International Macroeconomics and Finance

<u>Final Exam</u>

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Instructions:

- This exercise involves the analysis of a model economy similar to that of a recent research paper. Read carefully the description of the model economy and the specific assignment questions you are asked to address.

- Please submit your answers (codes, data, figures and explanatory text) electronically via Inspera.

- Your submission filename should only contain your ID number, not your name.

1 Model Environment

The world economy comprises two countries, A and B. In all countries, households consume two goods, tradables (T) and oil (O). Time is discrete and households are infinitely lived: $t = 1, 2, \ldots$.

In country B, a representative household receives a stochastic endowment of oil, whose period-t realization is denoted by $y_{O,t}$.

The price in units of foreign currency of oil is normalized to $P_{O,t}^{\$} = 1 \forall t$ (numeraire). The price in units of domestic currency of oil is $P_{O,t}$. The law of one price applies, hence the price of oil is equal to the nominal exchange rate, E_t, defined as the price of foreign currency in units of domestic currency: $P_{O,t} = E_t$. Denote by $P_{T,t}$ the price in units of domestic currency of tradable.

In country A, household preferences are defined over consumption and leisure: $u(c_{A,t}, l_t)$.

In country A, a unit-mass continuum of identical firms indexed by i have access to a technology to produce varieties of tradable good using labor as input:

$$y_{T,i,t} = l_{i,t}^{1-\alpha}. \tag{1}$$

A producer of final goods combines the individual varieties according to a CES aggregator:

$$y_{T,t} = \left[\int_0^1 y_{T,i,t}^{\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}}. \tag{2}$$

Preferences of the representative household in B are

$$u_B(c_{B,t}) = \log(c_{B,t}). \tag{3}$$

$c_{B,t}$ is an aggregator of goods O and T defined below.

The budget constraint of the representative household in B is:

$$c_{B,O,t} + P_{T,t}^{\$} c_{B,T,t} = y_{O,t} + n_{B,t} - n_{B,t+1}/R_t^{\$}, \tag{4}$$

where $n_{B,t}$ denotes wealth of this household, in units of foreign currency. $R_t^{\$}$ is the gross return on one-period, risk-free bonds in units of foreign currency. $P_{T,t}^{\$}$ is the foreign-currency price of the final good $y_{T,t}$, which satisfies (LOOP):

$$P_{T,t}^{\$} E_t = P_{T,t} \text{ and } P_{T,t} = \left[\int_0^1 P_{i,t}^{1-\theta} di \right]^{\frac{1}{1-\theta}}, \tag{5}$$

where $P_{i,t}$ is the price of an individual variety.

Labor market clearing implies: $l_t = \int_0^1 l_{i,t} di$.

We will now introduce several alternative model versions.

1.1 RAFAFP: Representative Agent, Financial Autarky, Flexible Prices

In this version of the model, a representative household inhabits country A. Her preferences are:

$$u_A\left(c_{A,t}, l_t\right) = \log\left(c_{A,t}\right) + \psi \log\left(1 - l_t\right),$$ (6)

where $1 - l_t$ denotes leisure.

For households in A and B, consumption is a CES aggregator over consumption of tradable and oil:

$$c_{j,t} = \left[s_T c_{j,T,t}^{\frac{\eta-1}{\eta}} + (1 - s_T) c_{j,O,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}.$$ (7)

The problem faced by each firm in A is:

$$\max \quad Profits_{i,t} = P_{i,t} y_{i,t} - W_t l_{i,t},$$

$$\text{s.t.} \quad y_{T,i,t} = l_{i,t}^{1-\alpha},$$ (8)

$$P_{i,t} = P_{T,t} \left(\frac{y_{T,i,t}}{y_{T,t}} \right)^{-\theta}.$$

where W_t denotes the wage in units of domestic currency.

Firms' profits are distributed to the representative household: $Profits_t = \int_0^1 Profits_{i,t}$.

