

# IMF, Problem Set 3

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## Q1

### 0.1 RAFAFP

The household's problem in Country A is:

$$\max_{\{C_{A,T,t}, C_{A,O,t}, l_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left( \log(c_{A,t}) + \phi \log(1 - l_t) \right) \quad (1)$$

subject to:

$$\begin{aligned} P_{O,t} c_{A,O,t} + P_{T,t} c_{A,T,t} &= W_t l_t + \Pi_t + E_t \left( n_{A,t} - \frac{n_{A,t+1}}{R_t^s} \right) \\ n_{A,t} &= 0 \\ c_{A,O,t}, c_{A,T,t} &\geq 0 \\ l_t &\in (0, 1) \end{aligned}$$

Similarly, the household's problem in Country B is:

$$\max_{\{C_{B,T,t}, C_{B,O,t}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \log(c_{B,t}) \quad (2)$$

subject to:

$$\begin{aligned} P_{O,t} c_{B,O,t}^s + P_{T,t}^s c_{B,T,t} &= y_{O,t} + \left( n_{B,t} - \frac{n_{B,t+1}}{R_t^s} \right) \\ n_{B,t} &= 0 \\ c_{B,O,t}, c_{B,T,t} &\geq 0 \end{aligned}$$

where for each household, consumption is aggregated as:

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

Moreover, it is assumed that the law of one price holds for both oil and tradeable goods, such that:

$$\begin{aligned} P_{T,t} &= E_t P_{T,t}^{\$} = P_{T,t}^{\$} \\ P_{O,t} &= E_t P_{O,t}^{\$} = 1 \end{aligned}$$

since  $E_t = 1$  due to the assumption of fixed exchange rate and  $P_{O,t} = 1$  due to normalisation.

The households' first order conditions consist of their oil-tradeable Euler equation:

$$(1-s_T) c_{j,O,t}^{-\frac{1}{\eta}} = \frac{s_T c_{j,T,t}^{-\frac{1}{\eta}}}{P_{T,t}}, \quad j \in \{A, B\} \quad (3)$$

the household's labour supply decision in Country A:

$$\frac{(1-s_T) c_{A,O,t}^{-\frac{1}{\eta}}}{s_T c_{A,T,t}^{1-\frac{1}{\eta}} + (1-s_T) c_{A,O,t}^{1-\frac{1}{\eta}}} W_t = \frac{\psi}{1-l_t} \quad (4)$$

and the budget constraints

$$P_{O,t} c_{A,O,t} + P_{T,t} c_{A,T,t} = W_t l_t + \Pi_t \quad (5)$$

$$P_{O,t} c_{B,O,t}^{\$} + P_{T,t} c_{B,T,t}^{\$} = y_{O,t} \quad (6)$$

Next, the monopolistically competitive firm's problem with flexible price is:

$$\max_{l_{it}} P_{i,t} y_{i,t} - W_t l_{i,t} \quad (7)$$

subject to:

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

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

The first order condition is:

$$P_{T,t}(1-\theta)(1-\alpha)l_{i,t}^{(1-\theta)(1-\alpha)-1} = y_{T,t}^{-\theta} W_t \quad (8)$$

Finally, define the oil endowment in Country B as an AR(1) process, such that:

$$y_{O,t} = \gamma + \rho y_{O,t-1} + \epsilon_{O,t} \quad (9)$$

I can now define an equilibrium. An equilibrium in this economy consists of sequences of quantities  $\{c_{A,O,t}, c_{A,T,t}, c_{B,O,t}, c_{B,T,t}, l_t, y_{T,t}, y_{O,t}, \Pi_t\}_{t=0}^{\infty}$  and prices  $\{P_{T,t}, P_{O,t}, P_{T,t}^s, P_{O,t}^s, W_t, E_t\}_{t=0}^{\infty}$  such that the FOCs 3 to 9 hold and market-clearing is satisfied on the tradeable goods market:

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

the oil market:

$$c_{A,O,t} + c_{B,O,t} = y_{O,t} \quad (11)$$

and the labour market:

$$l_t = \int_0^1 l_{i,t} di \quad (12)$$

## 0.2 RANBFP

The problem is similar to the RAFAFP economy, except households in Country A and B are no longer in financial autarky. Therefore, the households' problems are now:

$$\max_{\{C_{A,T,t}, C_{A,O,t}, l_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left( \log(c_{A,t}) + \phi \log(1 - l_t) \right) \quad (13)$$

subject to:

$$\begin{aligned} P_{O,t}c_{A,O,t} + P_{T,t}c_{A,T,t} &= W_t l_t + \Pi_t + E_t \left( n_{A,t} - \frac{n_{A,t+1}}{R_t^s} \right) \\ c_{A,O,t}, c_{A,T,t} &\geq 0 \\ l_t &\in (0, 1) \end{aligned}$$

and:

$$\max_{\{C_{B,T,t}, C_{B,O,t}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \log(c_{B,t}) \quad (14)$$

subject to:

$$\begin{aligned} P_{O,t}c_{B,O,t}^s + P_{T,t}c_{B,T,t}^s &= y_{O,t} + \left( n_{B,t} - \frac{n_{B,t+1}}{R_t^s} \right) \\ c_{B,O,t}, c_{B,T,t} &\geq 0 \end{aligned}$$

where  $n_{A,t}, n_{B,t} \in (-\infty, \infty)$ . The FOCs are identical to RAFAFP with the addition of the intertemporal Euler equations:

$$\frac{c_{J,O,t}^{-\frac{1}{\eta}}}{s_T c_{J,T,t}^{1-\frac{1}{\eta}} + (1-s_T) c_{J,O,t}^{1-\frac{1}{\eta}}} = \beta R_t^s \frac{c_{J,O,t+1}^{-\frac{1}{\eta}}}{s_T c_{J,T,t+1}^{1-\frac{1}{\eta}} + (1-s_T) c_{J,O,t+1}^{1-\frac{1}{\eta}}}, \quad j \in \{A, B\} \quad (15)$$

The equilibrium is now defined as follows. An equilibrium in this economy consists of sequences of quantities  $\{c_{A,O,t}, c_{A,T,t}, c_{B,O,t}, c_{B,T,t}, l_t, y_{T,t}, y_{O,t}, \Pi_t, n_{A,t}, n_{B,t}\}_{t=0}^{\infty}$  and prices  $\{P_{T,t}, P_{O,t}, P_{T,t}^s, P_{O,t}^s, W_t, E_t, R_t^s\}_{t=0}^{\infty}$  such that the FOCs (3) to (9), (15) hold and market-clearing conditions (10) to (12) are satisfied.

### 0.3 TANBFP

In the TANBFP economy, there is a mass of  $\chi$  Ricardian and  $(1 - \chi)$  hand-to-mouth (HTM) households in country A. Ricardian households' problem is defined as in equations (1) and HTM households' problem is defined as in equations (13). Ricardian households' FOCs are characterised by:

$$(1 - s_T)c_{AR,O,t}^{-\frac{1}{\eta}} = \frac{s_T c_{AR,T,t}^{-\frac{1}{\eta}}}{P_{T,t}} \quad (16)$$

$$\frac{c_{AR,O,t}^{-\frac{1}{\eta}}}{s_T c_{AR,T,t}^{1-\frac{1}{\eta}} + (1 - s_T)c_{AR,O,t}^{1-\frac{1}{\eta}}} = \beta R_t^{\$} \frac{c_{AR,O,t+1}^{-\frac{1}{\eta}}}{s_T c_{AR,T,t+1}^{1-\frac{1}{\eta}} + (1 - s_T)c_{AR,O,t+1}^{1-\frac{1}{\eta}}}, \quad j \in \{A, B\} \quad (17)$$

$$P_{O,t}c_{AR,O,t} + P_{T,t}c_{AR,T,t} = W_t l_{Rt} + \Pi_t + E_t(n_{AR,t} - \frac{n_{AR,t+1}}{R_t^{\$}}) \quad (18)$$

and HTM households' FOCs by:

$$(1 - s_T)c_{AH,O,t}^{-\frac{1}{\eta}} = \frac{s_T c_{AH,T,t}^{-\frac{1}{\eta}}}{P_{T,t}} \quad (19)$$

$$\frac{(1 - s_T)c_{AH,O,t}^{-\frac{1}{\eta}}}{s_T c_{AH,T,t}^{1-\frac{1}{\eta}} + (1 - s_T)c_{AH,O,t}^{1-\frac{1}{\eta}}} W_t = \frac{\psi}{1 - l_t} \quad (20)$$

$$P_{O,t}c_{AH,O,t} + P_{T,t}c_{AH,T,t} = W_t l_{Ht} + \Pi_t \quad (21)$$

### 0.4 TANBNR FER

In the TANBNR fixed exchange rate economy, the firm's FOC becomes:

$$W_t = (1 - \theta)(1 - \alpha)P_{T,t} \frac{l_{i,t}^{(1-\theta)(1-\alpha)-1}}{y_{T,t}^{-\theta}} - \phi \left[ \frac{P_{T,t}}{P_{T,t-1}} \frac{l_{i,t}^{-\theta(1-\alpha)}}{y_{T,t}^{-\theta}} \left( \frac{y_{i,t-1}}{y_{T,t-1}} \right)^{\theta} - 1 \right] \dots \quad (22)$$

$$P_{T,t} Y_{T,t} (-\theta)(1 - \alpha) \left[ \frac{P_{T,t}}{P_{T,t-1}} \frac{l_{i,t}^{-\theta(1-\alpha)}}{y_{T,t}^{-\theta}} \left( \frac{y_{i,t-1}}{y_{T,t-1}} \right)^{\theta} \right]$$

## 0.5 TANBNR PIT

The TANBNR price inflation targeting economy is identical to the TANBNR FER economy, except  $E_t$  is no longer fixed and the monetary authority in Country A fixes the price of the tradeable goods, such that  $P_{T,t} = P_{T,t-1}$ . The oil-tradeable Euler equation of households in Country B becomes:

$$\frac{(1 - s_T)c_{B,O,t}^{-\frac{1}{\eta}}}{E_t} = \frac{s_T c_{B,T,t}^{-\frac{1}{\eta}}}{P_{T,t}} \quad (23)$$

The Euler equation for Ricardian households is:

$$\frac{c_{AR,O,t}^{-\frac{1}{\eta}}}{s_T c_{AR,T,t}^{1-\frac{1}{\eta}} + (1 - s_T)c_{AR,O,t}^{1-\frac{1}{\eta}}} = \beta R_t^{\$} \frac{E_t}{E_{t+1}} \frac{c_{AR,O,t+1}^{-\frac{1}{\eta}}}{s_T c_{AR,T,t+1}^{1-\frac{1}{\eta}} + (1 - s_T)c_{AR,O,t+1}^{1-\frac{1}{\eta}}} \quad (24)$$

and labour supply decision for both households is:

$$\frac{(1 - s_T)c_{J,O,t}^{-\frac{1}{\eta}}}{s_T c_{J,T,t}^{1-\frac{1}{\eta}} + (1 - s_T)c_{J,O,t}^{1-\frac{1}{\eta}}} \frac{W_t}{E_t} = \frac{\psi}{1 - l_t}, \quad J \in \{AH, AR\} \quad (25)$$

## 0.6 TANBFPNH

The TANBFPNH economy is identical to the TANBFP economy (i.e. no nominal rigidity) except  $s_T$ , the weight given to the tradeable goods in the CES aggregator is allowed to vary between types of households, such that preferences are non-homothetic.

## Q2

The model is calibrated such that steady-state nominal output of Country A,  $P_T^* y_T^*$ , equals the nominal GDP of the EU in 2022, which was at 16.75 trillion euros. Moreover, average labour supply,  $l^*$ , is targeted to reflect the average work hour in the EU of 37.5 hours per week, resulting in a target value of 0.22. Finally, the model is calibrated to obtain steady-state oil endowment that is equal to the annual GDP of Saudi Arabia in 2022 denominated in euro, since I assume a fixed exchange rate between Country A and B throughout most models and the price of oil is the numeraire. This yields a target of 1 trillion euros for  $y_O^*$ .

For the parameters,  $\alpha = 0.3$  and  $\beta = 0.99$  were chosen to reflect standard values in the macroeconomic literature. The elasticity of labour supply was set to  $\psi = 1.5$  following Blundell et al. (2000). The elasticity of substitution between the tradeable good and oil was set at a low value such that  $\eta = 0.4$  such that tradeable goods and oil have low levels of substitutability in the consumption basket. The proportion of Ricardian households,  $\chi$ , was set at 0.8 to reflect the proportion of households that are not credit-constrained in the EU according to the HFCS survey data. I assumed a highly persistent oil endowment process, such that  $\rho = 0.9$ . Finally, the weight given to the tradeable goods,  $s_T$ , as well as the elasticity of substitution between the varieties of tradeables,  $\theta$ , and the intercept of the AR(1) process for oil endowment  $\gamma$ , were calibrated to attain the target moments described above.

Table 1: Targeted values

	Benchmark	RANBFP	TANBFP	TANBNR FER	TANBNR PIT	TANBFPNH
$P_T Y_T$	16.75	19.9	16.7	13.3	16.75	23.0
$l_t$	0.22	0.22	0.26	0.23	0.27	0.19
$Y_O$	1.0	1.0	1.0	1.0	1.0	1.0

Table 2: Calibrated values

	Benchmark	RANBFP	TANBFP	TANBNR FER	TANBNR PIT	TANBFPNH
$\alpha$	0.3	0.3	0.3	0.3	0.3	0.3
$\beta$	0.99	0.99	0.99	0.99	0.99	0.99
$\psi$	1.5	1.5	1.5	1.5	1.5	1.5
$\phi$				10	10	
$\eta$	0.4	0.4	0.4	0.4	0.4	0.4
$s_T$	0.8	0.8	0.8	0.8	0.8	0.8
$s_{AR,T}$						0.81
$s_{AH,T}$						0.75
$s_{B,T}$						0.8
$\theta$	1.0	1.0	1.0	1.0	1.0	1.0
$\rho$	0.9	0.9	0.9	0.9	0.9	0.9
$\gamma$	0.1	0.1	0.1	0.1	0.1	0.1
$\chi$	0.8	0.8	0.8	0.8	0.8	0.8



### Q3

The price index in all models is calculated from the CES aggregator, such that:

$$P_{j,t} = \left[ s_T P_{j,T,t}^{\frac{\eta-1}{\eta}} + (1 - s_T) P_{j,O,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \quad j \in \{A, B\} \quad (26)$$

Therefore, it follows that the price level is identical in Country A and B for all models, except TANBFPNH.

### 0.7 RAFAFP

Given a 10 percent negative shock to oil endowment, the price level in Country A and B increases due to the increase in the price of oil relative to the price of the tradeable goods. Since the price of tradeable goods relative to oil decreases while output stays constant, consumption in Country A decreases. Country B on the other hand, experiences an increase in consumption due to the increase in the price of oil. In fact, because of the low substitutability of oil and tradeables, the price effect dominates over the volume effect and Country B is able to consume more. This transfer of consumption from Country A to Country B is reflected by an increase in net export for Country A.

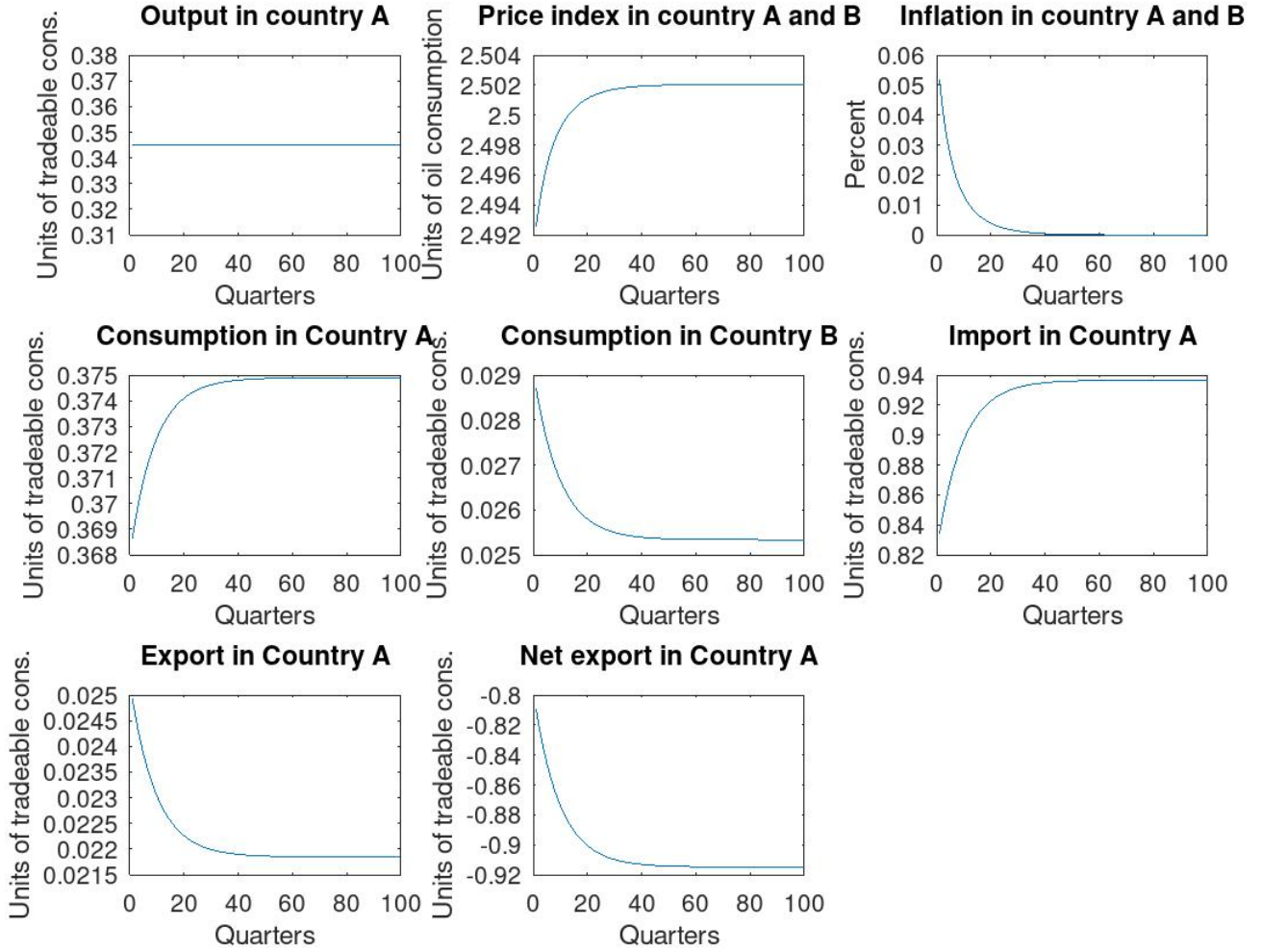


Figure 1: IRFs for RAFAFP

## 0.8 RANBFP

By opening financial markets, Country A borrows from Country B to smooth consumption. As a result, the shock to consumption in Country A should be less significant than in the RAFAFP model and as a result, the shock to all other variables should be damped compared to RAFAFP (which is indeed the case when we observe inflation).

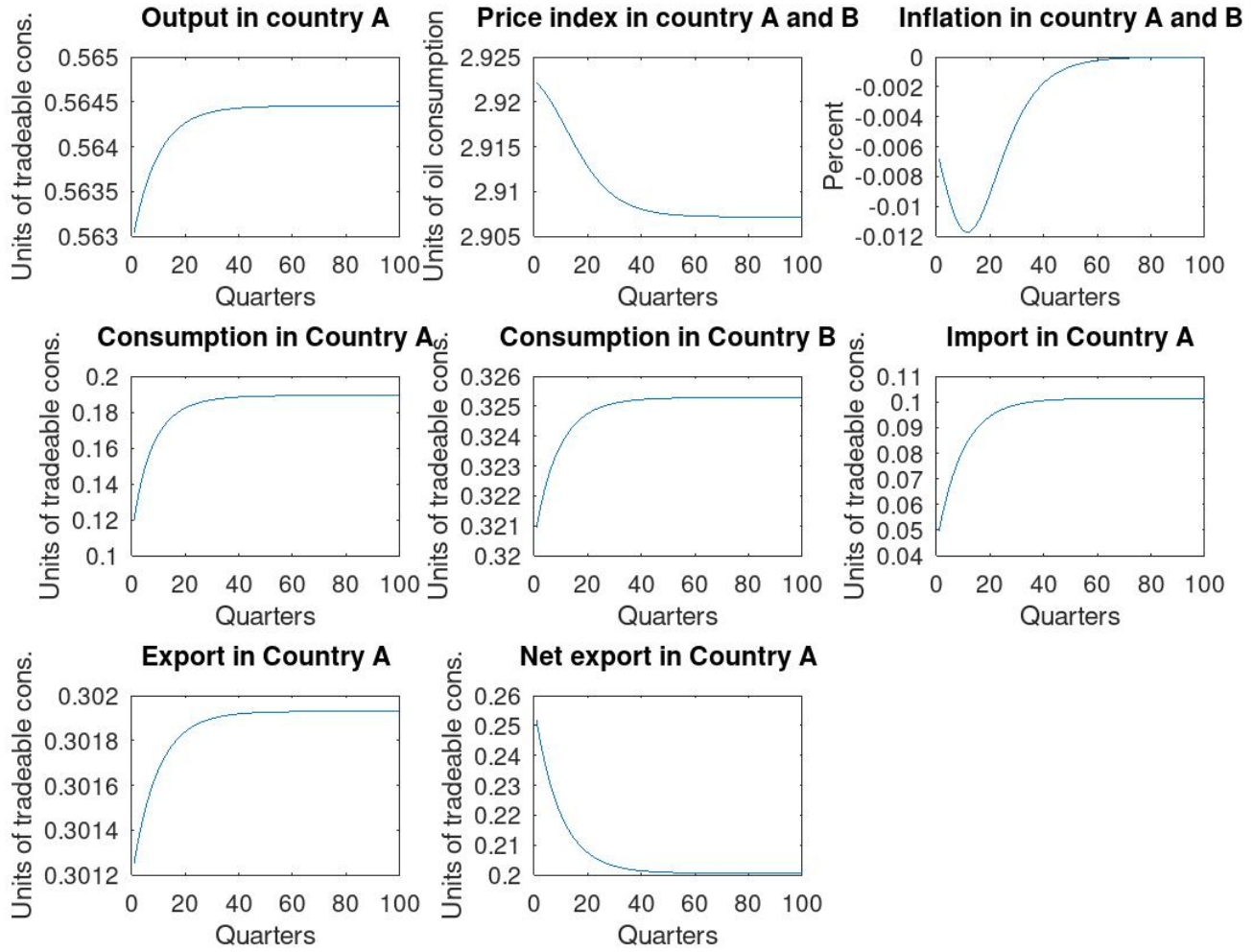


Figure 2: IRFs for RANBFP

## 0.9 TANBFP

Under TANBFP, I obtain an intermediary outcome between the RAFAFP and RANBFP models in terms of magnitude of the shock, since some of the shock is dampened by the share of Ricardian households.

