in Matlab, either in Command Window >> W4_ or in Matlab editor

Part E.1: Comparing responses to a risk premium shock

- See first figure generated.

- Discuss differences in the responses of the main macroeconomic variables under alternative pricing assumptions.

Part E.2: Comparing responses to a MP shock

- See second figure generated.

- Discuss differences in the responses of the main macroeconomic variables under alternative pricing assumptions.