MEcon 8,270 — Spring 2022

International Macroeconomics

Problem Set 2: Simulation of the EDEIR model and ToT shocks

4 May 2022

Due date and time:	Friday, 17 June 17 at 18:00h
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This problem set comes in two parts.

PART I: In the first part of this problem set, you are asked to simulate the EDEIR model from Uribe and Schmitt-Grohé (2017) for Switzerland, using your calibrated values from Problem Set 1. The first part proceeds in two steps: from analyzing impulse response functions from our baseline model, to introducing an alternative utility function.

PART II: The second part of the problem set asks you to simulate terms-of-trade (ToT) shocks, similar to chapter 7 of Uribe and Schmitt-Grohé (2017). The second part also proceeds in two steps. First you are asked to calibrate the model to a selection of small open high-income economies (including Switzerland). Second, you are asked to analyze impulse response functions for a variation in parameter values.

Please upload your solutions (as a **zip** file) in the respective folder on *Canvas*. Your zip file should contain your code, your data set, and a pdf file with your written solution. Please create one folder per question (e.g., a folder "Q6 Simulating the EDEIR model for Switzerland", etc.). Please name the zip file in the following way: PS2_surname_name_22.zip (e.g., PS2_Torun_David_22.zip). After the deadline for submission on Friday, 17 June at 18:00h, the *Canvas* folder will automatically close and you will not be able to submit your solutions anymore.

6 Simulating the EDEIR model for Switzerland

Simulate the EDEIR model for the Swiss economy, using the calibrated values from Question 4 in Problem Set 1, and the MATLAB routines from Question 4 in Problem Set 1.

The **deliverable product** for this question has *one* component: a verbal discussion of the impulse-response functions for a technology shock of one percent, and the corresponding graphs.

1. You have already completed this step in Question 4 of Problem Set 1. Set σ, δ, r^*, and β following Mendoza (1991), and calibrate α, $\bar{d}$, ω, ψ, ϕ, ρ, and η to match the same Swiss moments as in Question 4 of Problem Set 1.
2. **Paste** the code from *additional_run.m* to the bottom of your *edeir_run_Q4.m* file. Also, **copy** the file *ir.m* into the same folder as your *edeir_run_Q4.m* file.
3. **Simulate** the impulse-response functions (for ten periods after the shock) for output, consumption, investment, hours worked, the trade balance to output ratio, the TFP shock, and the current account to output ratio in Switzerland under a current technology shock of one percent. **Explain** the behavior of these variables.
4. **Use** the parameter values you received in Question 5.2 of Problem Set 1, where you reduced the standard deviation of (the cyclical component of) investment i_t to half of its actual value in the data. Then, **simulate** the impulse-response functions (for ten periods after the shock) for output, consumption, investment, hours worked, the trade balance to output ratio, the TFP shock, and the current account to output ratio in Switzerland under a current technology shock of one percent. **Compare** these results to those from item 3.

7 Simulating the EDEIR model for Switzerland under alternative preferences

Simulate the EDEIR model for the Swiss economy using an alternative utility function.

The **deliverable product** for this question has *four* components: a copy of your edited MATLAB code, an analytic derivation of the new equilibrium conditions, a verbal discussion of the ability of the model to explain observed business cycle patterns, and a comparison of the impulse-response functions from this version of the model with those from Question 6 above.

Drop the GHH specification by Greenwood et al. (1988) and adopt instead the following Cobb-Douglas specification, introduced in Lecture 5 as an alternative:

$$u(c_t, h_t) = \frac{\left[c_t^{\gamma}(\bar{h} - h_t)^{1-\gamma}\right]^{1-\sigma} - 1}{1-\sigma} \qquad \text{with } \gamma \in (0,1),\ \sigma > 0.$$

1. **Derive** for the decentralized economy the equilibrium conditions that *change* through the introduction of this alternative utility function. Note that the MATLAB code is written in terms of the social planner's solution (as in Chapter 4 of the textbook). You only need to rederive and **state** the following three conditions:

   (a) Under the alternative utility function, $u_c(c_t, h_t) = \lambda_t$ changes.
   Previously, the condition used to be $\left(c_t - \frac{h_t^{\omega}}{\omega}\right)^{-\sigma} = \lambda_t$.