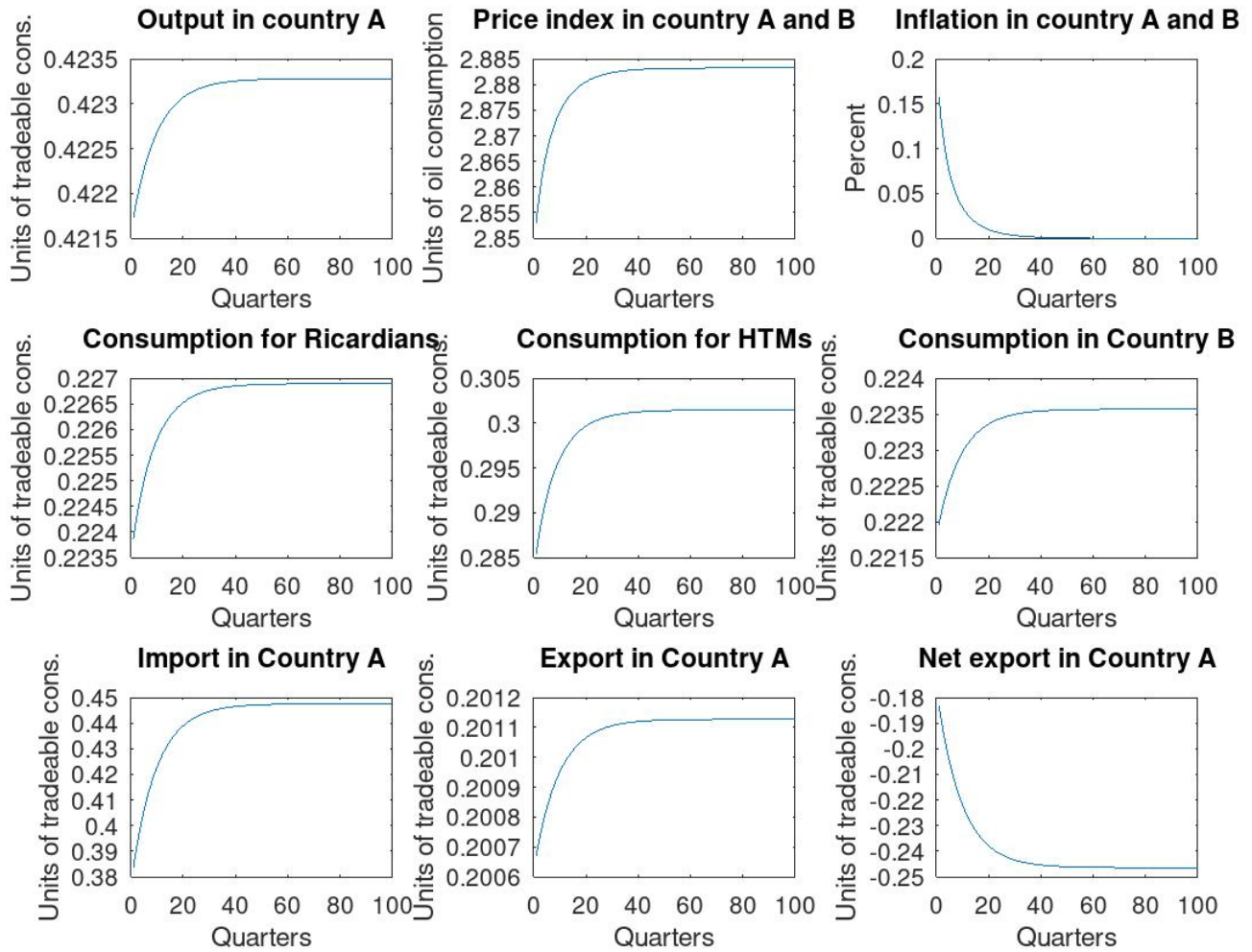


Figure 3: IRFs for TANBFP

## 0.10 TANBNR FER

The shock is more persistent when nominal rigidity is introduced compared to RAFAFP, as price take more time to adjust to their equilibrium level.

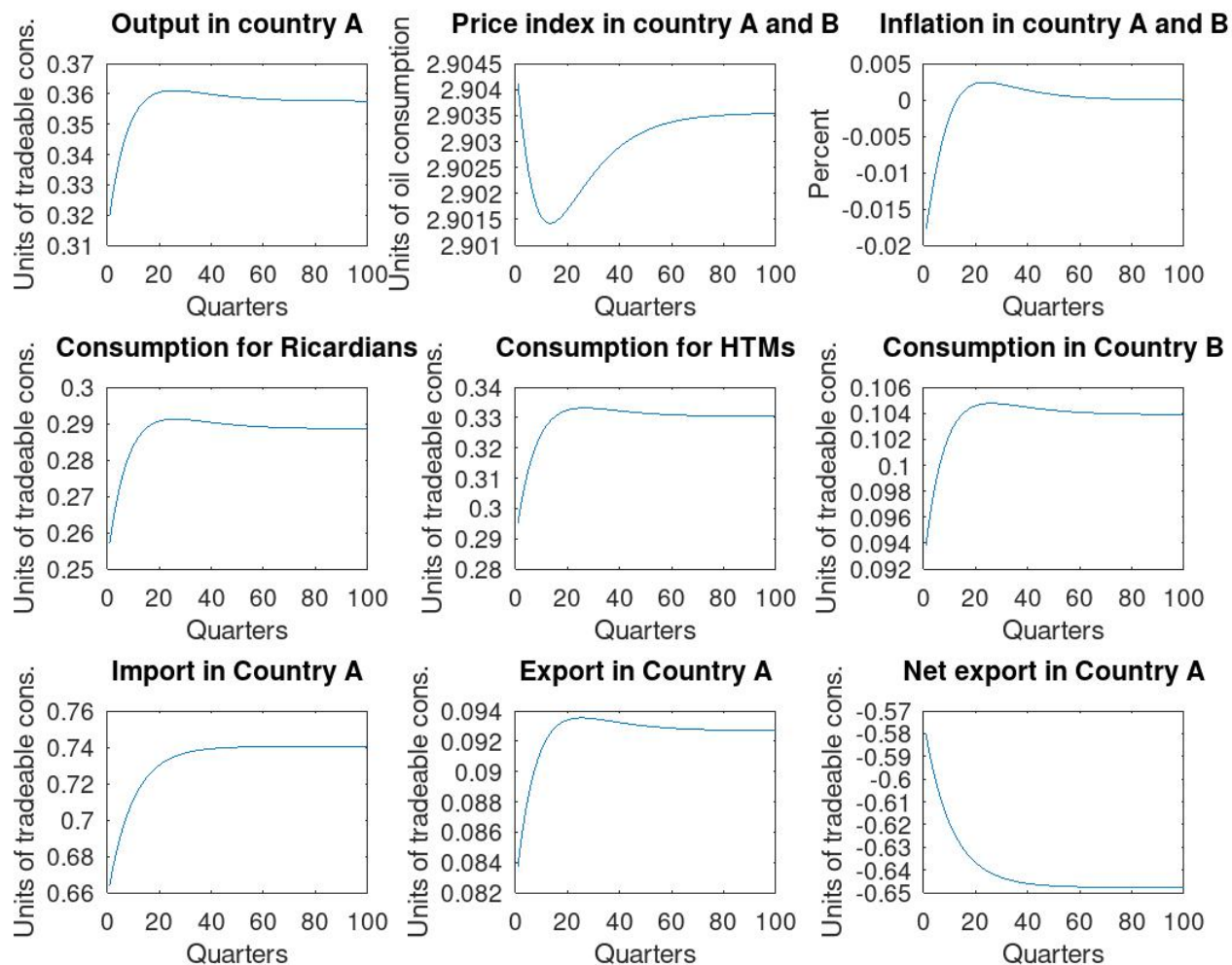


Figure 4: IRFs for TANBNR FER

### 0.11 TANBNR PIT

In theory, the effects of the foreign shock should be dampened by the exchange rate in Country A, which we do not observe in the IRFs.

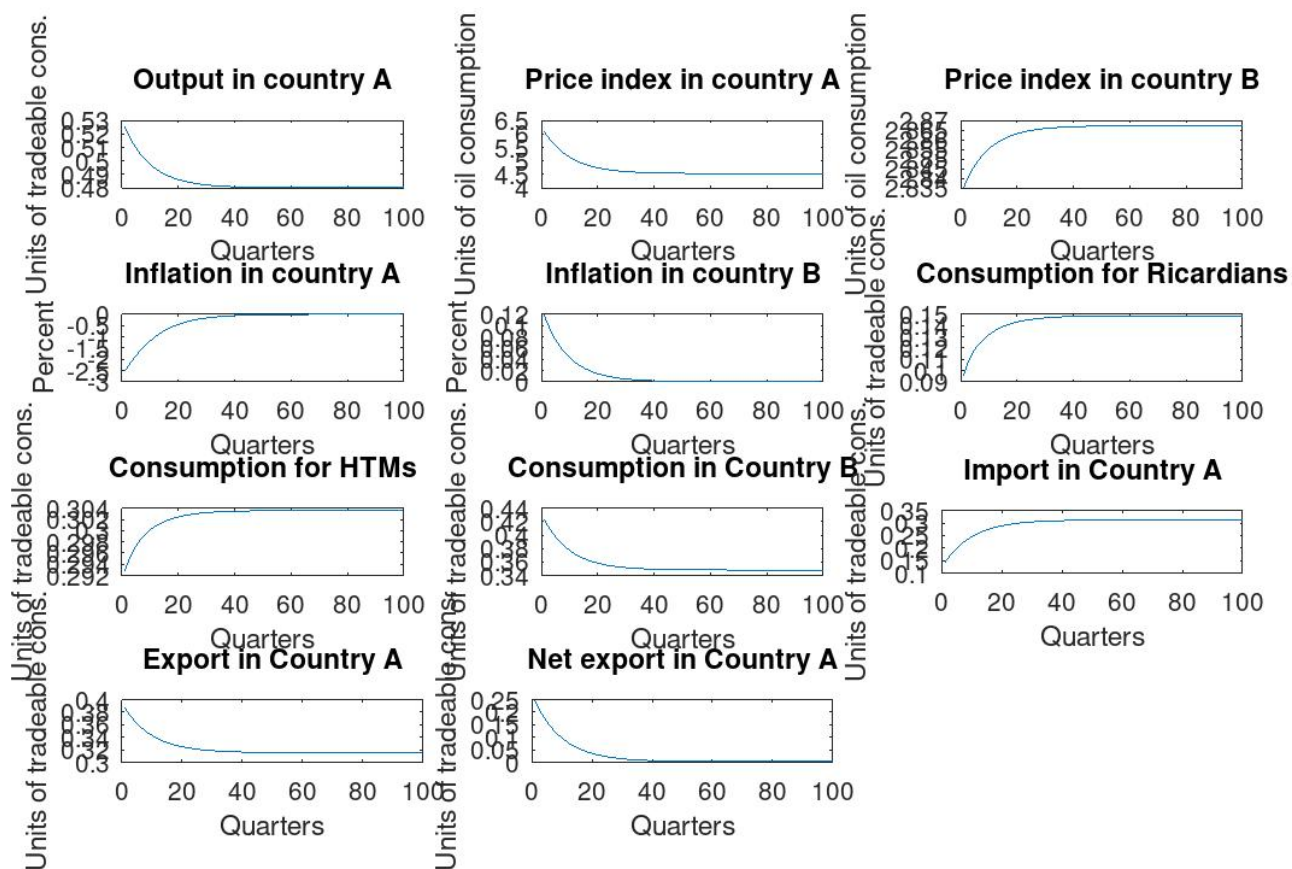


Figure 5: IRFs for TANBNR PIT



## 0.12 TANBFPNH

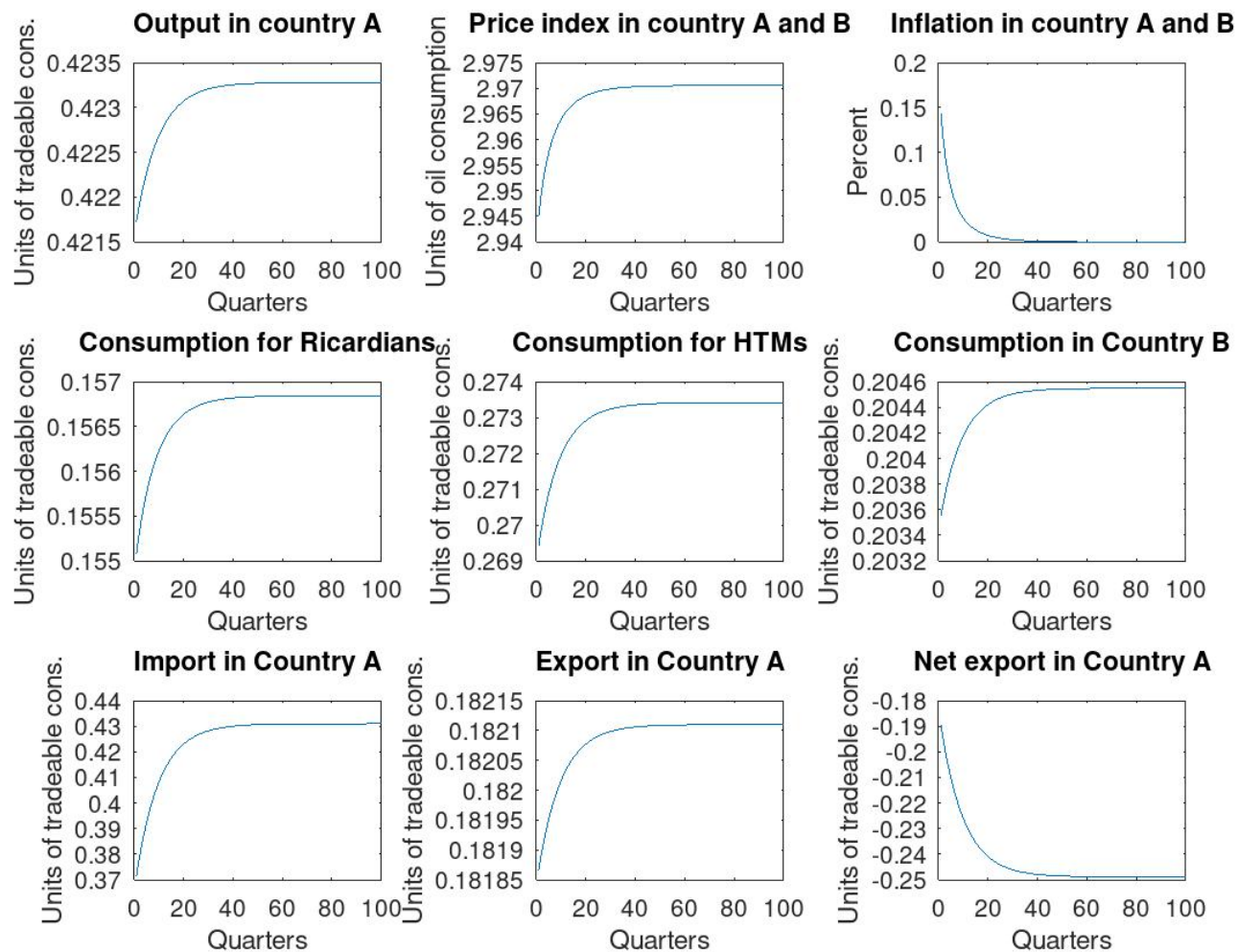


Figure 6: IRFs for TANBFPNH

## Appendix A: Main File

```
1
2 %
3 %
4 % Title: International Macro–Finance Problem Set 4, main file
5 % Author: —
6 % Date: 10/01/2024
7 % Description: Main file for the final problem set
8 %
9 %
10
11
12 %
13 % 0. Housekeeping (close all graphic windows)
14 %
15
16 close all;
17 clear all;
18
19
20 %
21 % 1. Load parameters
22 %
23
24 parameters;
25 save parameters par;
26
27
28 %
29 % 1. Run models
30 %
31
32 dynare rafafp;
33 dynare ranbfp;
34 dynare tanbfp;
35 dynare tanbnr_fer;
36 dynare tanbnr_pit;
37 dynare tanbfpnh;
38
39
40 %
41 % 2. Load results
42 %
43
44
45 rafafp_results = load("rafafp_results.mat");
46
47 RAFAFP.c_aoss = rafafp_results.oo_.steady_state(1);
48 RAFAFP.c_booss = rafafp_results.oo_.steady_state(2);
49 RAFAFP.c_atss = rafafp_results.oo_.steady_state(3);
50 RAFAFP.c_btss = rafafp_results.oo_.steady_state(4);
51 RAFAFP.lss = rafafp_results.oo_.steady_state(5);
52 RAFAFP.y_tss = rafafp_results.oo_.steady_state(6);
53 RAFAFP.y_oss = rafafp_results.oo_.steady_state(7);
54 RAFAFP.p_tss = rafafp_results.oo_.steady_state(8);
55 RAFAFP.wss = rafafp_results.oo_.steady_state(9);
56 RAFAFP.piss = rafafp_results.oo_.steady_state(10);
57
58 RAFAFP.c_ao = rafafp_results.oo_.irfs.c_ao_err_yo;
59 RAFAFP.c_at = rafafp_results.oo_.irfs.c_at_err_yo;
60 RAFAFP.c_bo = rafafp_results.oo_.irfs.c_bo_err_yo;
61 RAFAFP.c_bt = rafafp_results.oo_.irfs.c_bt_err_yo;
62 RAFAFP.l = rafafp_results.oo_.irfs.l_err_yo;
63 RAFAFP.p_t = rafafp_results.oo_.irfs.p_t_err_yo;
64 RAFAFP.pi = rafafp_results.oo_.irfs.pi_err_yo;
65 RAFAFP.w = rafafp_results.oo_.irfs.w_err_yo;
66 RAFAFP.y_o = rafafp_results.oo_.irfs.y_o_err_yo;
67 RAFAFP.y_t = rafafp_results.oo_.irfs.y_t_err_yo;
68
69 psi = rafafp_results.M_.params(2);
70 RAFAFP.eta = rafafp_results.M_.params(3);
71 RAFAFP.s_t = rafafp_results.M_.params(4);
72
73
```



```

74 ranbfp_results = load(" ranbfp_results.mat");
75
76 RANBFP.c_aoss = ranbfp_results.oo_.steady_state(1);
77 RANBFP.c_booss = ranbfp_results.oo_.steady_state(2);
78 RANBFP.c_atss = ranbfp_results.oo_.steady_state(3);
79 RANBFP.c_btss = ranbfp_results.oo_.steady_state(4);
80 RANBFP.lss = ranbfp_results.oo_.steady_state(5);
81 RANBFP.y_tss = ranbfp_results.oo_.steady_state(6);
82 RANBFP.y_oss = ranbfp_results.oo_.steady_state(7);
83 RANBFP.p_tss = ranbfp_results.oo_.steady_state(8);
84 RANBFP.wss = ranbfp_results.oo_.steady_state(9);
85 RANBFP.piss = ranbfp_results.oo_.steady_state(10);
86 RANBFP.n_ass = ranbfp_results.oo_.steady_state(11);
87 RANBFP.n_bss = ranbfp_results.oo_.steady_state(12);
88 RANBFP.r_starss = ranbfp_results.oo_.steady_state(13);
89
90 RANBFP.c_ao = ranbfp_results.oo_.irfs.c_ao_err_yo;
91 RANBFP.c_at = ranbfp_results.oo_.irfs.c_at_err_yo;
92 RANBFP.c_bo = ranbfp_results.oo_.irfs.c_bo_err_yo;
93 RANBFP.c_bt = ranbfp_results.oo_.irfs.c_bt_err_yo;
94 RANBFP.l = ranbfp_results.oo_.irfs.l_err_yo;
95 RANBFP.p_t = ranbfp_results.oo_.irfs.p_t_err_yo;
96 RANBFP.pi = ranbfp_results.oo_.irfs.pi_err_yo;
97 RANBFP.w = ranbfp_results.oo_.irfs.w_err_yo;
98 RANBFP.y_o = ranbfp_results.oo_.irfs.y_o_err_yo;
99 RANBFP.y_t = ranbfp_results.oo_.irfs.y_t_err_yo;
100
101 beta = ranbfp_results.M_.params(2);
102 RANBFP.eta = ranbfp_results.M_.params(4);
103 RANBFP.s_t = ranbfp_results.M_.params(5);
104
105
106 tanbfp_results = load(" tanbfp_results.mat");
107
108 TANBFP.c_ahoss = ranbfp_results.oo_.steady_state(1);
109 TANBFP.c_aross = tanbfp_results.oo_.steady_state(2);
110 TANBFP.c_booss = tanbfp_results.oo_.steady_state(3);
111 TANBFP.c_ahtss = tanbfp_results.oo_.steady_state(4);
112 TANBFP.c_artss = tanbfp_results.oo_.steady_state(5);
113 TANBFP.c_btss = tanbfp_results.oo_.steady_state(6);
114 TANBFP.l_hss = tanbfp_results.oo_.steady_state(7);
115 TANBFP.l_rss = tanbfp_results.oo_.steady_state(8);
116 TANBFP.lss = tanbfp_results.oo_.steady_state(9);
117 TANBFP.y_tss = tanbfp_results.oo_.steady_state(10);
118 TANBFP.y_oss = tanbfp_results.oo_.steady_state(11);
119 TANBFP.p_tss = tanbfp_results.oo_.steady_state(12);
120 TANBFP.wss = tanbfp_results.oo_.steady_state(13);
121 TANBFP.piss = tanbfp_results.oo_.steady_state(14);
122 TANBFP.n_ass = tanbfp_results.oo_.steady_state(15);
123 TANBFP.n_bss = tanbfp_results.oo_.steady_state(16);
124 TANBFP.rstarss = tanbfp_results.oo_.steady_state(17);
125 TANBFP.pirss = tanbfp_results.oo_.steady_state(18);
126 TANBFP.pihss = tanbfp_results.oo_.steady_state(19);
127
128 TANBFP.c_aro = tanbfp_results.oo_.irfs.c_aro_err_yo;
129 TANBFP.c_art = tanbfp_results.oo_.irfs.c_art_err_yo;
130 TANBFP.c_aho = tanbfp_results.oo_.irfs.c_aho_err_yo;
131 TANBFP.c_aht = tanbfp_results.oo_.irfs.c_aht_err_yo;
132 TANBFP.c_bo = tanbfp_results.oo_.irfs.c_bo_err_yo;
133 TANBFP.c_bt = tanbfp_results.oo_.irfs.c_bt_err_yo;
134 TANBFP.l_r = tanbfp_results.oo_.irfs.l_r_err_yo;
135 TANBFP.l_h = tanbfp_results.oo_.irfs.l_h_err_yo;
136 TANBFP.l = tanbfp_results.oo_.irfs.l_err_yo;
137 TANBFP.p_t = tanbfp_results.oo_.irfs.p_t_err_yo;
138 TANBFP.pi = tanbfp_results.oo_.irfs.pi_err_yo;
139 TANBFP.w = tanbfp_results.oo_.irfs.w_err_yo;
140 TANBFP.y_o = tanbfp_results.oo_.irfs.y_o_err_yo;
141 TANBFP.y_t = tanbfp_results.oo_.irfs.y_t_err_yo;
142
143 TANBFP.eta = tanbfp_results.M_.params(4);
144 TANBFP.s_t = tanbfp_results.M_.params(5);
145 chi = tanbfp_results.M_.params(9);
146
147