The budget constraint of the representative household in A is:

$$P_{O,t} c_{A,O,t} + P_{T,t} c_{A,T,t} = W_t l_t + Profits_t + E_t\left(n_{A,t} - n_{A,t+1}/R_t^{\$} \right),$$ (9)

where $n_{A,t}$ denotes wealth of this household, in units of foreign currency.

Market clearing for goods implies:

$$c_{A,T,t} + c_{B,T,t} = y_{T,t}, \quad c_{A,O,t} + c_{B,O,t} = y_{O,t}.$$ (10)

Countries cannot trade financial assets among each other. Hence:

$$n_{A,t} = n_{B,t} = 0 \forall t.$$ (11)

The nominal exchange rate is fixed and equal to 1.

1.2 RANBFP: Representative Agent, Nominal Bond, Flexible Prices

Everything as in RAFAFP, except that countries can trade bonds in units of foreign currency (or oil) among each other. Replace (11) with:

$$n_{A,t} + n_{B,t} = 0 \forall t.$$ (12)

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1.3 TANBFP: Two Agents, Nominal Bond, Flexible Prices

Modify the economy in TANBFP to consider two types of households instead of one in country A.

The Hand-to-Mouth household in A has the following budget constraint:

$$c_{H,O,t} + P_{T,t}c_{H,T,t} = W_t l_{H,t} + Profits_{H,t}. \tag{13}$$

The Ricardian household in A has the following budget constraint:

$$c_{R,O,t} + P_{T,t}c_{R,T,t} = W_t l_{R,t} + Profits_{R,t} + E_t \left(n_{R,A,t} - n_{R,A,t+1}/R_t^{\$} \right) \tag{14}$$

The two types of household have the same preferences, given by (6).

The market clearing condition for labor of the two types is:

$$l_t = \chi l_{R,T} + (1-\chi) l_{H,T}, \tag{15}$$

where χ denotes the mass of Ricardian households.

Market clearing for bonds is

$$\chi n_{R,A,t} + n_{B,t} = 0 \forall t. \tag{16}$$

Profits are distributed to the two types of households according to their mass: $Profits_t = \chi Profits_{R,T} + (1-\chi) Profits_{H,T}$.

1.4 TANBNR: Two Agents, Nominal Bond, Nominal Rigidities

Assume that intermediate firms as subject to nominal rigidities a-la Rotemberg. Whenever a firm changes its price, it must pay a quadratic cost. Firms' profits can be written as:

$$Profits = P_{it}y_{i,t} - W_t l_{i,t} - \frac{\phi}{2} \left(\frac{P_{i,t}}{P_{i,t-1}} - 1 \right)^2 P_{T,t}Y_{T,t}. \tag{17}$$

Consider two possible monetary policy rules. First, fixed exchange rates: $E_t = 1 \ \forall t$. Second, producer-price inflation targeting: $\frac{P_{T,t}}{P_{T,t-1}} = 1$. Under this policy, the exchange rate adjusts freely to be consistent with producer price inflation.

1.5 TANBFPNH: Two Agents, Nominal Bond, Nominal Rigidities, Non-Homothetic preferences

Assume that, in country A, s_T is different for Ricardian households and Hand-to-mouth households and it is lower for Hand-to-mouth households than for Ricardian households.

2 Assignment Questions

For each of the economies above detailed:

1. Write down the equilibrium conditions. Where household problems are not detailed in full, write them down. Specify a stochastic process of your choice for the oil endowment. You do not have to state multiple times equilibrium conditions that are common across countries.

2. Calibrate the steady state of the economy, by setting parameters to match key moments for the EU economy (Country A) and major oil and natural gas exporters (Country B)

3. Consider a negative shock to the oil endowment. What are its implications for:

   - Output in country A
   - The price level and inflation in the two countries
   - Household consumption and welfare
   - Imports, exports, and the trade balance

   Present the answers for the different model economies highlighting similarities and differences, as you would if writing an academic paper. Please reduce repetitions to a minimum.

4. In the two-agent economies, suggest a policy that reduces the detrimental effects of the oil shock for the households most severely affected by it.