   (b) Under the alternative utility function, $-u_h(c_t, h_t) = \lambda_t w_t = \lambda_t A_t F_h(k_t, h_t)$ changes.
   The old condition used to be $h_t^{\omega-1} = (1-\alpha)A_t(k_t/h_t)^{\alpha}$

   (c) Show that labor supply in steady state equals

   $$h = \frac{\bar{h}}{1 + \frac{1-\gamma}{\gamma(1-\alpha)}\left(1 - \delta\kappa^{1-\alpha} - \frac{tb}{y}\right)}.$$

   Hints: Note that $\kappa \equiv k/h$ so that $y = \kappa^{\alpha}h$. Also note that $tb = -r^*\bar{b} = r^*\bar{d}$. You may find it useful to rely on the steady-state level of consumption $c = y - \delta k - r^*\bar{d}$ in the derivation.

2. **Adjust** the conditions from item 1, as well as the definition of λ in steady state, in the respective MATLAB files. Note that tb/y is a targeted value in the MATLAB code.

3. This step is already completed in the code. Set σ, δ, r^*, and β following Mendoza (1991), and calibrate α and $\bar{d}$ to match the same Swiss first moments as in Question 4 of Problem Set 1.

4. This step is already completed in the code. Adjust the routine in order to calibrate γ, $\bar{h}$, ψ, ϕ, ρ, and η to match the same Swiss second moments as in Question 4 of Problem Set 1.

5. **Set** the Swiss target values for calibration as in Question 4 of Problem Set 1.

6. **Report** the calibrated parameter values for γ, $\bar{h}$, ϕ, ψ, ρ, and η.

7. **Compute** the model-implied (theoretical) second moments for the calibration to Switzerland.

8. **Comment** on the ability of the model to explain observed business cycle patterns in Switzerland between 1991 and 2020, and **compare** the results to those from Question 4 in Problem Set 1.

9. **Simulate** the impulse-response functions (for ten periods after the shock) for output, consumption, investment, hours worked, the trade balance to output ratio, the TFP shock, and the current account to output ratio in Switzerland under a current technology shock of one percent. **Explain** the behavior of these variables. **Compare** these impulse-response functions to those from Question 6 above.

8 Simulating ToT shocks for small open high-income economies

Simulate the SOE-MX Model for the following three small open economies (SOEs) with high per-capita incomes: Canada, Finland and Switzerland.

The **deliverable product** for this question has *one* component: a verbal comparison of the model-implied and SVAR-implied variances (both conditional on ToT shocks), including tables reporting these values.

1. **Load** the data in the files *data_Q8.csv*, *names_Q8.csv* and *iso_Q8.csv* into MATLAB.
2. This step is already completed in the code. Use the routine from Question 1 of Problem Set 1 to detrend the data of the following per capita variables: terms of trade ToT_t, trade balance to output ratio tb_t/y_t, output y_t, consumption c_t, and investment i_t.[1]
3. This step is already completed in the code. Code the SVAR model from Lecture 7:

$$\begin{bmatrix} \widehat{ToT}_{t+1} \\ \hat{\mathbf{v}}_{t+1} \end{bmatrix} = H \begin{bmatrix} \widehat{ToT}_t \\ \hat{\mathbf{v}}_t \end{bmatrix} + \Sigma \begin{bmatrix} \epsilon_t^1 \\ \boldsymbol{\epsilon}_t^2 \end{bmatrix}, \quad \text{where}$$

$$H \equiv \begin{bmatrix} \rho_1 & 0 \\ \boldsymbol{\alpha}_0\rho_1 + \boldsymbol{\alpha}_1 & \boldsymbol{\rho}_2 \end{bmatrix} \quad \text{and} \quad \Sigma \equiv \begin{bmatrix} \eta & 0 \\ \boldsymbol{\alpha}_0\eta & \boldsymbol{\gamma}_{22} \end{bmatrix}.$$