```

```

148 tanbnr_fer_results = load("tanbnr_fer_results.mat");
149
150 TANBNR_FER.c_ahoss = tanbnr_fer_results.oo_.steady_state(1);
151 TANBNR_FER.c_aross = tanbnr_fer_results.oo_.steady_state(2);
152 TANBNR_FER.c_boss = tanbnr_fer_results.oo_.steady_state(3);
153 TANBNR_FER.c_ahoss = tanbnr_fer_results.oo_.steady_state(4);
154 TANBNR_FER.c_artss = tanbnr_fer_results.oo_.steady_state(5);
155 TANBNR_FER.c_btss = tanbnr_fer_results.oo_.steady_state(6);
156 TANBNR_FER.l_hss = tanbnr_fer_results.oo_.steady_state(7);
157 TANBNR_FER.l_rss = tanbnr_fer_results.oo_.steady_state(8);
158 TANBNR_FER.lss = tanbnr_fer_results.oo_.steady_state(9);
159 TANBNR_FER.y_tss = tanbnr_fer_results.oo_.steady_state(10);
160 TANBNR_FER.y_oss = tanbnr_fer_results.oo_.steady_state(11);
161 TANBNR_FER.p_tss = tanbnr_fer_results.oo_.steady_state(12);
162 TANBNR_FER.wss = tanbnr_fer_results.oo_.steady_state(13);
163 TANBNR_FER.piss = tanbnr_fer_results.oo_.steady_state(14);
164 TANBNR_FER.n_oss = tanbnr_fer_results.oo_.steady_state(15);
165 TANBNR_FER.n_bss = tanbnr_fer_results.oo_.steady_state(16);
166 TANBNR_FER.r_starss = tanbnr_fer_results.oo_.steady_state(17);
167 TANBNR_FER.pirss = tanbnr_fer_results.oo_.steady_state(18);
168 TANBNR_FER.pihss = tanbnr_fer_results.oo_.steady_state(19);
169
170 TANBNR_FER.c_aro = tanbnr_fer_results.oo_.irfs.c_aro_err_yo;
171 TANBNR_FER.c_art = tanbnr_fer_results.oo_.irfs.c_art_err_yo;
172 TANBNR_FER.c_aho = tanbnr_fer_results.oo_.irfs.c_aho_err_yo;
173 TANBNR_FER.c_ah = tanbnr_fer_results.oo_.irfs.c_ah_err_yo;
174 TANBNR_FER.c_bo = tanbnr_fer_results.oo_.irfs.c_bo_err_yo;
175 TANBNR_FER.c_bt = tanbnr_fer_results.oo_.irfs.c_bt_err_yo;
176 TANBNR_FER.l_r = tanbnr_fer_results.oo_.irfs.l_r_err_yo;
177 TANBNR_FER.l_h = tanbnr_fer_results.oo_.irfs.l_h_err_yo;
178 TANBNR_FER.l = tanbnr_fer_results.oo_.irfs.l_err_yo;
179 TANBNR_FER.p_t = tanbnr_fer_results.oo_.irfs.p_t_err_yo;
180 TANBNR_FER.pi = tanbnr_fer_results.oo_.irfs.pi_err_yo;
181 TANBNR_FER.w = tanbnr_fer_results.oo_.irfs.w_err_yo;
182 TANBNR_FER.y_o = tanbnr_fer_results.oo_.irfs.y_o_err_yo;
183 TANBNR_FER.y_t = tanbnr_fer_results.oo_.irfs.y_t_err_yo;
184
185 TANBNR_FER.eta = tanbnr_fer_results.M_.params(5);
186 TANBNR_FER.s_t = tanbnr_fer_results.M_.params(6);
187
188
189 tanbnr_pit_results = load("tanbnr_pit_results.mat");
190
191 TANBNR_PIT.c_ahoss = tanbnr_pit_results.oo_.steady_state(1);
192 TANBNR_PIT.c_aross = tanbnr_pit_results.oo_.steady_state(2);
193 TANBNR_PIT.c_boss = tanbnr_pit_results.oo_.steady_state(3);
194 TANBNR_PIT.c_ahoss = tanbnr_pit_results.oo_.steady_state(4);
195 TANBNR_PIT.c_artss = tanbnr_pit_results.oo_.steady_state(5);
196 TANBNR_PIT.c_btss = tanbnr_pit_results.oo_.steady_state(6);
197 TANBNR_PIT.l_hss = tanbnr_pit_results.oo_.steady_state(7);
198 TANBNR_PIT.l_rss = tanbnr_pit_results.oo_.steady_state(8);
199 TANBNR_PIT.lss = tanbnr_pit_results.oo_.steady_state(9);
200 TANBNR_PIT.y_tss = tanbnr_pit_results.oo_.steady_state(10);
201 TANBNR_PIT.y_oss = tanbnr_pit_results.oo_.steady_state(11);
202 TANBNR_PIT.p_tss = tanbnr_pit_results.oo_.steady_state(12);
203 TANBNR_PIT.ess = tanbnr_pit_results.oo_.steady_state(13);
204 TANBNR_PIT.wss = tanbnr_pit_results.oo_.steady_state(14);
205 TANBNR_PIT.piss = tanbnr_pit_results.oo_.steady_state(15);
206 TANBNR_PIT.n_oss = tanbnr_pit_results.oo_.steady_state(16);
207 TANBNR_PIT.n_bss = tanbnr_pit_results.oo_.steady_state(17);
208 TANBNR_PIT.r_starss = tanbnr_pit_results.oo_.steady_state(18);
209 TANBNR_PIT.pirss = tanbnr_pit_results.oo_.steady_state(19);
210 TANBNR_PIT.pihss = tanbnr_pit_results.oo_.steady_state(20);
211
212 TANBNR_PIT.c_aro = tanbnr_pit_results.oo_.irfs.c_aro_err_yo;
213 TANBNR_PIT.c_art = tanbnr_pit_results.oo_.irfs.c_art_err_yo;
214 TANBNR_PIT.c_aho = tanbnr_pit_results.oo_.irfs.c_aho_err_yo;
215 TANBNR_PIT.c_ah = tanbnr_pit_results.oo_.irfs.c_ah_err_yo;
216 TANBNR_PIT.c_bo = tanbnr_pit_results.oo_.irfs.c_bo_err_yo;
217 TANBNR_PIT.c_bt = tanbnr_pit_results.oo_.irfs.c_bt_err_yo;
218 TANBNR_PIT.l_r = tanbnr_pit_results.oo_.irfs.l_r_err_yo;
219 TANBNR_PIT.l_h = tanbnr_pit_results.oo_.irfs.l_h_err_yo;
220 TANBNR_PIT.l = tanbnr_pit_results.oo_.irfs.l_err_yo;
221 TANBNR_PIT.p_t = tanbnr_pit_results.oo_.irfs.p_t_err_yo;

```

```

222 TANBNR_PIT.e      = tanbnr_pit_results.oo_.irfs.e_err_yo;
223 TANBNR_PIT.pi     = tanbnr_pit_results.oo_.irfs.pi_err_yo;
224 TANBNR_PIT.w      = tanbnr_pit_results.oo_.irfs.w_err_yo;
225 TANBNR_PIT.y_o    = tanbnr_pit_results.oo_.irfs.y_o_err_yo;
226 TANBNR_PIT.y_t    = tanbnr_pit_results.oo_.irfs.y_t_err_yo;
227
228 TANBNR_PIT.eta = tanbnr_pit_results.M_.params(5);
229 TANBNR_PIT.s_t = tanbnr_pit_results.M_.params(6);
230
231
232 tanbfpnh_results = load("tanbfpnh_results.mat");
233
234 TANBFPNH.c_ahoss = tanbfpnh_results.oo_.steady_state(1);
235 TANBFPNH.c_aross = tanbfpnh_results.oo_.steady_state(2);
236 TANBFPNH.c_boss = tanbfpnh_results.oo_.steady_state(3);
237 TANBFPNH.c_ahtss = tanbfpnh_results.oo_.steady_state(4);
238 TANBFPNH.c_artss = tanbfpnh_results.oo_.steady_state(5);
239 TANBFPNH.c_btss = tanbfpnh_results.oo_.steady_state(6);
240 TANBFPNH.l_hss = tanbfpnh_results.oo_.steady_state(7);
241 TANBFPNH.l_rss = tanbfpnh_results.oo_.steady_state(8);
242 TANBFPNH.lss = tanbfpnh_results.oo_.steady_state(9);
243 TANBFPNH.y_tss = tanbfpnh_results.oo_.steady_state(10);
244 TANBFPNH.y_oss = tanbfpnh_results.oo_.steady_state(11);
245 TANBFPNH.p_tss = tanbfpnh_results.oo_.steady_state(12);
246 TANBFPNH.wss = tanbfpnh_results.oo_.steady_state(13);
247 TANBFPNH.piss = tanbfpnh_results.oo_.steady_state(14);
248 TANBFPNH.n_ass = tanbfpnh_results.oo_.steady_state(15);
249 TANBFPNH.n_bss = tanbfpnh_results.oo_.steady_state(16);
250 TANBFPNH.rstarss = tanbfpnh_results.oo_.steady_state(17);
251 TANBFPNH.pirss = tanbfpnh_results.oo_.steady_state(18);
252 TANBFPNH.pihss = tanbfpnh_results.oo_.steady_state(19);
253
254 TANBFPNH.c_aro = tanbfpnh_results.oo_.irfs.c_aro_err_yo;
255 TANBFPNH.c_art = tanbfpnh_results.oo_.irfs.c_art_err_yo;
256 TANBFPNH.c_aho = tanbfpnh_results.oo_.irfs.c_aho_err_yo;
257 TANBFPNH.c_aht = tanbfpnh_results.oo_.irfs.c_aht_err_yo;
258 TANBFPNH.c_bo = tanbfpnh_results.oo_.irfs.c_bo_err_yo;
259 TANBFPNH.c_bt = tanbfpnh_results.oo_.irfs.c_bt_err_yo;
260 TANBFPNH.l_r = tanbfpnh_results.oo_.irfs.l_r_err_yo;
261 TANBFPNH.l_h = tanbfpnh_results.oo_.irfs.l_h_err_yo;
262 TANBFPNH.l = tanbfpnh_results.oo_.irfs.l_err_yo;
263 TANBFPNH.p_t = tanbfpnh_results.oo_.irfs.p_t_err_yo;
264 TANBFPNH.pi = tanbfpnh_results.oo_.irfs.pi_err_yo;
265 TANBFPNH.w = tanbfpnh_results.oo_.irfs.w_err_yo;
266 TANBFPNH.y_o = tanbfpnh_results.oo_.irfs.y_o_err_yo;
267 TANBFPNH.y_t = tanbfpnh_results.oo_.irfs.y_t_err_yo;
268
269 TANBFPNH.eta = tanbfpnh_results.M_.params(4);
270 TANBFPNH.s_art = tanbfpnh_results.M_.params(5);
271 TANBFPNH.s_aht = tanbfpnh_results.M_.params(6);
272 TANBFPNH.s_bt = tanbfpnh_results.M_.params(7);
273
274 TANBFPNH.s_t = chi * TANBFPNH.s_art + (1 - chi) * TANBFPNH.s_aht;
275
276
277 %-----
278 % 4. Function definition
279 %-----
280
281 % CES aggregator:
282
283 function cons = ces_agg(c_t, c_o, eta, s_t)
284
285     cons = (s_t * c_t.^(1 - 1 / eta) +
286             (1 - s_t) * c_o.^(1 - 1 / eta)).^(eta / (eta - 1));
287
288 endfunction
289
290
291
292 %-----
293 % 3. Create key variables
294 %-----
295

```

```

296 % output in country A
297
298 RAFAFP.output = RAFAFP.y_t + RAFAFP.y_tss;
299 RANBFP.output = RANBFP.y_t + RANBFP.y_tss;
300 TANBFP.output = TANBFP.y_t + TANBFP.y_tss;
301 TANBNR_FER.output = TANBNR_FER.y_t + TANBNR_FER.y_tss;
302 TANBNR_PIT.output = TANBNR_PIT.y_t + TANBNR_PIT.y_tss;
303 TANBFPNH.output = TANBFPNH.y_t + TANBFPNH.y_tss;
304
305
306 % price levels
307
308 % re-express eveything as levels
309 RAFAFP.p_t = RAFAFP.p_t + RAFAFP.p_tss;
310 RAFAFP.p_o = 1;
311
312 % create a price index
313 RAFAFP.price = ces_agg(RAFAFP.p_t, RAFAFP.p_o, RAFAFP.eta, RAFAFP.s_t);
314
315
316 RANBFP.p_t = RANBFP.p_t + RANBFP.p_tss;
317 RANBFP.p_o = 1;
318
319 RANBFP.price = ces_agg(RANBFP.p_t, RANBFP.p_o, RANBFP.eta, RANBFP.s_t);
320
321
322 TANBFP.p_t = TANBFP.p_t + TANBFP.p_tss;
323 TANBFP.p_o = 1;
324
325 TANBFP.price = ces_agg(TANBFP.p_t, TANBFP.p_o, TANBFP.eta, TANBFP.s_t);
326
327
328 TANBNR_FER.p_t = TANBNR_FER.p_t + TANBNR_FER.p_tss;
329 TANBNR_FER.p_o = 1;
330
331 TANBNR_FER.price = ces_agg(TANBNR_FER.p_t, TANBNR_FER.p_o, TANBNR_FER.eta, TANBNR_FER.s_t);
332
333
334 TANBNR_PIT.p_at = TANBNR_PIT.p_tss;
335 TANBNR_PIT.p_ao = TANBNR_PIT.e + TANBNR_PIT.ess;
336
337 TANBNR_PIT.price_a = ces_agg(TANBNR_PIT.p_at, TANBNR_PIT.p_ao, TANBNR_PIT.eta, TANBNR_PIT.s_t);
338
339
340 TANBNR_PIT.p_bt = TANBNR_PIT.p_tss ./ (TANBNR_PIT.e + TANBNR_PIT.ess);
341 TANBNR_PIT.p_bo = 1;
342
343 TANBNR_PIT.price_b = ces_agg(TANBNR_PIT.p_bt, TANBNR_PIT.p_bo, TANBNR_PIT.eta, TANBNR_PIT.s_t);
344
345
346 TANBFPNH.p_t = TANBFPNH.p_t + TANBFPNH.p_tss;
347 TANBFPNH.p_o = 1;
348
349 TANBFPNH.price = ces_agg(TANBFPNH.p_t, TANBFPNH.p_o, TANBFPNH.eta, TANBFPNH.s_t);
350
351
352
353 % Inflation
354 RAFAFP.infl = diff(RAFAFP.price) ./ RAFAFP.price(1:(end-1)) * 100;
355 RANBFP.infl = diff(RANBFP.price) ./ RANBFP.price(1:(end-1)) * 100;
356 TANBFP.infl = diff(TANBFP.price) ./ TANBFP.price(1:(end-1)) * 100;
357 TANBNR_FER.infl = diff(TANBNR_FER.price) ./ TANBNR_FER.price(1:(end-1)) * 100;
358 TANBNR_PIT.infl_a = diff(TANBNR_PIT.price_a) ./ TANBNR_PIT.price_a(1:(end-1)) * 100;
359 TANBNR_PIT.infl_b = diff(TANBNR_PIT.price_b) ./ TANBNR_PIT.price_b(1:(end-1)) * 100;
360 TANBFPNH.infl = diff(TANBFPNH.price) ./ TANBFPNH.price(1:(end-1)) * 100;
361
362
363 % consumption
364
365 % re-express eveything as levels
366 RAFAFP.c_at = RAFAFP.c_at + RAFAFP.c_atss;
367 RAFAFP.c_ao = RAFAFP.c_ao + RAFAFP.c_aoss;
368 RAFAFP.c_bt = RAFAFP.c_bt + RAFAFP.c_btss;
369 RAFAFP.c_bo = RAFAFP.c_bo + RAFAFP.c_boss;

```

```

370
371 % rule out negative consumption
372 RAFAFP.c_at = max(RAFAFP.c_at, eps);
373 RAFAFP.c_ao = max(RAFAFP.c_ao, eps);
374 RAFAFP.c_bt = max(RAFAFP.c_bt, eps);
375 RAFAFP.c_bo = max(RAFAFP.c_bo, eps);
376
377 % compute consumption basket
378 RAFAFP.c_a = ces_agg(RAFAFP.c_at, RAFAFP.c_ao, RAFAFP.eta, RAFAFP.s_t);
379 RAFAFP.c_b = ces_agg(RAFAFP.c_bt, RAFAFP.c_bo, RAFAFP.eta, RAFAFP.s_t);
380
381
382 RANBFP.c_at = RANBFP.c_at + RANBFP.c_atss;
383 RANBFP.c_ao = RANBFP.c_ao + RANBFP.c_aoss;
384 RANBFP.c_bt = RANBFP.c_bt + RANBFP.c_btss;
385 RANBFP.c_bo = RANBFP.c_bo + RANBFP.c_booss;
386
387 RANBFP.c_at = max(RANBFP.c_at, eps);
388 RANBFP.c_ao = max(RANBFP.c_ao, eps);
389 RANBFP.c_bt = max(RANBFP.c_bt, eps);
390 RANBFP.c_bo = max(RANBFP.c_bo, eps);
391
392 RANBFP.c_a = ces_agg(RANBFP.c_at, RANBFP.c_ao, RANBFP.eta, RANBFP.s_t);
393 RANBFP.c_b = ces_agg(RANBFP.c_bt, RANBFP.c_bo, RANBFP.eta, RANBFP.s_t);
394
395
396 TANBFP.c_art = TANBFP.c_art + TANBFP.c_artss;
397 TANBFP.c_aro = TANBFP.c_aro + TANBFP.c_aross;
398 TANBFP.c_aht = TANBFP.c_aht + TANBFP.c_ahtss;
399 TANBFP.c_aho = TANBFP.c_aho + TANBFP.c_ahoss;
400 TANBFP.c_bt = TANBFP.c_bt + TANBFP.c_btss;
401 TANBFP.c_bo = TANBFP.c_bo + TANBFP.c_booss;
402
403 TANBFP.c_art = max(TANBFP.c_art, eps);
404 TANBFP.c_aro = max(TANBFP.c_aro, eps);
405 TANBFP.c_aht = max(TANBFP.c_aht, eps);
406 TANBFP.c_aho = max(TANBFP.c_aho, eps);
407 TANBFP.c_bt = max(TANBFP.c_bt, eps);
408 TANBFP.c_bo = max(TANBFP.c_bo, eps);
409
410 TANBFP.c_ar = ces_agg(TANBFP.c_art, TANBFP.c_aro, TANBFP.eta, TANBFP.s_t);
411 TANBFP.c_ah = ces_agg(TANBFP.c_aht, TANBFP.c_aho, TANBFP.eta, TANBFP.s_t);
412 TANBFP.c_b = ces_agg(TANBFP.c_bt, TANBFP.c_bo, TANBFP.eta, TANBFP.s_t);
413
414
415 TANBNR_FER.c_art = TANBNR_FER.c_art + TANBNR_FER.c_artss;
416 TANBNR_FER.c_aro = TANBNR_FER.c_aro + TANBNR_FER.c_aross;
417 TANBNR_FER.c_aht = TANBNR_FER.c_aht + TANBNR_FER.c_ahtss;
418 TANBNR_FER.c_aho = TANBNR_FER.c_aho + TANBNR_FER.c_ahoss;
419 TANBNR_FER.c_bt = TANBNR_FER.c_bt + TANBNR_FER.c_btss;
420 TANBNR_FER.c_bo = TANBNR_FER.c_bo + TANBNR_FER.c_booss;
421
422 TANBNR_FER.c_art = max(TANBNR_FER.c_art, eps);
423 TANBNR_FER.c_aro = max(TANBNR_FER.c_aro, eps);
424 TANBNR_FER.c_aht = max(TANBNR_FER.c_aht, eps);
425 TANBNR_FER.c_aho = max(TANBNR_FER.c_aho, eps);
426 TANBNR_FER.c_bt = max(TANBNR_FER.c_bt, eps);
427 TANBNR_FER.c_bo = max(TANBNR_FER.c_bo, eps);
428
429 TANBNR_FER.c_ar = ces_agg(TANBNR_FER.c_art, TANBNR_FER.c_aro, TANBNR_FER.eta, TANBNR_FER.s_t);
430 TANBNR_FER.c_ah = ces_agg(TANBNR_FER.c_aht, TANBNR_FER.c_aho, TANBNR_FER.eta, TANBNR_FER.s_t);
431 TANBNR_FER.c_b = ces_agg(TANBNR_FER.c_bt, TANBNR_FER.c_bo, TANBNR_FER.eta, TANBNR_FER.s_t);
432
433
434 TANBNR_PIT.c_art = TANBNR_PIT.c_art + TANBNR_PIT.c_artss;
435 TANBNR_PIT.c_aro = TANBNR_PIT.c_aro + TANBNR_PIT.c_aross;
436 TANBNR_PIT.c_aht = TANBNR_PIT.c_aht + TANBNR_PIT.c_ahtss;
437 TANBNR_PIT.c_aho = TANBNR_PIT.c_aho + TANBNR_PIT.c_ahoss;
438 TANBNR_PIT.c_bt = TANBNR_PIT.c_bt + TANBNR_PIT.c_btss;
439 TANBNR_PIT.c_bo = TANBNR_PIT.c_bo + TANBNR_PIT.c_booss;
440
441 TANBNR_PIT.c_art = max(TANBNR_PIT.c_art, eps);
442 TANBNR_PIT.c_aro = max(TANBNR_PIT.c_aro, eps);
443 TANBNR_PIT.c_aht = max(TANBNR_PIT.c_aht, eps);

```

```

444 TANBNR_PIT.c_aho = max(TANBNR_PIT.c_aho, eps);
445 TANBNR_PIT.c_bt = max(TANBNR_PIT.c_bt, eps);
446 TANBNR_PIT.c_bo = max(TANBNR_PIT.c_bo, eps);
447
448 TANBNR_PIT.c_ar = ces_agg(TANBNR_PIT.c_art, TANBNR_PIT.c_aro, TANBNR_PIT.eta, TANBNR_PIT.s_t);
449 TANBNR_PIT.c_ah = ces_agg(TANBNR_PIT.c_aht, TANBNR_PIT.c_aho, TANBNR_PIT.eta, TANBNR_PIT.s_t);
450 TANBNR_PIT.c_b = ces_agg(TANBNR_PIT.c_bt, TANBNR_PIT.c_bo, TANBNR_PIT.eta, TANBNR_PIT.s_t);
451
452
453 TANBFPNH.c_art = TANBFPNH.c_art + TANBFPNH.c_artss;
454 TANBFPNH.c_aro = TANBFPNH.c_aro + TANBFPNH.c_arooss;
455 TANBFPNH.c_aht = TANBFPNH.c_aht + TANBFPNH.c_ahtss;
456 TANBFPNH.c_aho = TANBFPNH.c_aho + TANBFPNH.c_ahoss;
457 TANBFPNH.c_bt = TANBFPNH.c_bt + TANBFPNH.c_btss;
458 TANBFPNH.c_bo = TANBFPNH.c_bo + TANBFPNH.c_booss;
459
460 TANBFPNH.c_art = max(TANBFPNH.c_art, eps);
461 TANBFPNH.c_aro = max(TANBFPNH.c_aro, eps);
462 TANBFPNH.c_aht = max(TANBFPNH.c_aht, eps);
463 TANBFPNH.c_aho = max(TANBFPNH.c_aho, eps);
464 TANBFPNH.c_bt = max(TANBFPNH.c_bt, eps);
465 TANBFPNH.c_bo = max(TANBFPNH.c_bo, eps);
466
467 TANBFPNH.c_ar = ces_agg(TANBFPNH.c_art, TANBFPNH.c_aro, TANBFPNH.eta, TANBFPNH.s_art);
468 TANBFPNH.c_ah = ces_agg(TANBFPNH.c_aht, TANBFPNH.c_aho, TANBFPNH.eta, TANBFPNH.s_aht);
469 TANBFPNH.c_b = ces_agg(TANBFPNH.c_bt, TANBFPNH.c_bo, TANBFPNH.eta, TANBFPNH.s_bt);
470
471
472
473 % labour supply
474
475 RAFAFP.l = RAFAFP.l + RAFAFP.lss;
476
477 RANBFP.l = RANBFP.l + RANBFP.lss;
478
479 TANBFP.l = TANBFP.l + TANBFP.lss;
480 TANBFP.l_r = TANBFP.l_r + TANBFP.l_rss;
481 TANBFP.l_h = TANBFP.l_h + TANBFP.l_hss;
482
483 TANBNR_FER.l = TANBNR_FER.l + TANBNR_FER.lss;
484 TANBNR_FER.l_r = TANBNR_FER.l_r + TANBNR_FER.l_rss;
485 TANBNR_FER.l_h = TANBNR_FER.l_h + TANBNR_FER.l_hss;
486
487 TANBNR_PIT.l = TANBNR_PIT.l + TANBNR_PIT.lss;
488 TANBNR_PIT.l_r = TANBNR_PIT.l_r + TANBNR_PIT.l_rss;
489 TANBNR_PIT.l_h = TANBNR_PIT.l_h + TANBNR_PIT.l_hss;
490
491 TANBFPNH.l = TANBFPNH.l + TANBFPNH.lss;
492 TANBFPNH.l_r = TANBFPNH.l_r + TANBFPNH.l_rss;
493 TANBFPNH.l_h = TANBFPNH.l_h + TANBFPNH.l_hss;
494
495
496 % discount vector
497 betas = zeros(1, 100);
498
499 for t = 1:length(betas)
500
501     betas(1, t) = beta^(t - 1);
502
503 endfor
504
505
506
507 % welfare
508
509 RAFAFP.utility_a = log(RAFAFP.c_a) + psi * log(1 - RAFAFP.l);
510 RAFAFP.welfare_a = betas * RAFAFP.utility_a.';
511
512 RAFAFP.utility_b = log(RAFAFP.c_b);
513 RAFAFP.welfare_b = betas * RAFAFP.utility_b.';
514
515
516 RANBFP.utility_a = log(RANBFP.c_a) + psi * log(1 - RANBFP.l);
517 RANBFP.welfare_a = betas * RANBFP.utility_a.';

```

```

518
519 RANBFP.utility_b = log(RANBFP.c_b);
520 RANBFP.welfare_b = betas * RANBFP.utility_b.';
521
522
523 TANBFP.utility_ar = log(TANBFP.c_ar) + psi * log(1 - TANBFP.l_r);
524 TANBFP.welfare_ar = betas * TANBFP.utility_ar.';
525
526 TANBFP.utility_ah = log(TANBFP.c_ah) + psi * log(1 - TANBFP.l_h);
527 TANBFP.welfare_ah = betas * TANBFP.utility_ah.';
528
529 TANBFP.utility_b = log(TANBFP.c_b);
530 TANBFP.welfare_b = betas * TANBFP.utility_b.';
531
532
533 TANBNR_FER.utility_ar = log(TANBNR_FER.c_ar) + psi * log(1 - TANBNR_FER.l_r);
534 TANBNR_FER.welfare_ar = betas * TANBNR_FER.utility_ar.';
535
536 TANBNR_FER.utility_ah = log(TANBNR_FER.c_ah) + psi * log(1 - TANBNR_FER.l_h);
537 TANBNR_FER.welfare_ah = betas * TANBNR_FER.utility_ah.';
538
539 TANBNR_FER.utility_b = log(TANBNR_FER.c_b);
540 TANBNR_FER.welfare_b = betas * TANBNR_FER.utility_b.';
541
542
543 TANBNR_PIT.utility_ar = log(TANBNR_PIT.c_ar) + psi * log(1 - TANBNR_PIT.l_r);
544 TANBNR_PIT.welfare_ar = betas * TANBNR_PIT.utility_ar.';
545
546 TANBNR_PIT.utility_ah = log(TANBNR_PIT.c_ah) + psi * log(1 - TANBNR_PIT.l_h);
547 TANBNR_PIT.welfare_ah = betas * TANBNR_PIT.utility_ah.';
548
549 TANBNR_PIT.utility_b = log(TANBNR_PIT.c_b);
550 TANBNR_PIT.welfare_b = betas * TANBNR_PIT.utility_b.';
551
552
553 TANBFPNH.utility_ar = log(TANBFPNH.c_ar) + psi * log(1 - TANBFPNH.l_r);
554 TANBFPNH.welfare_ar = betas * TANBFPNH.utility_ar.';
555
556 TANBFPNH.utility_ah = log(TANBFPNH.c_ah) + psi * log(1 - TANBFPNH.l_h);
557 TANBFPNH.welfare_ah = betas * TANBFPNH.utility_ah.';
558
559 TANBFPNH.utility_b = log(TANBFPNH.c_b);
560 TANBFPNH.welfare_b = betas * TANBFPNH.utility_b.';
561
562
563
564 % import/export, trade balance in country A:
565 RAFAFP.import = RAFAFP.c_ao;
566 RAFAFP.export = RAFAFP.c_bt;
567 RAFAFP.nex = RAFAFP.export - RAFAFP.import;
568
569
570 RANBFP.import = RANBFP.c_ao;
571 RANBFP.export = RANBFP.c_bt;
572 RANBFP.nex = RANBFP.export - RANBFP.import;
573
574
575 TANBFP.import = chi * TANBFP.c_aro + (1 - chi) * TANBFP.c_aho;
576 TANBFP.export = TANBFP.c_bt;
577 TANBFP.nex = TANBFP.export - TANBFP.import;
578
579
580 TANBNR_FER.import = chi * TANBNR_FER.c_aro + (1 - chi) * TANBNR_FER.c_aho;
581 TANBNR_FER.export = TANBNR_FER.c_bt;
582 TANBNR_FER.nex = TANBNR_FER.export - TANBNR_FER.import;
583
584
585 TANBNR_PIT.import = chi * TANBNR_PIT.c_aro + (1 - chi) * TANBNR_PIT.c_aho;
586 TANBNR_PIT.export = TANBNR_PIT.c_bt;
587 TANBNR_PIT.nex = TANBNR_PIT.export - TANBNR_PIT.import;
588
589
590 TANBFPNH.import = chi * TANBFPNH.c_aro + (1 - chi) * TANBFPNH.c_aho;
591 TANBFPNH.export = TANBFPNH.c_bt;

```



```

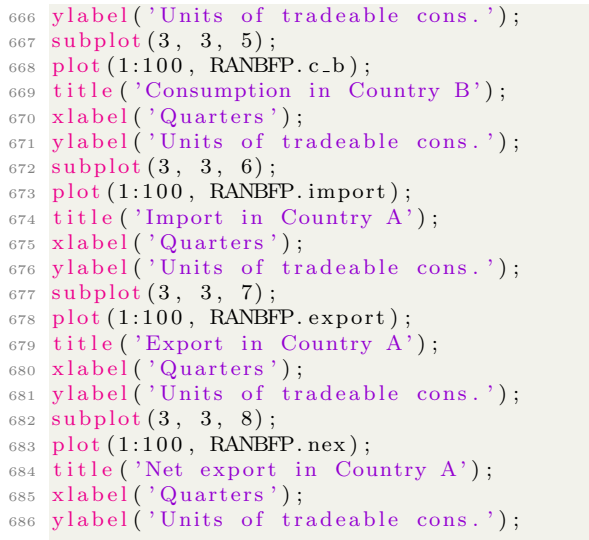
592 TANBFPNH.nex = TANBFPNH.export - TANBFPNH.import;
593
594
595 %
596 % 4. Plot IRFs
597 %
598
599 % RAFAFP
600
601 subplot(3, 3, 1);
602 plot(1:100, RAFAFP.output, 1:100);
603 title('Output in country A');
604 xlabel('Quarters');
605 ylabel('Units of tradeable cons. ');
606 subplot(3, 3, 2);
607 plot(1:100, RAFAFP.price, 1:100, RAFAFP.p_tss);
608 title('Price index in country A and B');
609 xlabel('Quarters');
610 ylabel('Units of oil consumption ');
611 subplot(3, 3, 3);
612 plot(1:99, RAFAFP.infl);
613 title('Inflation in country A and B');
614 xlabel('Quarters');
615 ylabel('Percent ');
616 subplot(3, 3, 4);
617 plot(1:100, RAFAFP.c_a);
618 title('Consumption in Country A');
619 xlabel('Quarters');
620 ylabel('Units of tradeable cons. ');
621 subplot(3, 3, 5);
622 plot(1:100, RAFAFP.c_b);
623 title('Consumption in Country B');
624 xlabel('Quarters');
625 ylabel('Units of tradeable cons. ');
626 subplot(3, 3, 6);
627 plot(1:100, RAFAFP.import);
628 title('Import in Country A');
629 xlabel('Quarters');
630 ylabel('Units of tradeable cons. ');
631 subplot(3, 3, 7);
632 plot(1:100, RAFAFP.export);
633 title('Export in Country A');
634 xlabel('Quarters');
635 ylabel('Units of tradeable cons. ');
636 subplot(3, 3, 8);
637 plot(1:100, RAFAFP.nex);
638 title('Net export in Country A');
639 xlabel('Quarters');
640 ylabel('Units of tradeable cons. ');
641
642 saveas(gcf, 'rafafp.jpg');
643
644
645 % RANBFP
646
647 subplot(3, 3, 1);
648 plot(1:100, RANBFP.output);
649 title('Output in country A');
650 xlabel('Quarters');
651 ylabel('Units of tradeable cons. ');
652 subplot(3, 3, 2);
653 plot(1:100, RANBFP.price);
654 title('Price index in country A and B');
655 xlabel('Quarters');
656 ylabel('Units of oil consumption ');
657 subplot(3, 3, 3);
658 plot(1:99, RANBFP.infl);
659 title('Inflation in country A and B');
660 xlabel('Quarters');
661 ylabel('Percent ');
662 subplot(3, 3, 4);
663 plot(1:100, RANBFP.c_a);
664 title('Consumption in Country A');
665 xlabel('Quarters');

```



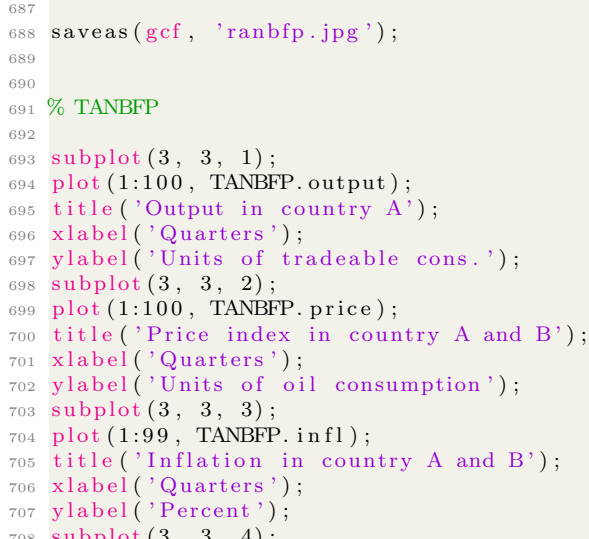
```

666 ylabel('Units of tradeable cons.');
```



```

667 subplot(3, 3, 5);
668 plot(1:100, RANBFP.c_b);
669 title('Consumption in Country B');
670 xlabel('Quarters');
671 ylabel('Units of tradeable cons.');
```



```

672 subplot(3, 3, 6);
673 plot(1:100, RANBFP.import);
674 title('Import in Country A');
675 xlabel('Quarters');
676 ylabel('Units of tradeable cons.');
```

```

677 subplot(3, 3, 7);
678 plot(1:100, RANBFP.export);
679 title('Export in Country A');
680 xlabel('Quarters');
681 ylabel('Units of tradeable cons.');
```

```

682 subplot(3, 3, 8);
683 plot(1:100, RANBFP.nex);
684 title('Net export in Country A');
685 xlabel('Quarters');
686 ylabel('Units of tradeable cons.');
```

```

687
688 saveas(gcf, 'ranbfp.jpg');
```

```

689
690
691 % TANBFP
692
693 subplot(3, 3, 1);
694 plot(1:100, TANBFP.output);
695 title('Output in country A');
696 xlabel('Quarters');
697 ylabel('Units of tradeable cons.');
```

```

698 subplot(3, 3, 2);
699 plot(1:100, TANBFP.price);
700 title('Price index in country A and B');
701 xlabel('Quarters');
702 ylabel('Units of oil consumption');
```

```

703 subplot(3, 3, 3);
704 plot(1:99, TANBFP.infl);
705 title('Inflation in country A and B');
706 xlabel('Quarters');
707 ylabel('Percent');
```

```

708 subplot(3, 3, 4);
709 plot(1:100, TANBFP.c_ar);
710 title('Consumption for Ricardians');
```

```

711 xlabel('Quarters');
```

```

712 ylabel('Units of tradeable cons.');
```

```

713 subplot(3, 3, 5);
714 plot(1:100, TANBFP.c_ah);
715 title('Consumption for HTMs');
```

```

716 xlabel('Quarters');
```

```

717 ylabel('Units of tradeable cons.');
```

```

718 subplot(3, 3, 6);
719 plot(1:100, TANBFP.c_b);
720 title('Consumption in Country B');
```

```

721 xlabel('Quarters');
```

```

722 ylabel('Units of tradeable cons.');
```

```

723 subplot(3, 3, 7);
724 plot(1:100, TANBFP.import);
725 title('Import in Country A');
```

```

726 xlabel('Quarters');
```

```

727 ylabel('Units of tradeable cons.');
```

```

728 subplot(3, 3, 8);
729 plot(1:100, TANBFP.export);
730 title('Export in Country A');
```

```

731 xlabel('Quarters');
```

```

732 ylabel('Units of tradeable cons.');
```

```

733 subplot(3, 3, 9);
734 plot(1:100, TANBFP.nex);
735 title('Net export in Country A');
```

```

736 xlabel('Quarters');
```

```

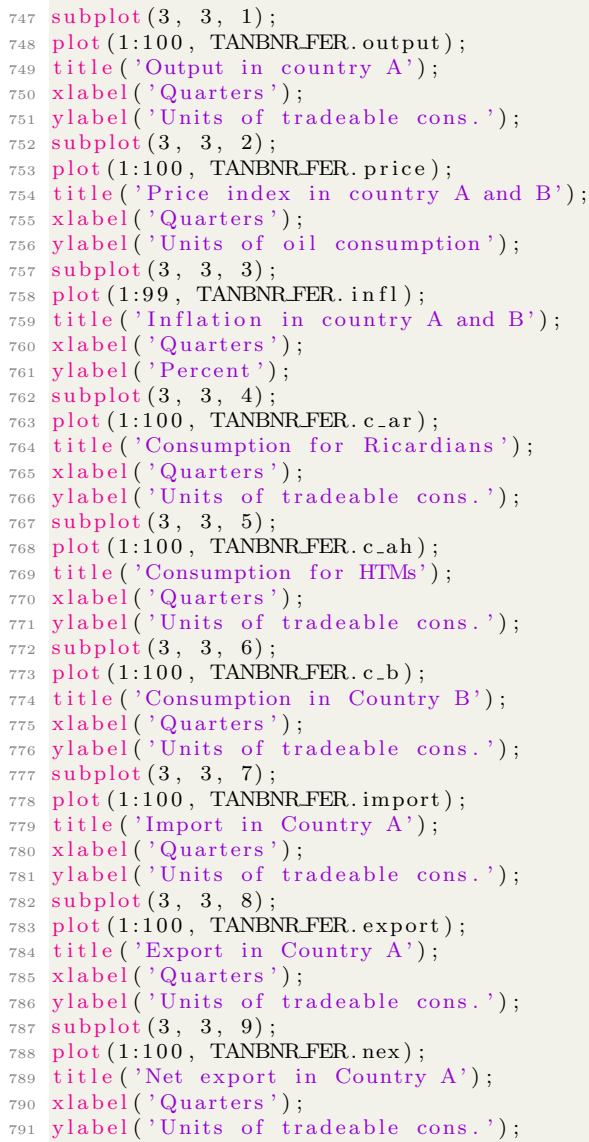
737 ylabel('Units of tradeable cons.');
```

```

738
739 saveas(gcf, 'tanbfp.jpg');
```

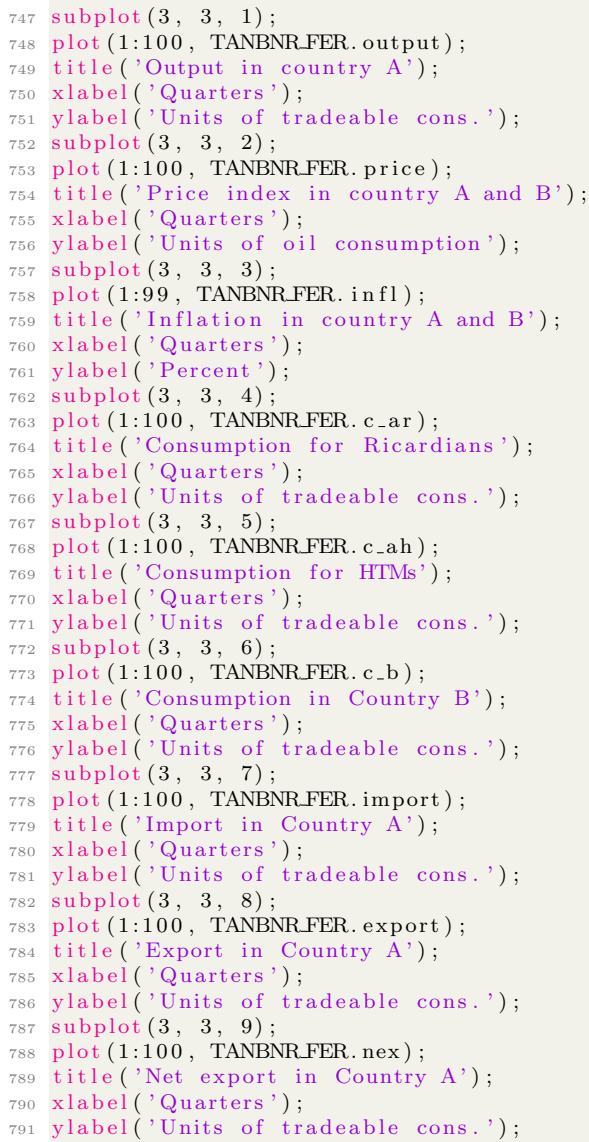
```

740
741
742
743
744
745 % TANBNR_FER
746
747 subplot(3, 3, 1);
748 plot(1:100, TANBNR_FER.output);
749 title('Output in country A');
750 xlabel('Quarters');
751 ylabel('Units of tradeable cons.');
```



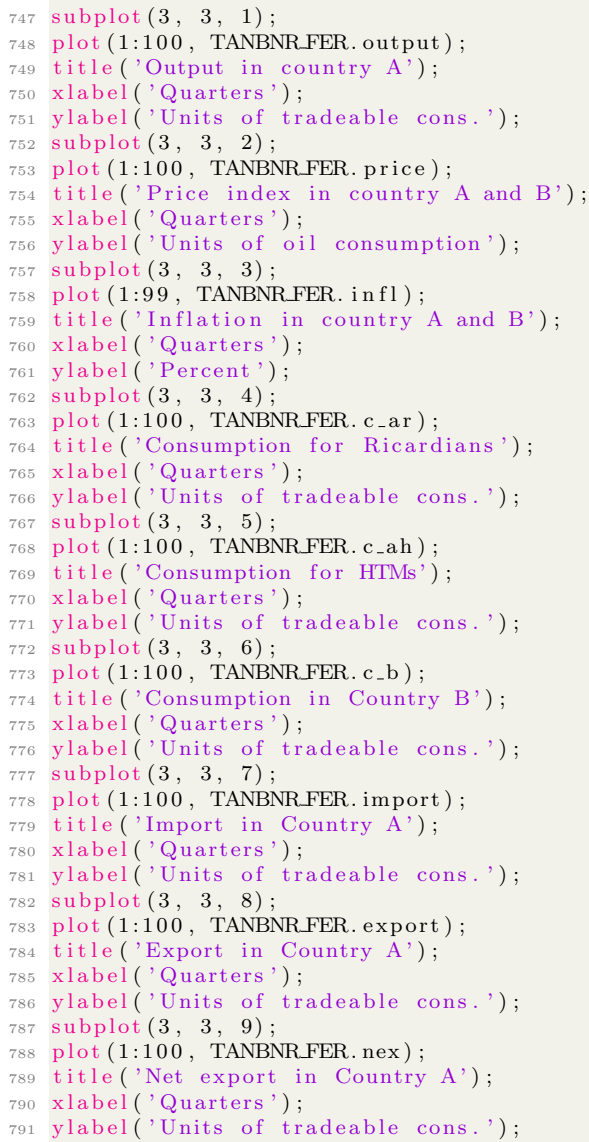
```

752 subplot(3, 3, 2);
753 plot(1:100, TANBNR_FER.price);
754 title('Price index in country A and B');
755 xlabel('Quarters');
756 ylabel('Units of oil consumption');
```



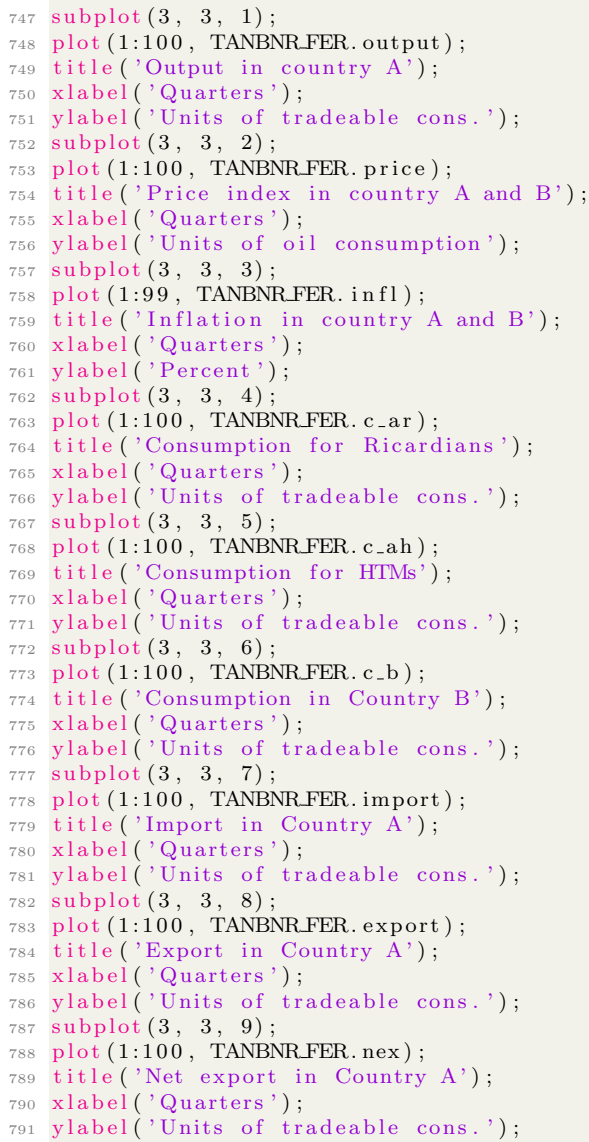
```

757 subplot(3, 3, 3);
758 plot(1:99, TANBNR_FER.infl);
759 title('Inflation in country A and B');
760 xlabel('Quarters');
761 ylabel('Percent');
```



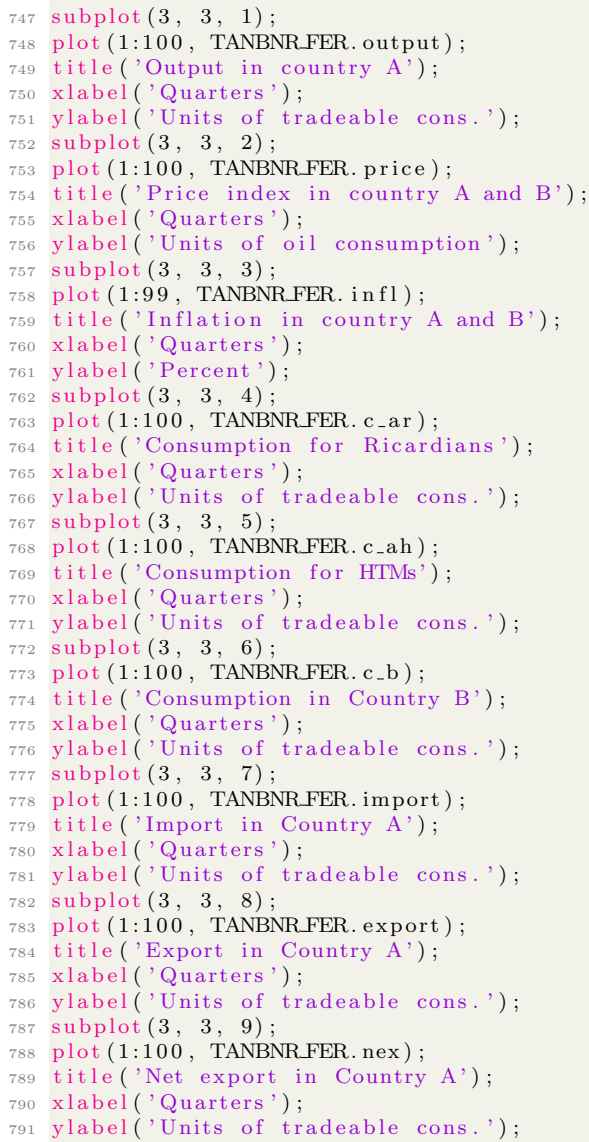
```

762 subplot(3, 3, 4);
763 plot(1:100, TANBNR_FER.c_ar);
764 title('Consumption for Ricardians');
```