   $\mathbf{v}_t$ is a vector of relevant macro variables, ρ_1 is a persistence scalar, $\boldsymbol{\rho}_2$ is a persistence matrix with zero off-diagonal entries, ϵ_t^1 is a random scalar (zero mean, unit variance), and $\boldsymbol{\epsilon}_t^2$ is a random vector (zero mean, full-rank variance-covariance matrix).
   Compute estimates for the matrices H (called h_x in the code files provided) and Σ (called Π in the code files provided).
4. This step is already completed in the code. Set all parameters reported in the first row of Table 7.5 in the Uribe and Schmitt-Grohé textbook equal to the values displayed in the table. Set $s_x = 0.32$, $s_{tb} = -0.1$, and $s_{yx} = 0.52$ in order to match empirical averages for SOEs.
5. This step is already completed in the code. Adjust the routine in order to calibrate country-specific values for ϕ $(= \phi_x = \phi_m)$ and ψ to match the two empirical moments σ_i/σ_y and $\sigma_{tb/y}/\sigma_y$.
6. Produce and **report** tables that correspond to Tables 7.4, 7.6 and 7.7 in the Uribe and Schmitt-Grohé textbook.
7. **Compare** the model-implied variances of tb/y, y, c and i (conditional on ToT shocks) to those measured by the SVAR model. Briefly **discuss**. Then **compare** your version of Table 7.6 with that in the Uribe and Schmitt-Grohé textbook.
8. **Compare** Table 7.7 in the Uribe and Schmitt-Grohé textbook with your results. **Comment** on plausible reasons to set $\phi_m = \phi_x$, as is done in the code.

9 Simulating impulse-response functions for different values of the interest sensitivity to external debt ψ

The so-called Deterministic External Debt-Elastic Interest Rate (EDEIR) crucially depends on the interest sensitivity to external debt ψ:

$$r_t = r_0^* + \bar{p} + \psi\left(\exp\{-(b_t - \bar{b})\} - 1\right) \quad \text{for} \quad r^* = r_0^* + \bar{p}.$$

Denote with $\widehat{\psi}$ the calibrated value of the interest sensitivity to external debt from Question 8. Simulate the impulse-response functions implied by the model fitted in Question 8 above for two different values of ψ: $\widehat{\psi}$ and $10 \cdot \widehat{\psi}$. Note that no re-calibration is necessary. (Keep the remaining parameters fixed, altering ψ only).

The **deliverable product** for this question has *one* component: a verbal discussion of the impulse-response functions for a terms of trade shock of ten percent under $\widehat{\psi}$ and $10 \cdot \widehat{\psi}$, and the corresponding graphs.

1. **Simulate** the impulse-response functions (for ten periods after the shock) for all variables specified in the code *plot_mx_ir_Q9.m* under a current terms of trade shock of ten percent. Use the median response of our SOEs for the plots. **Explain** the behavior of these variables. **Explain** the differences between the impulse-response functions when using $\widehat{\psi}$ or $10 \cdot \widehat{\psi}$.
2. **Relate** the impulse-response functions to the Harberger-Laursen-Metzler (HLM) Effect and the Obstfeld-Razin-Svensson (ORS) Effect. Briefly **discuss.**

[1] All variables, except for tb_t/y_t, have to be log-quadratically detrended. tb_t/y_t has to be divided by the secular component of output, and then detrended in levels, as in Problem Set 1.

References

Greenwood, Jeremy, Zvi Hercowitz, and Gregory W. Huffman, "Investment, Capacity Utilization, and the Real Business Cycle," *American Economic Review*, June 1988, *78* (3), 402–17.

Mendoza, Enrique G., "Real Business Cycles in a Small Open Economy," *American Economic Review*, September 1991, *81* (4), 797–818.

Uribe, Martín and Stephanie Schmitt-Grohé, *Open economy macroeconomics*, Princeton and Oxford: Princeton University Press, 2017.