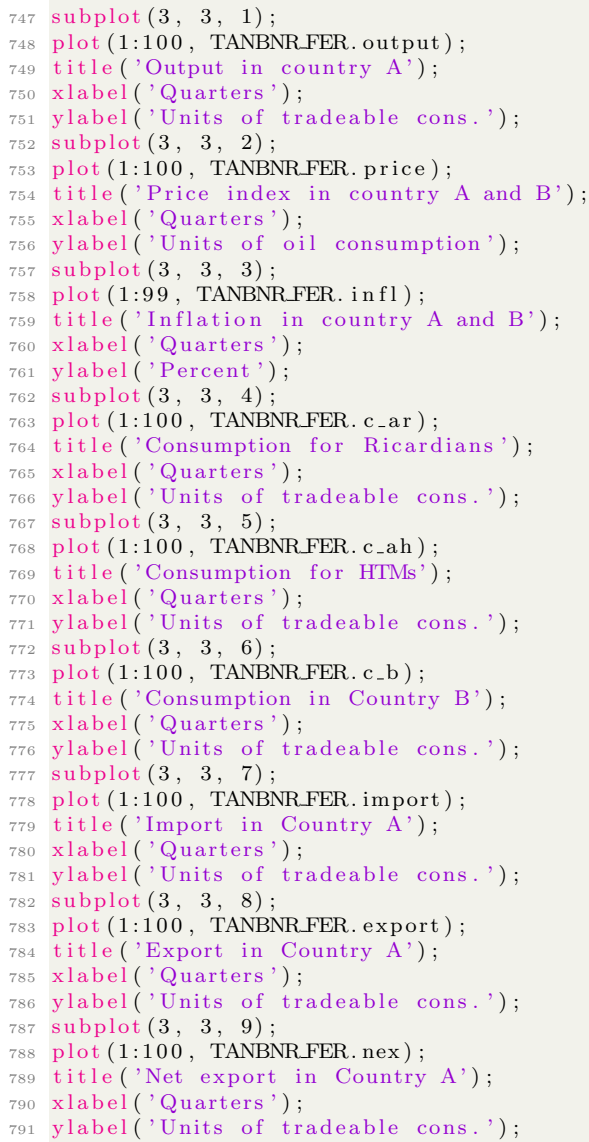
```

765 xlabel('Quarters');
```



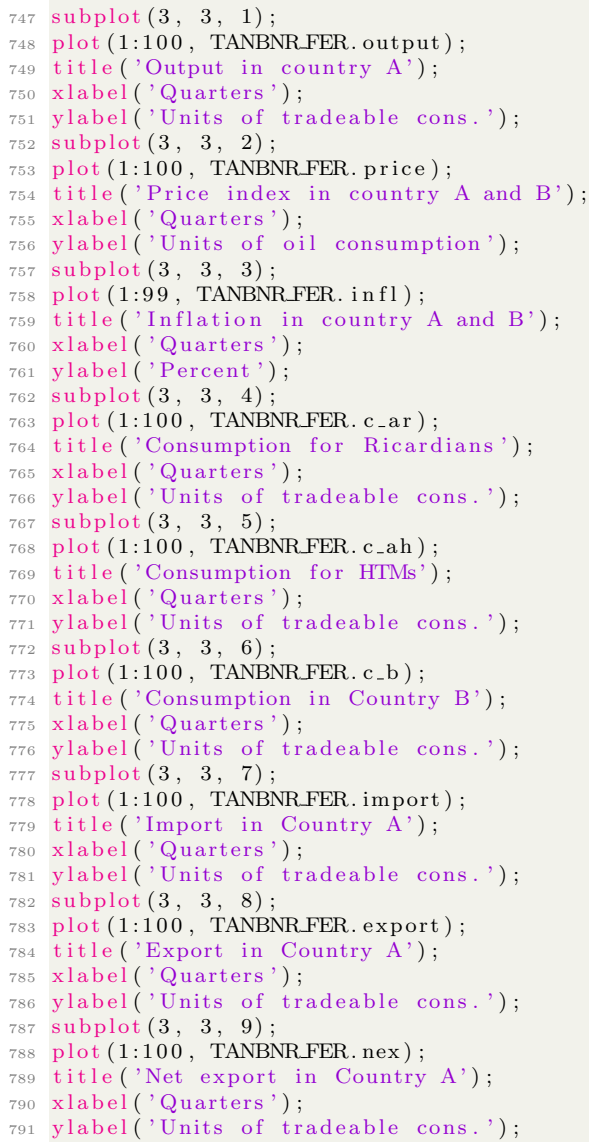
```

766 ylabel('Units of tradeable cons.');
```



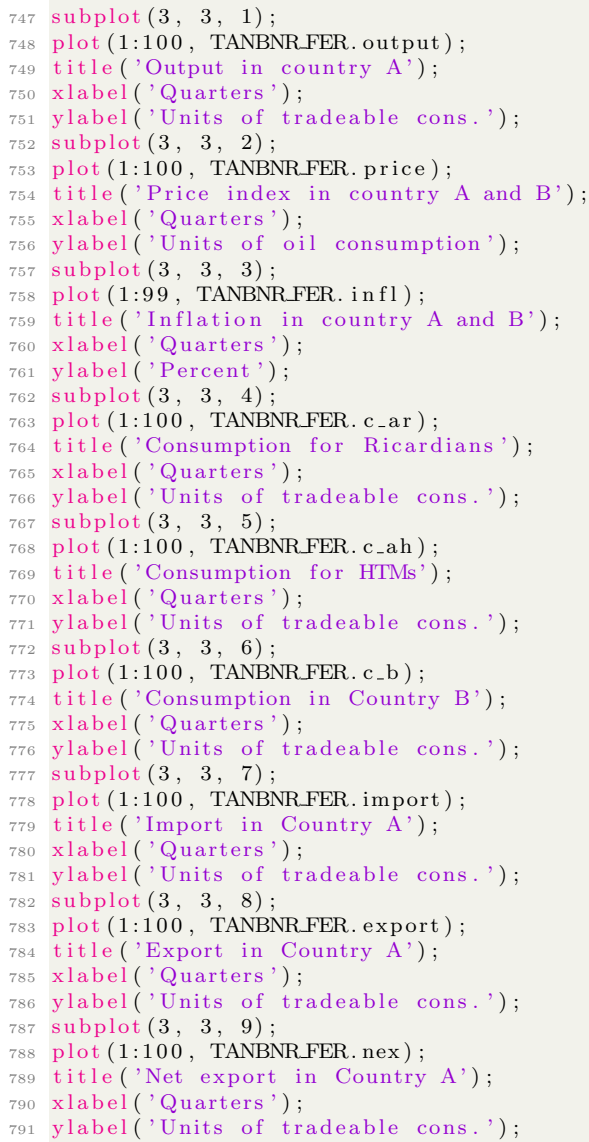
```

767 subplot(3, 3, 5);
768 plot(1:100, TANBNR_FER.c_ah);
769 title('Consumption for HTMs');
```



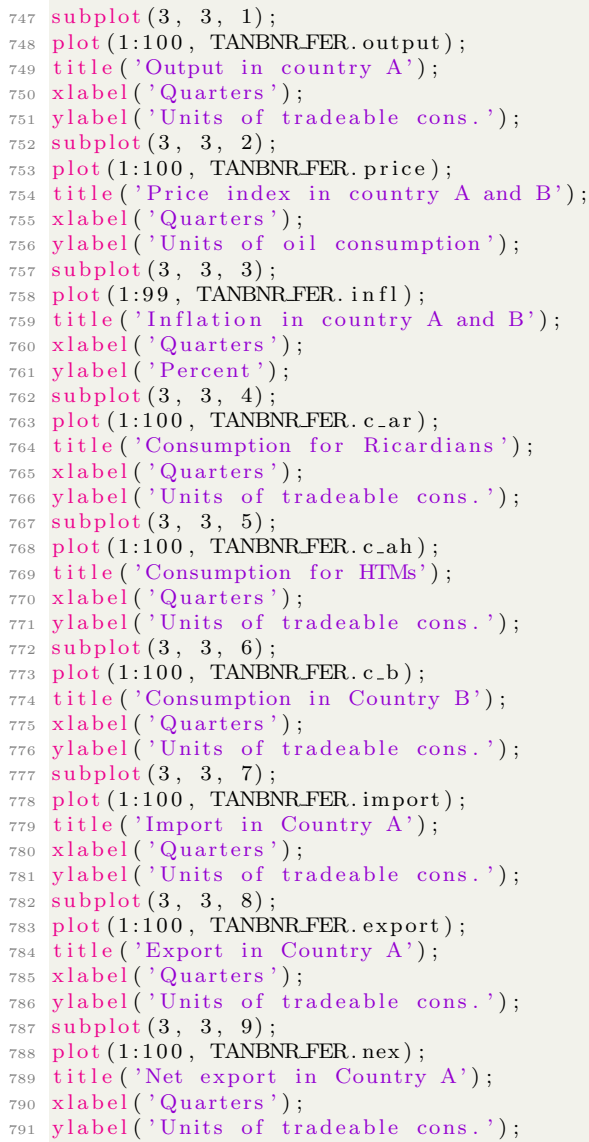
```

770 xlabel('Quarters');
```



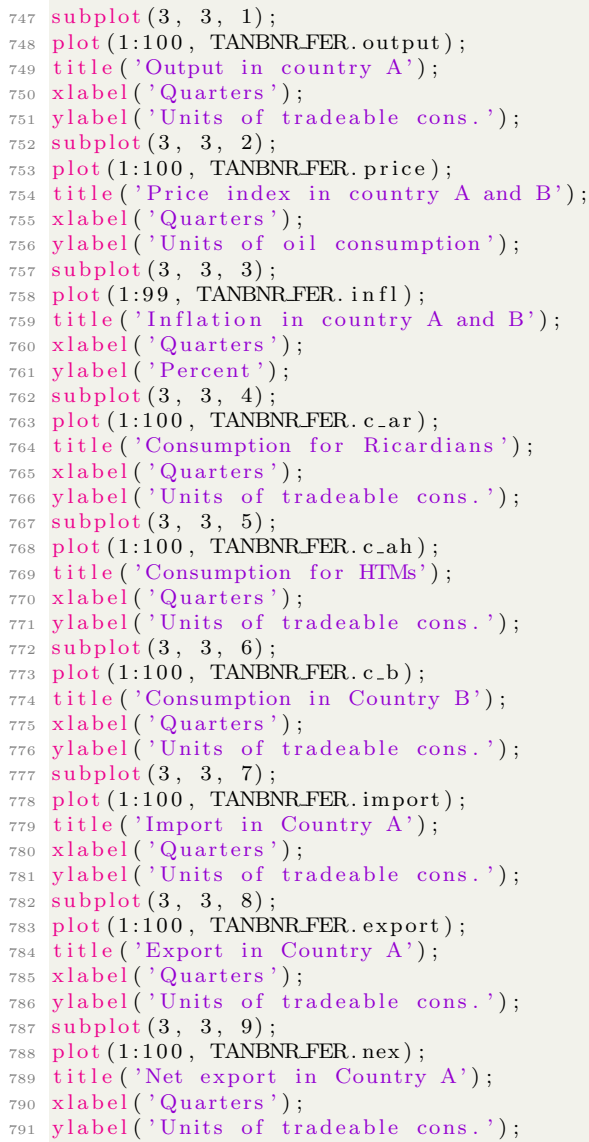
```

771 ylabel('Units of tradeable cons.');
```



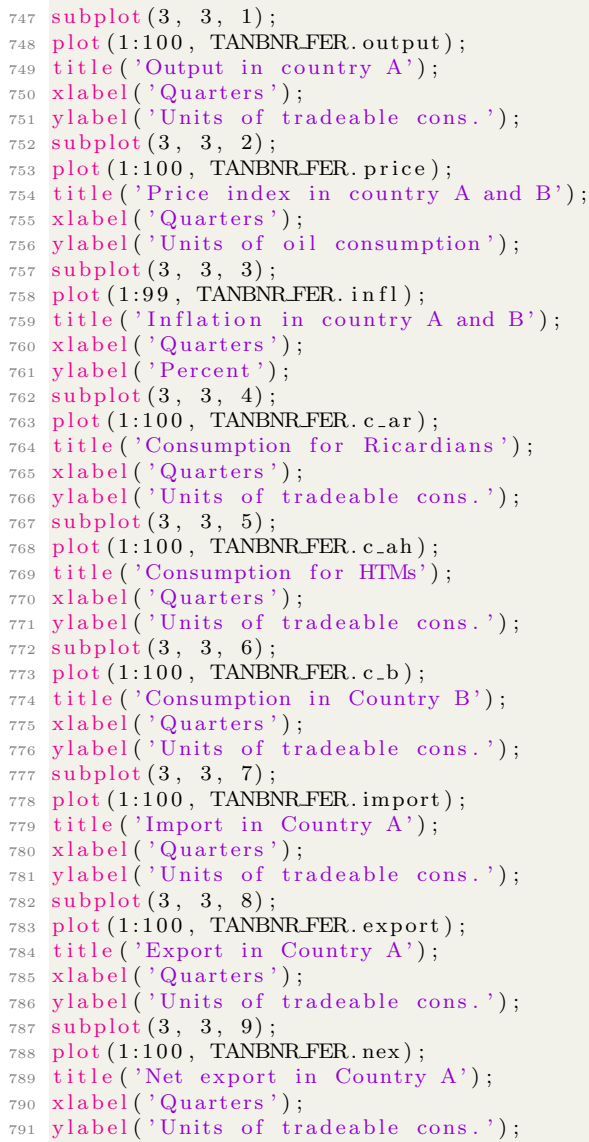
```

772 subplot(3, 3, 6);
773 plot(1:100, TANBNR_FER.c_b);
774 title('Consumption in Country B');
```



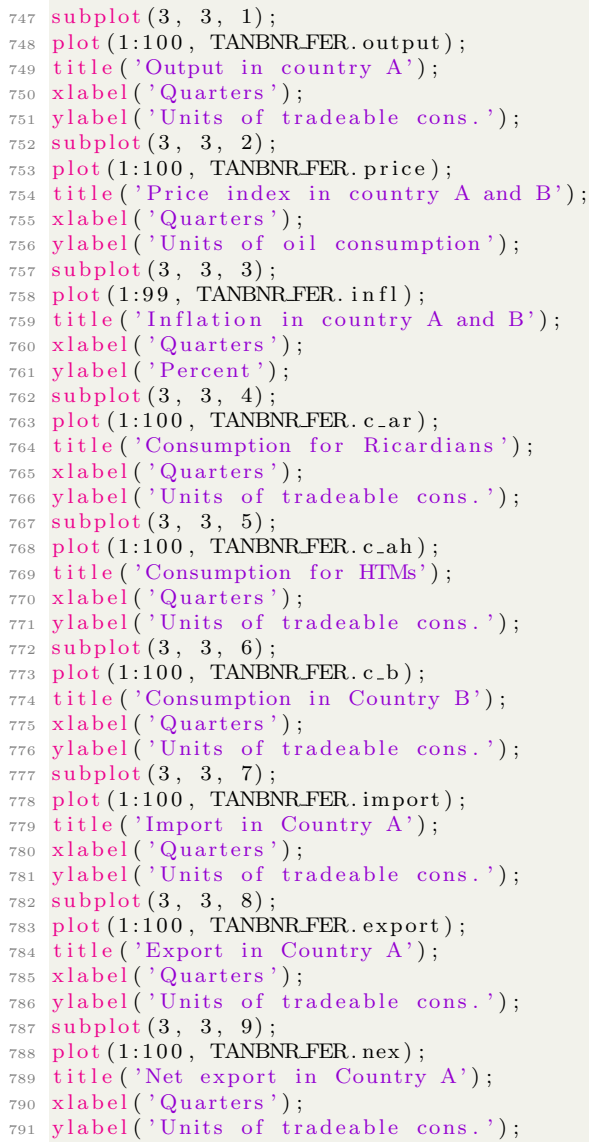
```

775 xlabel('Quarters');
```



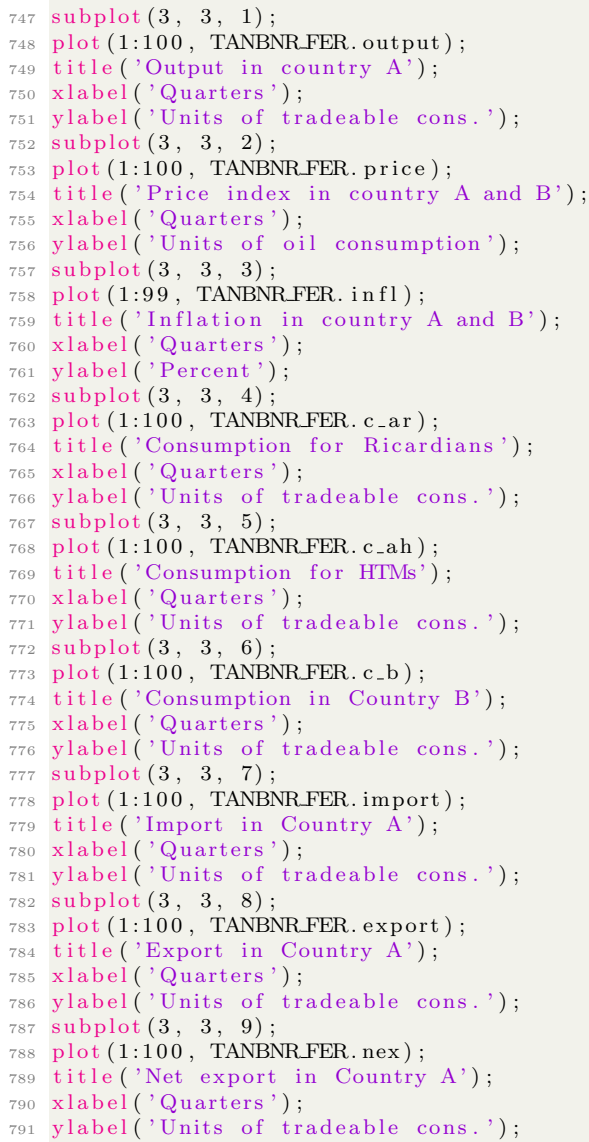
```

776 ylabel('Units of tradeable cons.');
```



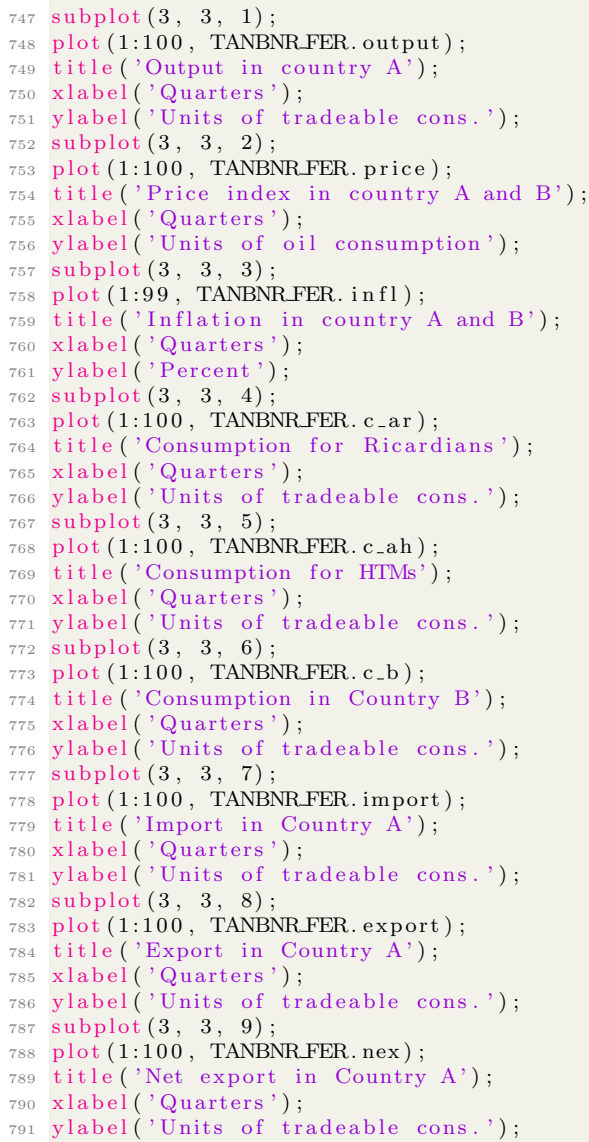
```

777 subplot(3, 3, 7);
778 plot(1:100, TANBNR_FER.import);
779 title('Import in Country A');
```



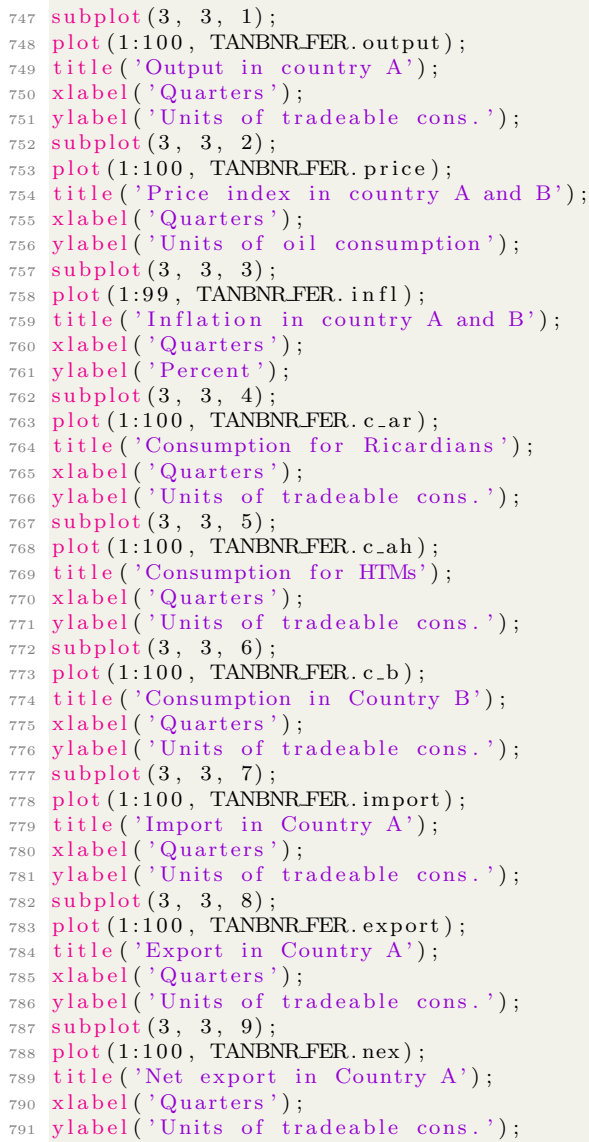
```

780 xlabel('Quarters');
```



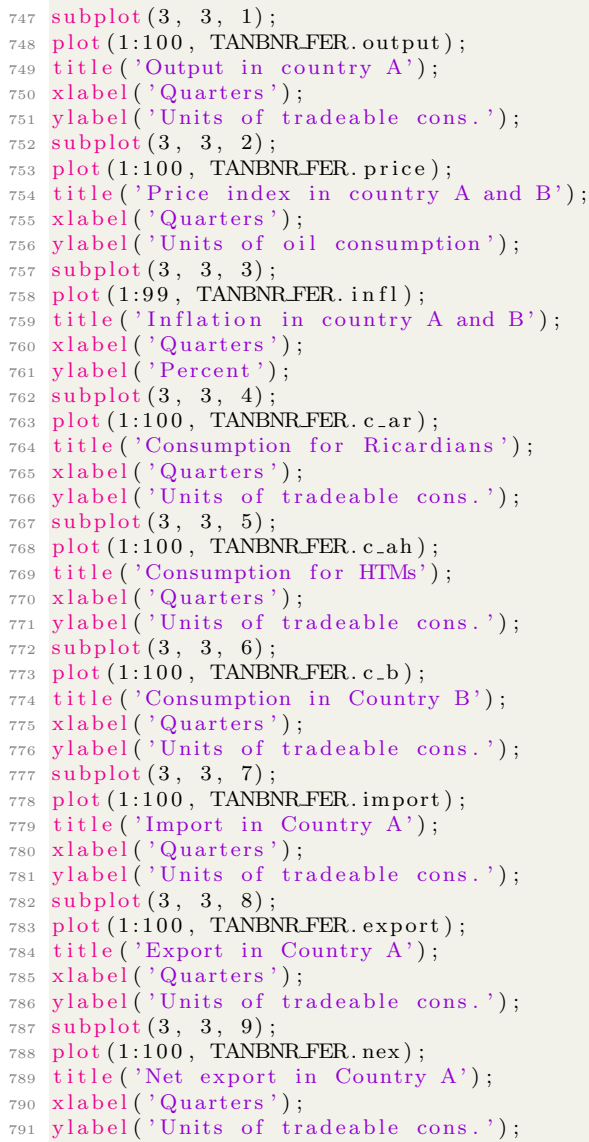
```

781 ylabel('Units of tradeable cons.');
```



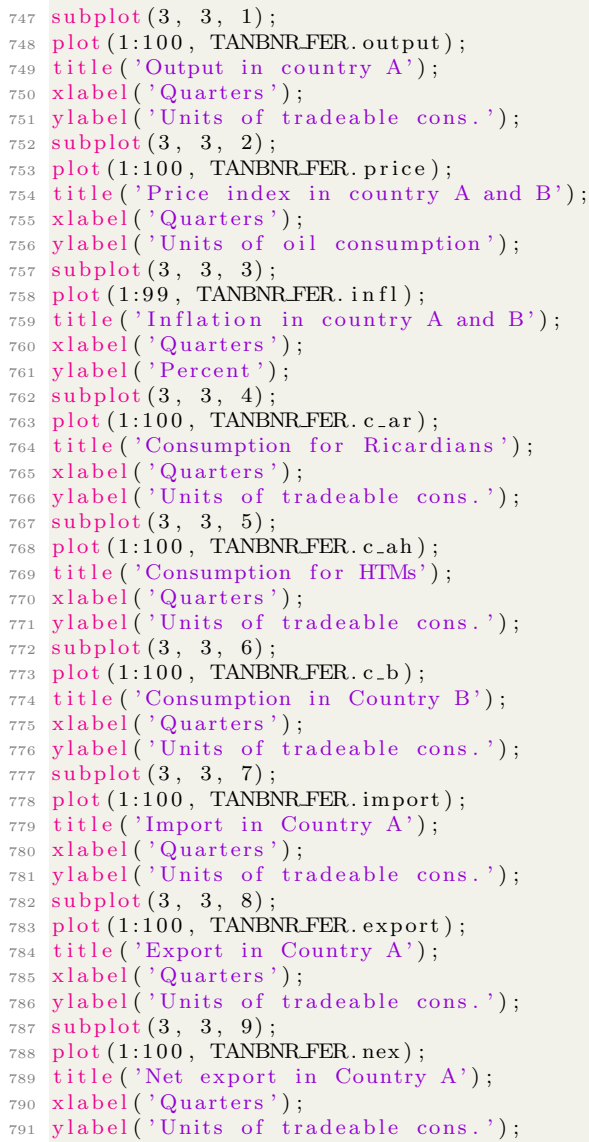
```

782 subplot(3, 3, 8);
783 plot(1:100, TANBNR_FER.export);
784 title('Export in Country A');
```



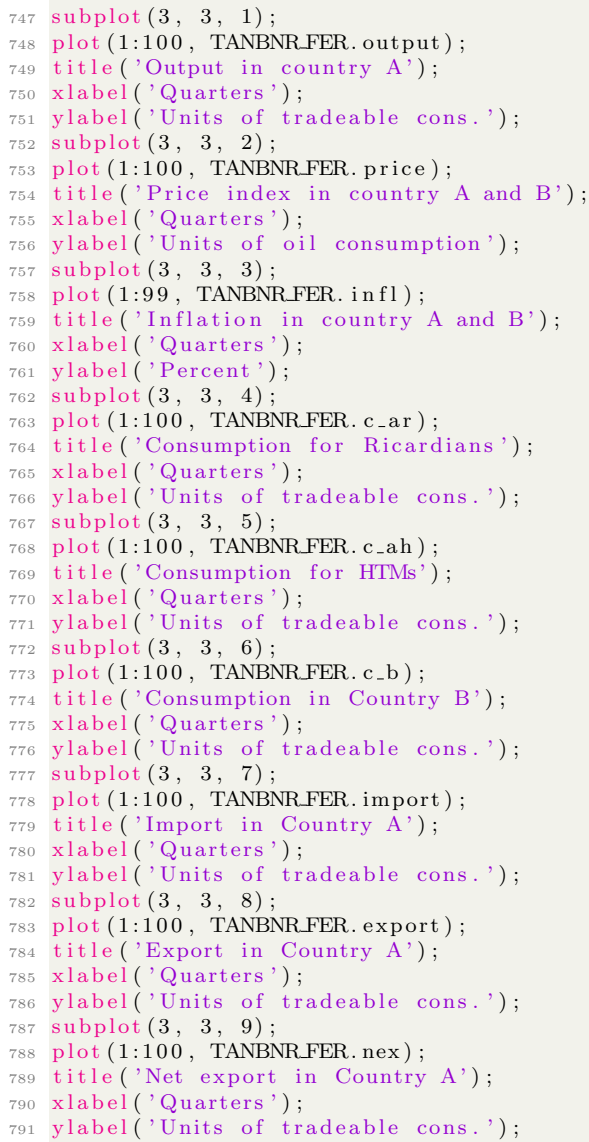
```

785 xlabel('Quarters');
```



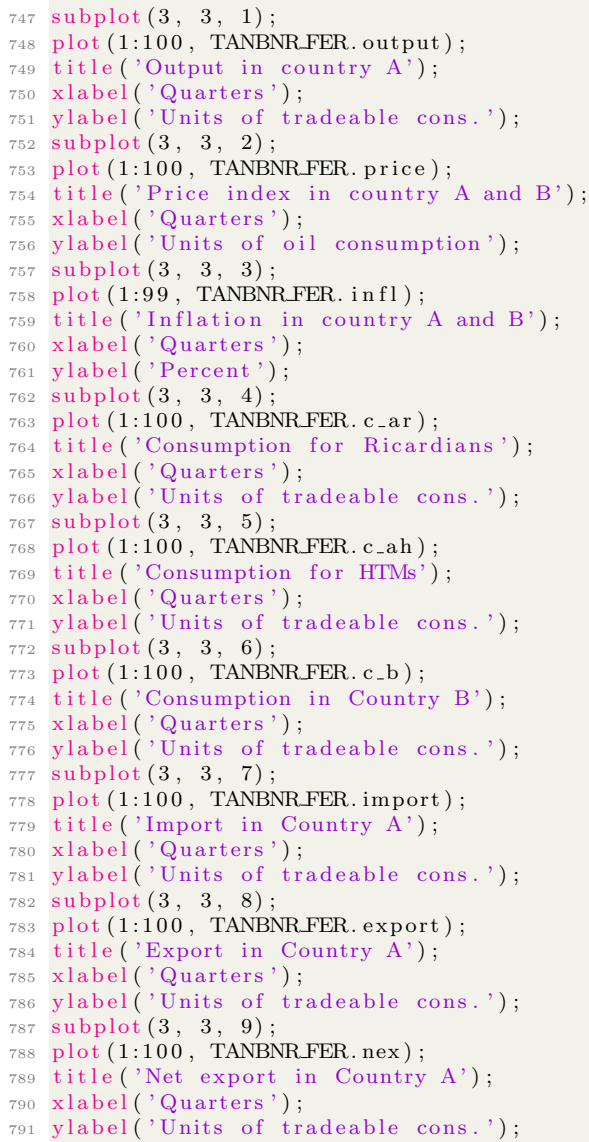
```

786 ylabel('Units of tradeable cons.');
```



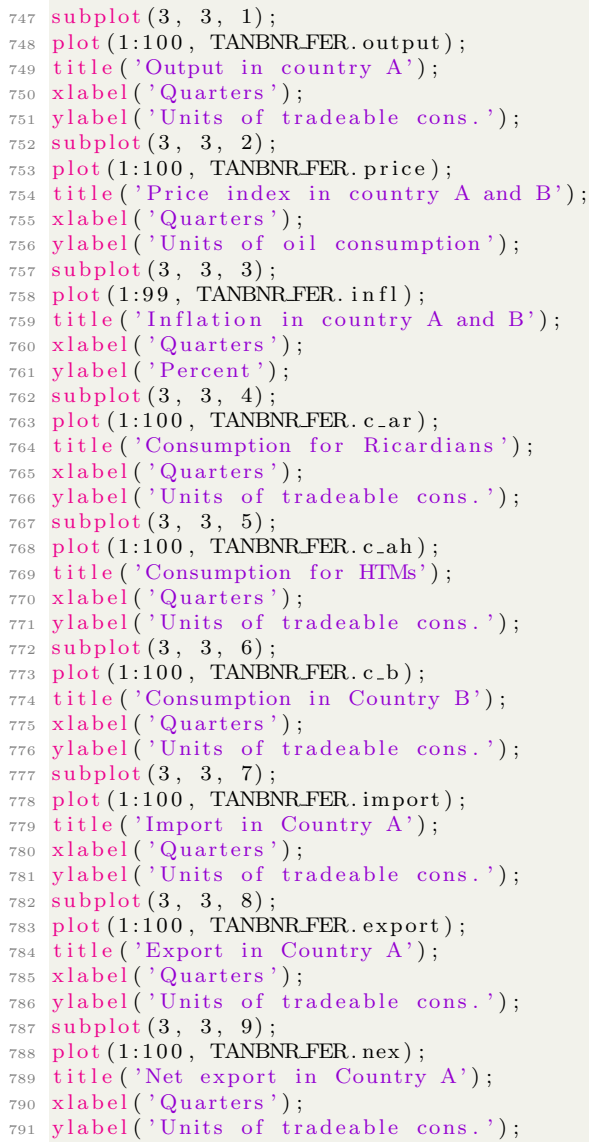
```

787 subplot(3, 3, 9);
788 plot(1:100, TANBNR_FER.nex);
789 title('Net export in Country A');
```



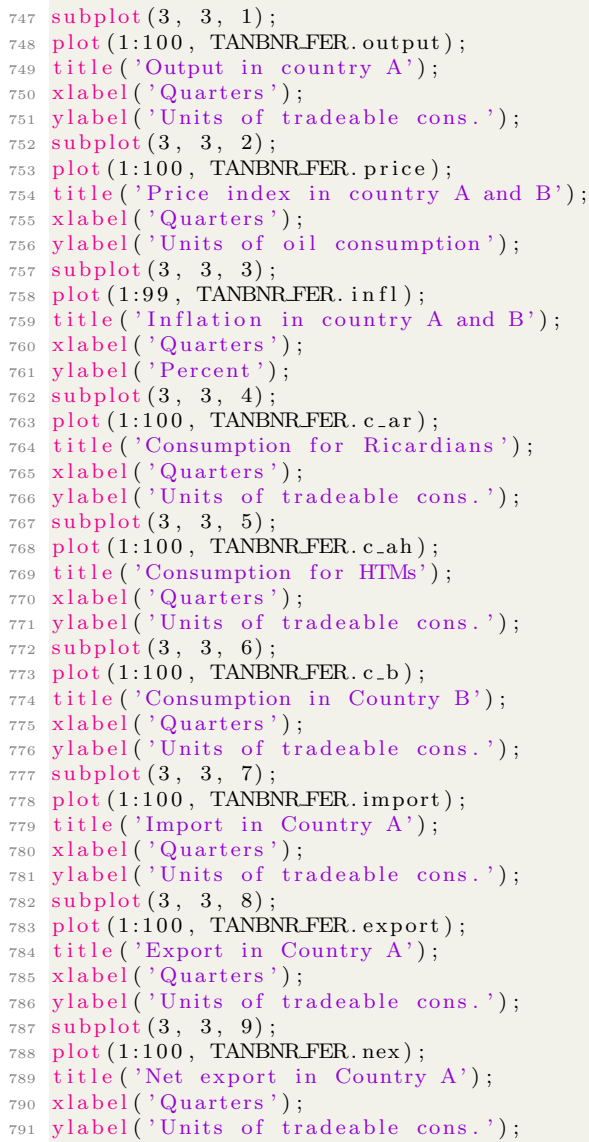
```

790 xlabel('Quarters');
```



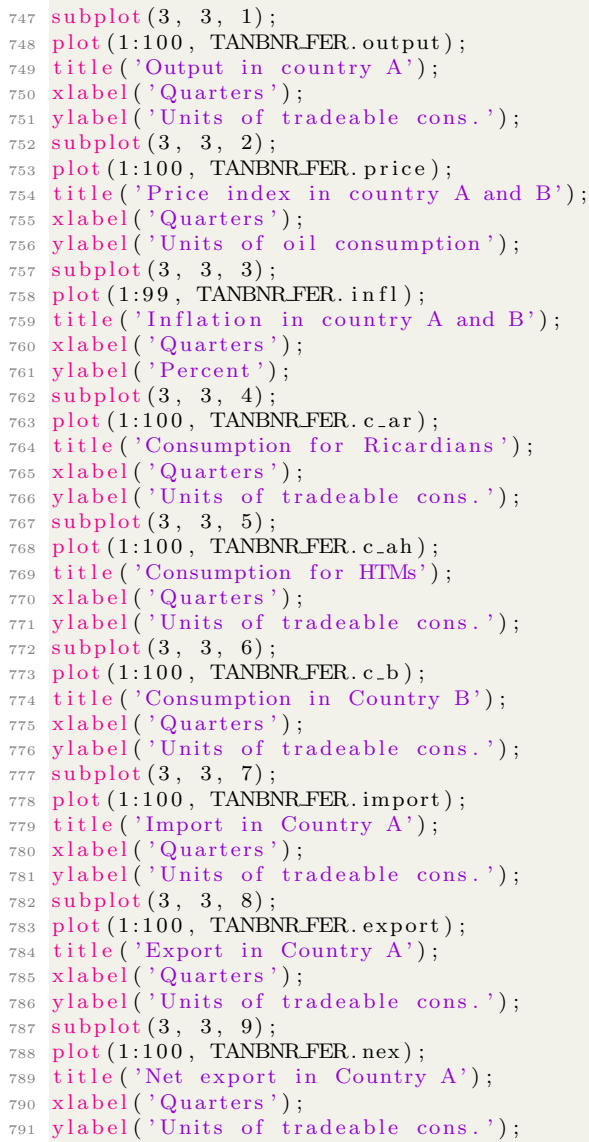
```

791 ylabel('Units of tradeable cons.');
```



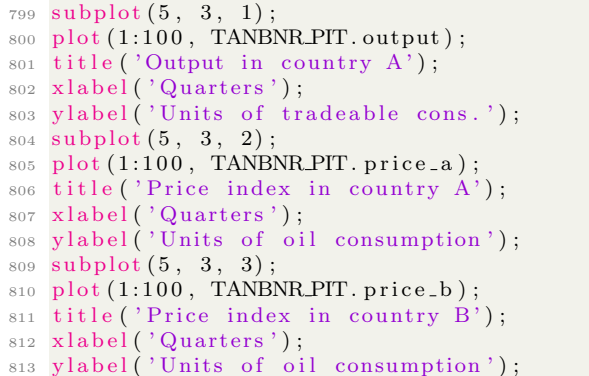
```

792
793 saveas(gcf, 'tanbnr_fer.jpg');
```



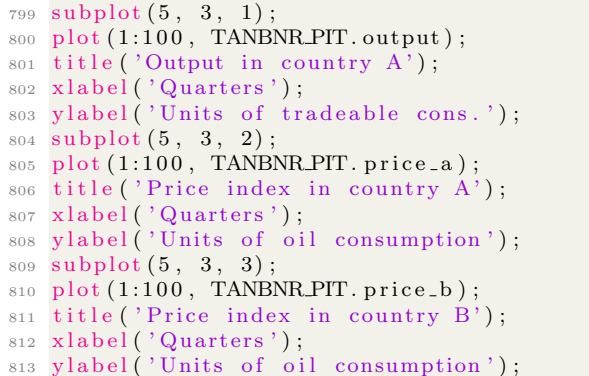
```

794
795
796
797 % TANBNR_PIT
798
799 subplot(5, 3, 1);
800 plot(1:100, TANBNR_PIT.output);
801 title('Output in country A');
```



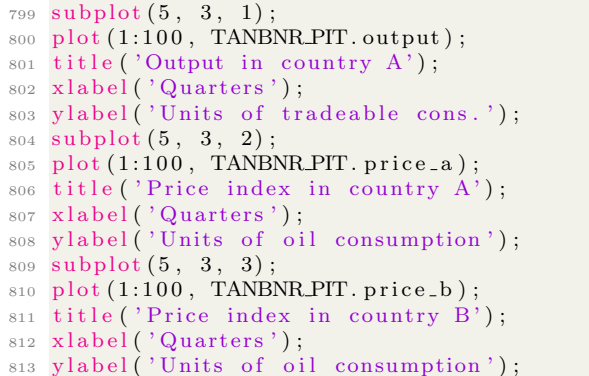
```

802 xlabel('Quarters');
```



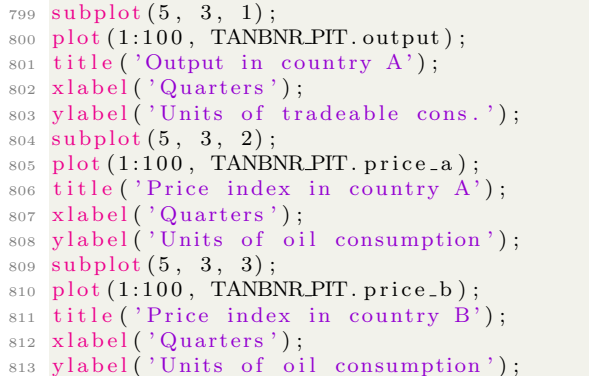
```

803 ylabel('Units of tradeable cons.');
```



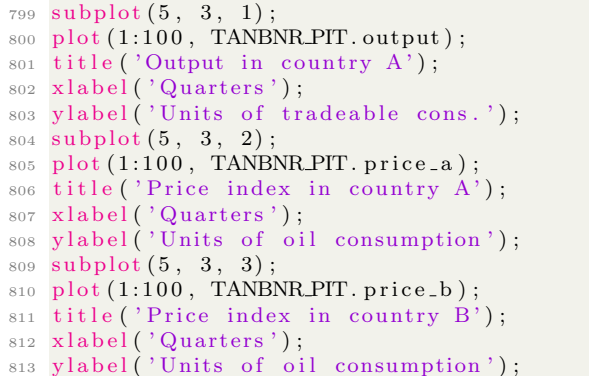
```

804 subplot(5, 3, 2);
805 plot(1:100, TANBNR_PIT.price_a);
806 title('Price index in country A');
```



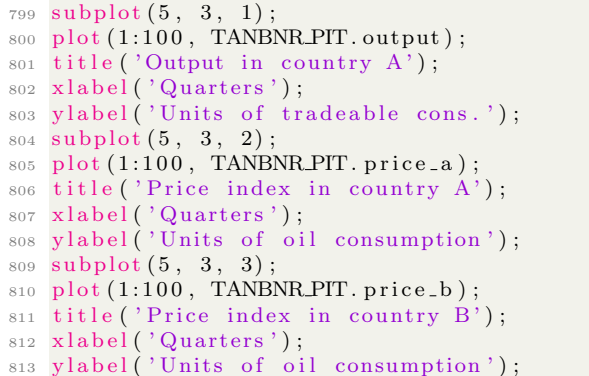
```

807 xlabel('Quarters');
```



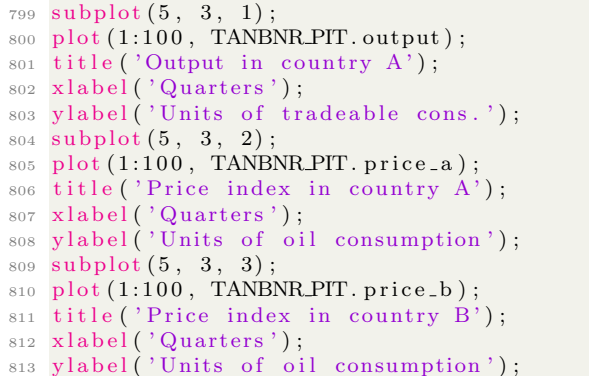
```

808 ylabel('Units of oil consumption');
```



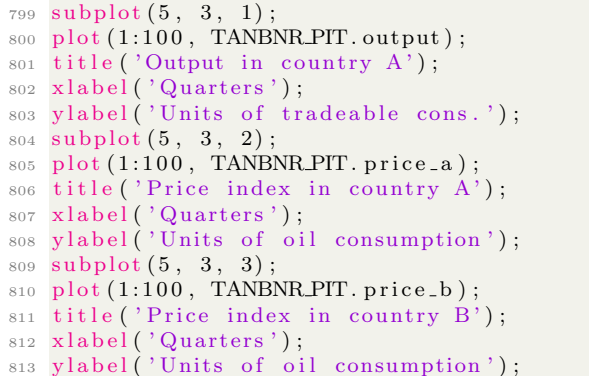
```

809 subplot(5, 3, 3);
810 plot(1:100, TANBNR_PIT.price_b);
811 title('Price index in country B');
```



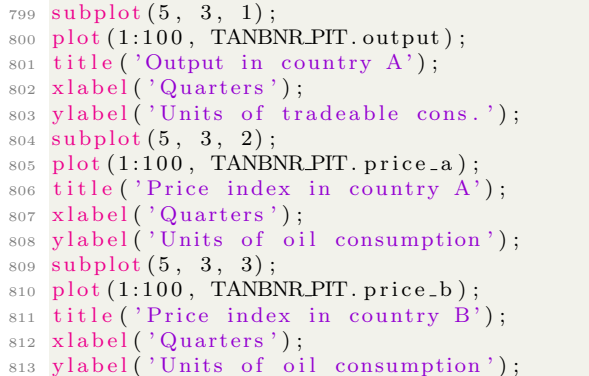
```

812 xlabel('Quarters');
```



```

813 ylabel('Units of oil consumption');
```



```

814 subplot(5, 3, 4);
815 plot(1:99, TANBNR_PIT.infl_a);
816 title('Inflation in country A');
817 xlabel('Quarters');
818 ylabel('Percent');
819 subplot(5, 3, 5);
820 plot(1:99, TANBNR_PIT.infl_b);
821 title('Inflation in country B');
822 xlabel('Quarters');
823 ylabel('Percent');
824 subplot(5, 3, 6);
825 plot(1:100, TANBNR_PIT.c_ar);
826 title('Consumption for Ricardians');
827 xlabel('Quarters');
828 ylabel('Units of tradeable cons. ');
829 subplot(5, 3, 7);
830 plot(1:100, TANBNR_PIT.c_ah);
831 title('Consumption for HTMs');
832 xlabel('Quarters');
833 ylabel('Units of tradeable cons. ');
834 subplot(5, 3, 8);
835 plot(1:100, TANBNR_PIT.c_b);
836 title('Consumption in Country B');
837 xlabel('Quarters');
838 ylabel('Units of tradeable cons. ');
839 subplot(5, 3, 9);
840 plot(1:100, TANBNR_PIT.import);
841 title('Import in Country A');
842 xlabel('Quarters');
843 ylabel('Units of tradeable cons. ');
844 subplot(5, 3, 10);
845 plot(1:100, TANBNR_PIT.export);
846 title('Export in Country A');
847 xlabel('Quarters');
848 ylabel('Units of tradeable cons. ');
849 subplot(5, 3, 11);
850 plot(1:100, TANBNR_PIT.nex);
851 title('Net export in Country A');
852 xlabel('Quarters');
853 ylabel('Units of tradeable cons. ');
854
855 saveas(gcf, 'tanbnr_pit.jpg');
856
857
858
859 % TANBFPNH
860
861 subplot(3, 3, 1);
862 plot(1:100, TANBFP.output);
863 title('Output in country A');
864 xlabel('Quarters');
865 ylabel('Units of tradeable cons. ');
866 subplot(3, 3, 2);
867 plot(1:100, TANBFPNH.price);
868 title('Price index in country A and B');
869 xlabel('Quarters');
870 ylabel('Units of oil consumption');
871 subplot(3, 3, 3);
872 plot(1:99, TANBFPNH.infl);
873 title('Inflation in country A and B');
874 xlabel('Quarters');
875 ylabel('Percent');
876 subplot(3, 3, 4);
877 plot(1:100, TANBFPNH.c_ar);
878 title('Consumption for Ricardians');
879 xlabel('Quarters');
880 ylabel('Units of tradeable cons. ');
881 subplot(3, 3, 5);
882 plot(1:100, TANBFPNH.c_ah);
883 title('Consumption for HTMs');
884 xlabel('Quarters');
885 ylabel('Units of tradeable cons. ');
886 subplot(3, 3, 6);
887 plot(1:100, TANBFPNH.c_b);

```

```

888 title('Consumption in Country B');
889 xlabel('Quarters');
890 ylabel('Units of tradeable cons.');
```



```

891 subplot(3, 3, 7);
892 plot(1:100, TANBFPNH.import);
893 title('Import in Country A');
894 xlabel('Quarters');
895 ylabel('Units of tradeable cons.');
```



```

896 subplot(3, 3, 8);
897 plot(1:100, TANBFPNH.export);
898 title('Export in Country A');
899 xlabel('Quarters');
900 ylabel('Units of tradeable cons.');
```



```

901 subplot(3, 3, 9);
902 plot(1:100, TANBFPNH.nex);
903 title('Net export in Country A');
904 xlabel('Quarters');
905 ylabel('Units of tradeable cons.');
```



```

906
907 saveas(gcf, 'tanbfpnh.jpg');
```

## Appendix A2: Parameter File

```

1
2 %-----
3 %
4 % Title: International Macro–Finance Problem Set 4, parameter file
5 % Author: —
6 % Date: 10/01/2024
7 % Description: Parameter file for the final problem set
8 %
9 %-----
10
11
12 %-----
13 % 0. Housekeeping (close all graphic windows)
14 %-----
15
16 close all;
17 clear all;
18
19 %-----
20 % 1. Defining parameters
21 %-----
22
23
24 % key moments to target:
25 % y_o = 12.1 * 365 * 90 * 10^(-6) = .4 Saudi oil production in 2022, tn euro
26 % c_ao = .46 EU import of oil from Saudi Arabia in 2022, tn euro
27 % l = .22; average weekly work hours in the EU (37.5 / (24 * 7))
28 % y_t * p_t = 16.75 EU GDP in 2022, tn USD
29
30 % this implies:
31 % y_t = l^(1 - alpha) = .35 with alpha = .3
32 % p_t = 16.75 / .35 = 47.86
33
34
35 par.alpha = .3; % income share of capital
36 par.beta = .99;
37 par.psi = 1.5; % elasticity of labour supply, normally between 1 and 2 (see Blundell et al. 2000)
38 par.phi = 10; % strength of the nominal rigidity
39 par.eta = .4; % elasticity of substitution between the tradeable good and oil
40 par.s_t = .75; % home bias towards tradeable in both countries
41 par.s_art = .78; % home bias towards tradeable for ricardians
42 par.s_aht = .9; % home bias towards tradeable for htms
43 par.s_bt = .8; % home bias towards tradeable in country b
44 par.theta = .4; % elasticity of substitution between goods in the tradeable sector
45 par.rho = .9; % persistence of shock
46 par.gamma = .1; % mean oil endowment of country b (y_bbar = gamma / (1 - rho))
47 par.chi = .8; % proportion of ricardian HHs in country a
```

## Appendix B: RAFAFP mod file

```
1
2 %
3 %
4 % Title: International Macro–Finance Final Assignment, model file
5 % Author: —
6 % Date: 25/12/2023
7 % Description: Representative agent, financial autarky, flexible prices
8 %
9 %
10
11
12 %
13 % 0. Housekeeping (close all graphic windows)
14 %
15
16 close all;
17
18 %
19 % 1. Defining variables
20 %
21
22 var c_ao c_bo c_at c_bt l y_t y_o p_t w pi;
23
24 varexo err_yo;
25
26
27 %
28 % 2. Calibration
29 %
30
31 parameters alpha psi eta s_t theta rho gamma;
32
33 load parameters;
34
35 set_param_value('alpha', par.alpha);
36 set_param_value('psi', par.psi);
37 set_param_value('eta', par.eta);
38 set_param_value('s_t', par.s_t);
39 set_param_value('theta', par.theta);
40 set_param_value('rho', par.rho);
41 set_param_value('gamma', par.gamma);
42
43
44 %
45 % 3. Model
46 %
47
48
49 model;
50
51 % consumption allocation between oil and tradeable in country a
52 (1 - s_t) * c_ao^(-1 / eta) - s_t * c_at^(-1 / eta) / p_t;
53
54 % consumption allocation between oil and tradeable in country b
55 (1 - s_t) * c_bo^(-1 / eta) - s_t * c_bt^(-1 / eta) / p_t;
56
57 % HH's labour supply decision in country a
58 psi - (1 - s_t) * c_ao^(-1 / eta) / (s_t * c_at^(1 - 1 / eta) +
59      (1 - s_t) * c_ao^(1 - 1 / eta)) *
60      w * (1 - l);
61
62 % HH's budget constraint in country a
63 p_t * c_at + c_ao - w * l - pi;
64
65 % HH's budget constraint in country b
66 c_bo + p_t * c_bt - y_o;
67
68 % firm's FOC
69 (1 - theta) * (1 - alpha) * p_t *
70      l^((1 - theta) * (1 - alpha) - 1) * y_t^theta - w;
71
72 % firm's profit
73 p_t * l^(1 - alpha) - w * l - pi;
```

```

74
75 % tradeable goods market-clearing condition
76 y_t = c_at + c_bt;
77
78 % oil market-clearing condition
79 y_o = c_ao + c_bo;
80
81 % oil endowment, stochastic process
82 gamma + rho * y_o(-1) - err_yo - y_o;
83
84 end;
85
86
87 %
88 % 4. Steady state
89 %
90
91
92 initval;
93
94 l = .22;
95 c_ao = .46;
96 y_t = l^(1 - alpha);
97 p_t = 16.75 / y_t;
98 c_at = s_t^eta * c_ao / (p_t^eta * (1 - s_t)^eta);
99 c_bt = y_t - c_at;
100 y_o = gamma / (1 - rho);
101 c_bo = y_o - c_ao;
102 w = (1 - theta) * (1 - alpha) * p_t *
103     l^((1 - theta) * (1 - alpha) - 1) * y_t^theta;
104 pi = p_t * l^(1 - alpha) - w * l;
105
106 end;
107
108 steady(maxit = 1000, solve_algo = 1);
109
110
111 %
112 % 5. Impulse response function
113 %
114
115
116 shocks;
117
118 var err_yo;
119 stderr .1;
120
121 end;
122
123
124 stoch_simul(order=1, irf=100, irf_plot_threshold=0) c_ao
125     c_bo c_at c_bt l y_t y_o p_t w pi;

```

## Appendix C: RANBFP mod file

```
1
2 %
3 %
4 % Title: International Macro–Finance Final Assignment, model file
5 % Author: —
6 % Date: 25/12/2023
7 % Description: Representative agent, nominal bond, flexible prices
8 %
9 %
10
11
12 %
13 % 0. Housekeeping (close all graphic windows)
14 %
15
16 close all;
17
18 %
19 % 1. Defining variables
20 %
21
22 var c_ao c_bo c_at c_bt l y_t y_o p_t w pi n_a n_b r_star;
23
24 varexo err_yo;
25
26
27 %
28 % 2. Calibration
29 %
30
31 parameters alpha beta psi eta s_t theta rho gamma;
32
33 load parameters;
34
35 set_param_value('alpha', par.alpha);
36 set_param_value('beta', par.beta);
37 set_param_value('psi', par.psi);
38 set_param_value('eta', par.eta);
39 set_param_value('s_t', par.s_t);
40 set_param_value('theta', par.theta);
41 set_param_value('rho', par.rho);
42 set_param_value('gamma', par.gamma);
43
44 s_t = .8;
45 theta = .65;
46
47
48 %
49 % 3. Model
50 %
51
52
53 model;
54
55 % consumption allocation between oil and tradeable in country a
56 (1 - s_t) * c_ao^(-1 / eta) - s_t * c_at^(-1 / eta) / p_t;
57
58 % consumption allocation between oil and tradeable in country b
59 (1 - s_t) * c_bo^(-1 / eta) - s_t * c_bt^(-1 / eta) / p_t;
60
61 % Euler equation in country a
62 c_ao^(-1 / eta) / (s_t * c_at^(1 - 1 / eta) +
63 (1 - s_t) * c_ao^(1 - 1 / eta))
64 - beta * r_star *
65 c_ao(+1)^(-1 / eta) / (s_t * c_at(+1)^(1 - 1 / eta) +
66 (1 - s_t) * c_ao(+1)^(1 - 1 / eta));
67
68 % Euler equation in country b
69 c_bo^(-1 / eta) / (s_t * c_bt^(1 - 1 / eta) +
70 (1 - s_t) * c_bo^(1 - 1 / eta)) -
71 beta * r_star *
72 c_bo(+1)^(-1 / eta) / (s_t * c_bt(+1)^(1 - 1 / eta) +
73 (1 - s_t) * c_bo(+1)^(1 - 1 / eta));
```

```

74
75 % HH's labour supply decision in country a
76 psi = (1 - s_t) * c_ao^(-1 / eta) / (s_t * c_at^(1 - 1 / eta) +
77     (1 - s_t) * c_ao^(1 - 1 / eta)) *
78     w * (1 - l);
79
80 % HH's budget constraint in country a
81 p_t * c_at + c_ao - w * l - pi = (n_a(-1) - n_a / r_star);
82
83 % HH's budget constraint in country b
84 c_bo + p_t * c_bt - y_o = (n_b(-1) - n_b / r_star);
85
86 % firm's FOC
87 (1 - theta) * (1 - alpha) * p_t *
88     l^((1 - theta) * (1 - alpha) - 1) * y_t^theta - w;
89
90 % firm's profit
91 p_t * l^(1 - alpha) - w * l - pi;
92
93 % tradeable goods market-clearing condition
94 y_t - c_at - c_bt;
95
96 % oil market-clearing condition
97 y_o - c_ao - c_bo;
98
99 % bond market clearing condition
100 n_a + n_b;
101
102 % oil endowment, stochastic process
103 gamma + rho * y_o(-1) - err_yo - y_o;
104
105 end;
106
107
108 %-----
109 % 4. Steady state
110 %-----
111
112
113 initval;
114
115 l = .22;
116 c_ao = .46;
117 y_t = l^(1 - alpha); % from production function
118 p_t = 16.75 / y_t; % from target GDP in country a
119 c_at = s_t^eta * c_ao / (p_t^eta * (1 - s_t)^eta); % from tradeable-oil tradeoff
120 c_bt = y_t - c_at; % from tradeable MC
121 y_o = gamma / (1 - rho); % from oil stochastic process
122 c_bo = y_o - c_ao; % from oil MC
123 w = (1 - theta) * (1 - alpha) * p_t *
124     l^((1 - theta) * (1 - alpha) - 1) * y_t^theta; % from firm's FOC
125 pi = p_t * l^(1 - alpha) - w * l; % from firm's profit
126 r_star = 1 / beta; % from SS Euler
127 n_a = r_star / (r_star - 1) * (p_t * c_at + c_ao - w * l - pi); % from the BC
128 n_b = - n_a; % from bond MC
129
130 end;
131
132 steady(maxit = 1000);
133
134
135 %-----
136 % 5. Impulse response function
137 %-----
138
139 initval;
140
141 c_ao = 0.425983;
142 c_bo = 0.174017;
143 c_at = 0.318506;
144 c_bt = 0.130112;
145 l = 0.318186;
146 y_t = 0.448618;
147 y_o = 0.6;

```



```

148 p_t = 30.8469;
149 w = 4.56664;
150 pi = 12.3854;
151 n_a = -358.757;
152 n_b = 358.757;
153 r_star = 1.0101;
154
155
156 end;
157
158 endval;
159
160 n_a = -358.757;
161 n_b = 358.757;
162
163 end;
164
165
166 shocks;
167
168 var err_yo;
169 stderr .1;
170
171 end;
172
173
174 stoch_simul(order=1, irf=100, irf_plot_threshold=0) c_ao
175 c_bo c_at c_bt l y_t y_o p_t w pi r_star
176 n_a n_b;
177
178 model_diagnostics;

```

## Appendix D: TANBFP mod file

```
1
2 %
3 %
4 % Title: International Macro-Finance Final Assignment, model file
5 % Author: —
6 % Date: 25/12/2023
7 % Description: Two agent, nominal bond, flexible prices
8 %
9 %
10
11
12 %
13 % 0. Housekeeping (close all graphic windows)
14 %
15
16 close all;
17
18 %
19 % 1. Defining variables
20 %
21
22 var c_aho c_aro c_bo c_aht c_art c_bt l_h l_r l y_t y_o p_t w pi
23      n_a n_b r_star pi_r pi_h;
24
25 varexo err_yo;
26
27
28 %
29 % 2. Calibration
30 %
31
32 parameters alpha beta psi eta s_t theta rho gamma chi;
33 load parameters;
34
35 set_param_value('alpha', par.alpha);
36 set_param_value('beta', par.beta);
37 set_param_value('psi', par.psi);
38 set_param_value('eta', par.eta);
39 set_param_value('s_t', par.s_t);
40 set_param_value('theta', par.theta);
41 set_param_value('rho', par.rho);
42 set_param_value('gamma', par.gamma);
43 set_param_value('chi', par.chi);
44
45 s_t = .8;
46 theta = .5;
47
48
49 %
50 % 3. Model
51 %
52 %
53
54
55 model;
56
57 % consumption allocation between oil and tradeable for htm HHs in country a
58 (1 - s_t) * c_aho^(-1 / eta) - s_t * c_aht^(-1 / eta) / p_t;
59
60 % consumption allocation between oil and tradeable for ricardian HHs in country a
61 (1 - s_t) * c_aro^(-1 / eta) - s_t * c_art^(-1 / eta) / p_t;
62
63 % consumption allocation between oil and tradeable in country b
64 (1 - s_t) * c_bo^(-1 / eta) - s_t * c_bt^(-1 / eta) / p_t;
65
66 % Euler equation for ricardian HHs in country a
67 c_aro^(-1 / eta) / (s_t * c_art^(1 - 1 / eta) +
68     (1 - s_t) * c_aro^(1 - 1 / eta)) -
69     beta * r_star *
70     c_aro(+1)^(-1 / eta) / (s_t * c_art(+1)^(1 - 1 / eta) +
71     (1 - s_t) * c_aro(+1)^(1 - 1 / eta));
72
73 % Euler equation in country b
```

```

74 c_bo^(-1 / eta) / (s_t * c_bt^(1 - 1 / eta) +
75 (1 - s_t) * c_bo^(1 - 1 / eta)) -
76 beta * r_star *
77 c_bo(+1)^(-1 / eta) / (s_t * c_bt(+1)^(1 - 1 / eta) +
78 (1 - s_t) * c_bo(+1)^(1 - 1 / eta));
79
80 % labour supply decision for htm HHs in country a
81 psi - (1 - s_t) * c_aho^(-1 / eta) / (s_t * c_aht^(1 - 1 / eta) +
82 (1 - s_t) * c_aho^(1 - 1 / eta)) *
83 w * (1 - l_h);
84
85 % labour supply decision for ricardian HHs in country a
86 psi - (1 - s_t) * c_aro^(-1 / eta) / (s_t * c_art^(1 - 1 / eta) +
87 (1 - s_t) * c_aro^(1 - 1 / eta)) *
88 w * (1 - l_r);
89
90 % htm's budget constraint in country a
91 p_t * c_aht + c_aho - w * l_h - pi_h;
92
93 % ricardian's budget constraint in country a
94 p_t * c_art + c_aro - w * l_r - pi_r - (n_a(-1) - n_a / r_star);
95
96 % HH's budget constraint in country b
97 c_bo + p_t * c_bt - y_o - (n_b(-1) - n_b / r_star);
98
99 % firm's FOC
100 (1 - theta) * (1 - alpha) * p_t *
101 l^((1 - theta) * (1 - alpha) - 1) * y_t^theta - w;
102
103 % firm's profit
104 p_t * l^(1 - alpha) - w * l - pi;
105
106 % profit distribution
107 chi * pi_r + (1 - chi) * pi_h - pi;
108
109 % fix ricardian's profit
110 pi_r - pi;
111
112 % tradeable goods market-clearing condition
113 y_t - (1 - chi) * c_aht - chi * c_art - c_bt;
114
115 % oil market-clearing condition
116 y_o - (1 - chi) * c_aho - chi * c_aro - c_bo;
117
118 % labour market-clearing condition
119 chi * l_r + (1 - chi) * l_h - l;
120
121 % bond market clearing condition
122 chi * n_a + n_b;
123
124 % oil endowment, stochastic process
125 gamma + rho * y_o(-1) - err_yo - y_o;
126
127 end;
128
129
130 %
131 % 4. Steady state
132 %
133
134
135 initval;
136
137 l_r = .22;
138 l_h = .22;
139 c_aro = .46;
140 c_aho = .46;
141 l = chi * l_r + (1 - chi) * l_h;
142 y_t = l^(1 - alpha); % from production function
143 p_t = 16.75 / y_t; % from target GDP in country a
144 c_art = s_t^eta * c_aro / (p_t^eta * (1 - s_t)^eta); % from tradeable-oil tradeoff
145 c_aht = s_t^eta * c_aho / (p_t^eta * (1 - s_t)^eta);
146 c_bt = y_t - chi * c_art - (1 - chi) * c_aht; % from tradeable MC
147 y_o = gamma / (1 - rho); % from oil stochastic process

```

```

148 c_bo = y_o - chi * c_aro - (1 - chi) * c_aho; % from oil MC
149 w = (1 - theta) * (1 - alpha) * p_t *
150     l^((1 - theta) * (1 - alpha) - 1) * y_t^theta; % from firm's FOC
151 pi = p_t * l^(1 - alpha) - w * l; % from firm's profit
152 pi_r = pi;
153 pi_h = (pi - chi * pi_r) / (1 - chi);
154 r_star = 1 / beta; % from SS Euler
155 n_a = r_star / (r_star - 1) * (p_t * c_art + c_aro - w * l - pi_r); % from the BC
156 n_b = - chi * n_a; % from bond MC
157
158 end;
159
160 steady(maxit = 1000, solve_algo = 3);
161
162
163
164 %
165 % 5. Impulse response function
166 %
167
168
169 shocks;
170
171 var err_yo;
172 stderr .1;
173
174 end;
175
176
177 stoch_simul(order=1, irf=100, irf_plot_threshold=0)
178     c_aho c_aro c_bo c_aht c_art c_bt l_h
179     l_r l y_t y_o p_t w pi n_a n_b r_star;

```

## Appendix E: TANBFP mod file

```
1
2 %
3 %
4 % Title: International Macro-Finance Final Assignment, model file
5 % Author: —
6 % Date: 25/12/2023
7 % Description: Two agent, nominal bond, flexible prices
8 %
9 %
10
11
12 %
13 % 0. Housekeeping (close all graphic windows)
14 %
15
16 close all;
17
18 %
19 % 1. Defining variables
20 %
21
22 var c_aho c_aro c_bo c_aht c_art c_bt l_h l_r l_y t_y o_p t_w pi
23      n_a n_b r_star pi_r pi_h;
24
25 varexo err_yo;
26
27
28 %
29 % 2. Calibration
30 %
31
32 parameters alpha beta psi eta s_t theta rho gamma chi;
33 load parameters;
34
35 set_param_value('alpha', par.alpha);
36 set_param_value('beta', par.beta);
37 set_param_value('psi', par.psi);
38 set_param_value('eta', par.eta);
39 set_param_value('s_t', par.s_t);
40 set_param_value('theta', par.theta);
41 set_param_value('rho', par.rho);
42 set_param_value('gamma', par.gamma);
43 set_param_value('chi', par.chi);
44
45 s_t = .8;
46 theta = .5;
47
48
49
50 %
51 % 3. Model
52 %
53
54
55 model;
56
57 % consumption allocation between oil and tradeable for htm HHs in country a
58 (1 - s_t) * c_aho^(-1 / eta) - s_t * c_aht^(-1 / eta) / p_t;
59
60 % consumption allocation between oil and tradeable for ricardian HHs in country a
61 (1 - s_t) * c_aro^(-1 / eta) - s_t * c_art^(-1 / eta) / p_t;
62
63 % consumption allocation between oil and tradeable in country b
64 (1 - s_t) * c_bo^(-1 / eta) - s_t * c_bt^(-1 / eta) / p_t;
65
66 % Euler equation for ricardian HHs in country a
67 c_aro^(-1 / eta) / (s_t * c_art^(1 - 1 / eta) +
68   (1 - s_t) * c_aro^(1 - 1 / eta)) -
69   beta * r_star *
70   c_aro(+1)^(-1 / eta) / (s_t * c_art(+1)^(1 - 1 / eta) +
71   (1 - s_t) * c_aro(+1)^(1 - 1 / eta));
72
73 % Euler equation in country b
```

```

74 c_bo^(-1 / eta) / (s_t * c_bt^(1 - 1 / eta) +
75 (1 - s_t) * c_bo^(1 - 1 / eta)) -
76 beta * r_star *
77 c_bo(+1)^(-1 / eta) / (s_t * c_bt(+1)^(1 - 1 / eta) +
78 (1 - s_t) * c_bo(+1)^(1 - 1 / eta));
79
80 % labour supply decision for htm HHs in country a
81 psi - (1 - s_t) * c_aho^(-1 / eta) / (s_t * c_aht^(1 - 1 / eta) +
82 (1 - s_t) * c_aho^(1 - 1 / eta)) *
83 w * (1 - l_h);
84
85 % labour supply decision for ricardian HHs in country a
86 psi - (1 - s_t) * c_aro^(-1 / eta) / (s_t * c_art^(1 - 1 / eta) +
87 (1 - s_t) * c_aro^(1 - 1 / eta)) *
88 w * (1 - l_r);
89
90 % htm's budget constraint in country a
91 p_t * c_aht + c_aho - w * l_h - pi_h;
92
93 % ricardian's budget constraint in country a
94 p_t * c_art + c_aro - w * l_r - pi_r - (n_a(-1) - n_a / r_star);
95
96 % HH's budget constraint in country b
97 c_bo + p_t * c_bt - y_o - (n_b(-1) - n_b / r_star);
98
99 % firm's FOC
100 (1 - theta) * (1 - alpha) * p_t *
101 l^((1 - theta) * (1 - alpha) - 1) * y_t^theta - w;
102
103 % firm's profit
104 p_t * l^(1 - alpha) - w * l - pi;
105
106 % profit distribution
107 chi * pi_r + (1 - chi) * pi_h - pi;
108
109 % fix ricardian's profit
110 pi_r - pi;
111
112 % tradeable goods market-clearing condition
113 y_t - (1 - chi) * c_aht - chi * c_art - c_bt;
114
115 % oil market-clearing condition
116 y_o - (1 - chi) * c_aho - chi * c_aro - c_bo;
117
118 % labour market-clearing condition
119 chi * l_r + (1 - chi) * l_h - l;
120
121 % bond market clearing condition
122 chi * n_a + n_b;
123
124 % oil endowment, stochastic process
125 gamma + rho * y_o(-1) - err_yo - y_o;
126
127 end;
128
129
130 %
131 % 4. Steady state
132 %
133
134
135 initval;
136
137 l_r = .22;
138 l_h = .22;
139 c_aro = .46;
140 c_aho = .46;
141 l = chi * l_r + (1 - chi) * l_h;
142 y_t = l^(1 - alpha); % from production function
143 p_t = 16.75 / y_t; % from target GDP in country a
144 c_art = s_t^eta * c_aro / (p_t^eta * (1 - s_t)^eta); % from tradeable-oil tradeoff
145 c_aht = s_t^eta * c_aho / (p_t^eta * (1 - s_t)^eta);
146 c_bt = y_t - chi * c_art - (1 - chi) * c_aht; % from tradeable MC
147 y_o = gamma / (1 - rho); % from oil stochastic process

```

```

148 c_bo = y_o - chi * c_aro - (1 - chi) * c_aho; % from oil MC
149 w = (1 - theta) * (1 - alpha) * p_t *
150     l^((1 - theta) * (1 - alpha) - 1) * y_t^theta; % from firm's FOC
151 pi = p_t * l^(1 - alpha) - w * l; % from firm's profit
152 pi_r = pi;
153 pi_h = (pi - chi * pi_r) / (1 - chi);
154 r_star = 1 / beta; % from SS Euler
155 n_a = r_star / (r_star - 1) * (p_t * c_art + c_aro - w * l - pi_r); % from the BC
156 n_b = - chi * n_a; % from bond MC
157
158 end;
159
160 steady(maxit = 1000, solve_algo = 3);
161
162
163
164 %
165 % 5. Impulse response function
166 %
167
168
169 shocks;
170
171 var err_yo;
172 stderr .1;
173
174 end;
175
176
177 stoch_simul(order=1, irf=100, irf_plot_threshold=0)
178     c_aho c_aro c_bo c_ahh c_art c_bt l_h
179     l_r l y_t y_o p_t w pi n_a n_b r_star;

```

## Appendix F: TANBNR FER mod file

```
1
2 %
3 %
4 % Title: International Macro–Finance Final Assignment, model file
5 % Author: —
6 % Date: 25/12/2023
7 % Description: Two agent, nominal bond, nominal rigidities, fixed exchange rate
8 %
9 %
10
11
12 %
13 % 0. Housekeeping (close all graphic windows)
14 %
15
16 close all;
17
18 %
19 % 1. Defining variables
20 %
21
22 var c_aho c_aro c_bo c_aht c_art c_bt l_h l_r l_y t_y o_p t_w pi
23      n_a n_b r_star pi_r pi_h;
24
25 varexo err_yo;
26
27
28 %
29 % 2. Calibration
30 %
31
32 parameters alpha beta psi phi eta s_t theta rho gamma chi;
33
34 load parameters;
35
36 set_param_value('alpha', par.alpha);
37 set_param_value('beta', par.beta);
38 set_param_value('psi', par.psi);
39 set_param_value('phi', par.phi);
40 set_param_value('eta', par.eta);
41 set_param_value('s_t', par.s_t);
42 set_param_value('theta', par.theta);
43 set_param_value('rho', par.rho);
44 set_param_value('gamma', par.gamma);
45 set_param_value('chi', par.chi);
46
47 s_t = .8;
48 theta = .5;
49
50
51 %
52 % 3. Model
53 %
54
55
56 model;
57
58 % consumption allocation between oil and tradeable for htm HHs in country a
59 (1 - s_t) * c_aho^(-1 / eta) - s_t * c_aht^(-1 / eta) / p_t;
60
61 % consumption allocation between oil and tradeable for ricardian HHs in country a
62 (1 - s_t) * c_aro^(-1 / eta) - s_t * c_art^(-1 / eta) / p_t;
63
64 % consumption allocation between oil and tradeable in country b
65 (1 - s_t) * c_bo^(-1 / eta) - s_t * c_bt^(-1 / eta) / p_t;
66
67 % Euler equation for ricardian HHs in country a
68 c_aro^(-1 / eta) / (s_t * c_art^(1 - 1 / eta) +
69      (1 - s_t) * c_aro^(1 - 1 / eta)) -
70      beta * r_star *
71      c_aro(+1)^(-1 / eta) / (s_t * c_art(+1)^(1 - 1 / eta) +
72      (1 - s_t) * c_aro(+1)^(1 - 1 / eta));
73
```



```

74 % Euler equation in country b
75 c_bo^(-1 / eta) / (s_t * c_bt^(1 - 1 / eta) +
76 (1 - s_t) * c_bo^(1 - 1 / eta)) -
77 beta * r_star *
78 c_bo(+1)^(1 - 1 / eta) / (s_t * c_bt(+1)^(1 - 1 / eta) +
79 (1 - s_t) * c_bo(+1)^(1 - 1 / eta));
80
81 % labour supply decision for htm HHs in country a
82 psi - (1 - s_t) * c_aho^(-1 / eta) / (s_t * c_aht^(1 - 1 / eta) +
83 (1 - s_t) * c_aho^(1 - 1 / eta)) *
84 w * (1 - l_h);
85
86 % labour supply decision for ricardian HHs in country a
87 psi - (1 - s_t) * c_aro^(-1 / eta) / (s_t * c_art^(1 - 1 / eta) +
88 (1 - s_t) * c_aro^(1 - 1 / eta)) *
89 w * (1 - l_r);
90
91 % htm's budget constraint in country a
92 p_t * c_aht + c_aho - w * l_h - pi_h;
93
94 % ricardian's budget constraint in country a
95 p_t * c_art + c_aro - w * l_r - pi_r - (n_a(-1) - n_a / r_star);
96
97 % HH's budget constraint in country b
98 c_bo + p_t * c_bt - y_o - (n_b(-1) - n_b / r_star);
99
100 % firm's FOC
101 p_t * (1 - theta) * (1 - alpha) * l^((1 - theta) * (1 - alpha) - 1) * y_t^theta -
102 w - phi * (p_t * y_t^theta * l(-1)^(theta * (1 - alpha)) /
103 (p_t(-1) * l^(theta * (1 - alpha)) * y_t(-1)^theta) - 1) *
104 p_t * y_t * (-theta) * (1 - alpha) * p_t * y_t^theta *
105 l(-1)^(theta * (1 - alpha)) / (p_t(-1) *
106 l^(theta * (1 - alpha) + 1) * y_t(-1)^theta);
107
108 % firm's profit
109 p_t * l^(1 - alpha) - w * l - phi / 2 * (p_t / p_t(-1) - 1)^2 * p_t * y_t - pi;
110
111 % profit distribution
112 chi * pi_r + (1 - chi) * pi_h - pi;
113
114 % impose profit for ricardians
115 pi_r - pi;
116
117 % tradeable goods market-clearing condition
118 y_t - (1 - chi) * c_aht - chi * c_art - c_bt;
119
120 % oil market-clearing condition
121 y_o - (1 - chi) * c_aho - chi * c_aro - c_bo;
122
123 % labour market-clearing condition
124 chi * l_r + (1 - chi) * l_h - l;
125
126 % bond market clearing condition
127 chi * n_a + n_b;
128
129 % oil endowment, stochastic process
130 gamma + rho * y_o(-1) - err_yo - y_o;
131
132 end;
133
134
135 %
136 % 4. Steady state
137 %
138
139
140 initval;
141
142 l_r = .22;
143 l_h = .22;
144 c_aro = .46;
145 c_aho = .46;
146 l = chi * l_r + (1 - chi) * l_h;
147 y_t = l^(1 - alpha); % from production function

```

```

148 p_t = 16.75 / y_t; % from target GDP in country a
149 c_art = s_t^eta * c_aro / (p_t^eta * (1 - s_t)^eta); % from tradeable-oil tradeoff
150 c_aht = s_t^eta * c_aho / (p_t^eta * (1 - s_t)^eta);
151 c_bt = y_t - chi * c_art - (1 - chi) * c_aht; % from tradeable MC
152 y_o = gamma / (1 - rho); % from oil stochastic process
153 c_bo = y_o - chi * c_aro - (1 - chi) * c_aho; % from oil MC
154 w = (1 - theta) * (1 - alpha) * p_t *
155     l^((1 - theta) * (1 - alpha) - 1) * y_t^theta; % from firm's FOC at SS
156 pi = p_t * l^(1 - alpha) - w * l; % from firm's profit at SS
157 pi_r = pi;
158 pi_h = (pi - chi * pi_r) / (1 - chi);
159 r_star = 1 / beta; % from SS Euler
160 n_a = r_star / (r_star - 1) * (p_t * c_art + c_aro - w * l - pi_r); % from the BC
161 n_b = - n_a; % from bond MC
162
163 end;
164
165 steady(maxit = 1000, solve_algo = 3);
166
167
168
169
170 %-----
171 % 5. Impulse response function
172 %-----
173
174 shocks;
175
176 var err_yo;
177 stderr .1;
178
179 end;
180
181
182 stoch_simul(order=1, irf=100, irf_plot_threshold=0)
183         c_aro c_aro c_bo c_aht c_art c_bt l_h
184         l_r l y_t y_o p_t w pi n_a n_b r_star;
185
186 model_diagnostics;

```

## Appendix G: TANBNR PIT mod file

```
1 %
2 %
3 %
4 % Title: International Macro–Finance Final Assignment, model file
5 % Author: —
6 % Date: 25/12/2023
7 % Description: Two agent, nominal bond, nominal rigidities,
8 %               price inflation targeting
9 %
10 %
11 %
12 %
13 %
14 % 0. Housekeeping (close all graphic windows)
15 %
16
17 close all;
18
19 %
20 % 1. Defining variables
21 %
22
23 var c_aho c_aro c_bo c_aht c_art c_bt l_h l_r l_yt y_o p_t
24     e w pi n_a n_b r_star pi_r pi_h;
25
26 varexo err_yo;
27
28 %
29 % 2. Calibration
30 %
31 %
32
33 parameters alpha beta psi phi eta s_t theta rho gamma chi;
34
35 load parameters;
36
37 set_param_value('alpha', par.alpha);
38 set_param_value('beta', par.beta);
39 set_param_value('psi', par.psi);
40 set_param_value('phi', par.phi);
41 set_param_value('eta', par.eta);
42 set_param_value('s_t', par.s_t);
43 set_param_value('theta', par.theta);
44 set_param_value('rho', par.rho);
45 set_param_value('gamma', par.gamma);
46 set_param_value('chi', par.chi);
47
48
49 s_t = .8;
50 theta = .562;
51
52 %
53 % 3. Model
54 %
55 %
56
57 model;
58
59 % consumption allocation between oil and tradeable for htm HHs in country a
60 (1 - s_t) * c_aho^(-1 / eta) / e - s_t * c_aht^(-1 / eta) / p_t;
61
62 % consumption allocation between oil and tradeable for ricardian HHs in country a
63 (1 - s_t) * c_aro^(-1 / eta) / e - s_t * c_art^(-1 / eta) / p_t;
64
65 % consumption allocation between oil and tradeable in country b
66 % here, p_tstar = p_t / e by LOOP
67 (1 - s_t) * c_bo^(-1 / eta) - s_t * c_bt^(-1 / eta) / (p_t / e);
68
69 % Euler equation for ricardian HHs in country a
70 c_aro^(-1 / eta) / ((s_t * c_art^(1 - 1 / eta) +
71     (1 - s_t) * c_aro^(1 - 1 / eta)) * e) -
72     beta * r_star *
```

```

74         c_aro(+1)^(-1 / eta) / ((s_t * c_art(+1)^(1 - 1 / eta) +
75             (1 - s_t) * c_aro(+1)^(1 - 1 / eta)) * e(+1));
76
77 % Euler equation in country b
78 c_bo^(-1 / eta) / (s_t * c_bt^(1 - 1 / eta) +
79     (1 - s_t) * c_bo^(1 - 1 / eta)) -
80     beta * r_star *
81         c_bo(+1)^(-1 / eta) / (s_t * c_bt(+1)^(1 - 1 / eta) +
82             (1 - s_t) * c_bo(+1)^(1 - 1 / eta));
83
84 % labour supply decision for htm HHs in country a
85 psi - (1 - s_t) * c_aho^(-1 / eta) / ((s_t * c_aht^(1 - 1 / eta) +
86     (1 - s_t) * c_aho^(1 - 1 / eta)) * e) *
87     w * (1 - l_h);
88
89 % labour supply decision for ricardian HHs in country a
90 psi - (1 - s_t) * c_aro^(-1 / eta) / ((s_t * c_art^(1 - 1 / eta) +
91     (1 - s_t) * c_aro^(1 - 1 / eta)) * e) *
92     w * (1 - l_r);
93
94 % htm's budget constraint in country a
95 p_t * c_aht + e * c_aho - w * l_h - pi_h;
96
97 % ricardian's budget constraint in country a
98 p_t * c_art + e * c_aro - w * l_r - pi_r - e * (n_a(-1) - n_a / r_star);
99
100 % HH's budget constraint in country b
101 c_bo + (p_t / e) * c_bt - y_o - (n_b(-1) - n_b / r_star);
102
103 % firm's FOC
104 p_t * (1 - theta) * (1 - alpha) * l^((1 - theta) * (1 - alpha) - 1) * y_t^theta -
105     w - phi * (p_t * y_t^theta * l(-1)^(theta * (1 - alpha)) /
106         (p_t(-1) * l^(theta * (1 - alpha)) * y_t(-1)^theta - 1) *
107             p_t * y_t * (-theta) * (1 - alpha) * p_t * y_t^theta *
108                 l(-1)^(theta * (1 - alpha)) / (p_t(-1) *
109                     l^(theta * (1 - alpha) + 1) * y_t(-1)^theta);
110
111 % firm's profit
112 p_t * l^(1 - alpha) - w * l - pi;
113
114 % profit distribution
115 chi * pi_r + (1 - chi) * pi_h - pi;
116
117 % impose profit for ricardians
118 pi_r - pi;
119
120 % tradeable goods market-clearing condition
121 y_t - (1 - chi) * c_aht - chi * c_art - c_bt;
122
123 % oil market-clearing condition
124 y_o - (1 - chi) * c_aho - chi * c_aro - c_bo;
125
126 % labour market-clearing condition
127 chi * l_r + (1 - chi) * l_h - l;
128
129 % bond market clearing condition
130 chi * n_a + n_b;
131
132 % oil endowment, stochastic process
133 gamma + rho * y_o(-1) - err_yo - y_o;
134
135 % monetary policy rule
136 p_t - p_t(-1);
137
138 end;
139
140
141 %
142 % 4. Steady state
143 %
144
145
146 initval;
147

```

```

148 l_r = .22;
149 l_h = .22;
150 c_aro = .46;
151 c_aho = .46;
152 e = 1;
153 l = chi * l_r + (1 - chi) * l_h;
154 y_t = l^(1 - alpha); % from production function
155 p_t = 16.75 / y_t; % from target GDP in country a
156 c_art = s_t^eta * e^eta * c_aro / (p_t^eta * (1 - s_t)^eta); % from tradeable-oil tradeoff
157 c_aht = s_t^eta * e^eta * c_aho / (p_t^eta * (1 - s_t)^eta);
158 c_bt = y_t - chi * c_art - (1 - chi) * c_aht; % from tradeable MC
159 y_o = gamma / (1 - rho); % from oil stochastic process
160 c_bo = y_o - chi * c_aro - (1 - chi) * c_aho; % from oil MC
161 w = (1 - theta) * (1 - alpha) * p_t *
162       l^((1 - theta) * (1 - alpha) - 1) * y_t^theta; % from firm's FOC at SS
163 pi = p_t * l^(1 - alpha) - w * l; % from firm's profit at SS
164 pi_r = pi;
165 pi_h = (pi - chi * pi_r) / (1 - chi);
166 r_star = 1 / beta; % from SS Euler
167 n_a = r_star / ((r_star - 1) * e) * (p_t * c_art + e * c_aro - w * l - pi_r); % from the BC
168 n_b = - n_a; % from bond MC
169
170
171 end;
172
173 steady(maxit = 1000);
174
175
176
177
178 %-----
179 % 5. Impulse response function
180 %-----
181
182 shocks;
183
184 var err_yo;
185 stderr .1;
186
187 end;
188
189
190 stoch_simul(order=1, irf=100, solve_algo = 3, irf_plot_threshold=0)
191       c_aho c_aro c_bo c_aht c_art c_bt l_h
192       l_r l_yt y_o p_t e w pi n_a n_b r_star;
193
194
195 model_diagnostics;

```

## Appendix H: TANBFPNH mod file

```
1
2 %
3 %
4 % Title: International Macro–Finance Final Assignment, model file
5 % Author: —
6 % Date: 25/12/2023
7 % Description: Two agent, nominal bond, flexible prices,
8 %               non–homothetic preferences
9 %
10 %
11
12
13 %
14 % 0. Housekeeping (close all graphic windows)
15 %
16
17 close all;
18
19 %
20 % 1. Defining variables
21 %
22
23 var c_aho c_aro c_bo c_aht c_art c_bt l_h l_r l_yt y_o p_t w pi
24     n_a n_b r_star pi_r pi_h;
25
26 varexo err_yo;
27
28
29 %
30 % 2. Calibration
31 %
32
33 parameters alpha beta psi eta s_art s_aht s_bt theta rho gamma chi;
34 load parameters;
35
36 set_param_value('alpha', par.alpha);
37 set_param_value('beta', par.beta);
38 set_param_value('psi', par.psi);
39 set_param_value('eta', par.eta);
40 set_param_value('theta', par.theta);
41 set_param_value('rho', par.rho);
42 set_param_value('gamma', par.gamma);
43 set_param_value('chi', par.chi);
44
45 chi = .7;
46 s_t = .8;
47 s_aht = .75; % home bias towards tradeable for htm
48 s_art = (s_t - (1 - chi) * s_aht) / chi; % home bias towards tradeable for ricardians
49 s_bt = s_t; % home bias towards tradeable in country b
50 theta = .68;
51
52
53 %
54 % 3. Model
55 %
56
57
58 model;
59
60 % consumption allocation between oil and tradeable for htm HHs in country a
61 (1 - s_aht) * c_aho^(-1 / eta) - s_aht * c_aht^(-1 / eta) / p_t;
62
63 % consumption allocation between oil and tradeable for ricardian HHs in country a
64 (1 - s_art) * c_aro^(-1 / eta) - s_art * c_art^(-1 / eta) / p_t;
65
66 % consumption allocation between oil and tradeable in country b
67 (1 - s_bt) * c_bo^(-1 / eta) - s_bt * c_bt^(-1 / eta) / p_t;
68
69 % Euler equation for ricardian HHs in country a
70 c_aro^(-1 / eta) / (s_art * c_art^(1 - 1 / eta) +
71     (1 - s_art) * c_aro^(1 - 1 / eta)) -
72     beta * r_star *
73     c_aro(+1)^(-1 / eta) / (s_art * c_art(+1)^(1 - 1 / eta) +
```

```

74         (1 - s_art) * c_aro(+1)^(1 - 1 / eta));
75
76 % Euler equation in country b
77 c_bo^(-1 / eta) / (s_bt * c_bt^(1 - 1 / eta) +
78     (1 - s_bt) * c_bo^(1 - 1 / eta)) -
79     beta * r_star *
80     c_bo(+1)^(-1 / eta) / (s_bt * c_bt(+1)^(1 - 1 / eta) +
81     (1 - s_bt) * c_bo(+1)^(1 - 1 / eta));
82
83 % labour supply decision for htm HHs in country a
84 psi - (1 - s_aht) * c_aho^(-1 / eta) / (s_aht * c_aht^(1 - 1 / eta) +
85     (1 - s_aht) * c_aho^(1 - 1 / eta)) *
86     w * (1 - l_h);
87
88 % labour supply decision for ricardian HHs in country a
89 psi - (1 - s_art) * c_aro^(-1 / eta) / (s_art * c_art^(1 - 1 / eta) +
90     (1 - s_art) * c_aro^(1 - 1 / eta)) *
91     w * (1 - l_r);
92
93 % htm's budget constraint in country a
94 p_t * c_aht + c_aho - w * l_h - pi_h;
95
96 % ricardian's budget constraint in country a
97 p_t * c_art + c_aro - w * l_r - pi_r - (n_a(-1) - n_a / r_star);
98
99 % HH's budget constraint in country b
100 c_bo + p_t * c_bt - y_o - (n_b(-1) - n_b / r_star);
101
102 % firm's FOC
103 (1 - theta) * (1 - alpha) * p_t *
104     l^((1 - theta) * (1 - alpha) - 1) * y_t^theta - w;
105
106 % firm's profit
107 p_t * l^(1 - alpha) - w * l - pi;
108
109 % profit distribution
110 chi * pi_r + (1 - chi) * pi_h - pi;
111
112 % impose profit for ricardians
113 pi_r - pi;
114
115 % tradeable goods market-clearing condition
116 y_t - (1 - chi) * c_aht - chi * c_art - c_bt;
117
118 % oil market-clearing condition
119 y_o - (1 - chi) * c_aho - chi * c_aro - c_bo;
120
121 % labour market-clearing condition
122 chi * l_r + (1 - chi) * l_h - l;
123
124 % bond market clearing condition
125 chi * n_a + n_b;
126
127 % oil endowment, stochastic process
128 gamma + rho * y_o(-1) - err_yo - y_o;
129
130 end;
131
132
133 %
134 % 4. Steady state
135 %
136
137
138 initval;
139
140 l_r = .22;
141 l_h = .22;
142 c_aro = .46;
143 c_aho = .46;
144 l = chi * l_r + (1 - chi) * l_h;
145 y_t = l^(1 - alpha); % from production function
146 p_t = 16.75 / y_t; % from target GDP in country a
147 c_art = s_art^eta * c_aro / (p_t^eta * (1 - s_art)^eta); % from tradeable-oil tradeoff

```

```

148 c_aht = s_aht^eta * c_aho / (p_t^eta * (1 - s_aht)^eta);
149 c_bt = y_t - chi * c_art - (1 - chi) * c_aht; % from tradeable MC
150 y_o = gamma / (1 - rho); % from oil stochastic process
151 c_bo = y_o - chi * c_aro - (1 - chi) * c_aho; % from oil MC
152 w = (1 - theta) * (1 - alpha) * p_t *
153       l^((1 - theta) * (1 - alpha) - 1) * y_t^theta; % from firm's FOC
154 pi = p_t * l^(1 - alpha) - w * l; % from firm's profit
155 pi_r = pi;
156 pi_h = (pi - chi * pi_r) / (1 - chi);
157 r_star = 1 / beta; % from SS Euler
158 n_a = r_star / (r_star - 1) * (p_t * c_art + c_aro - w * l - pi_r); % from the BC
159 n_b = - n_a; % from bond MC
160
161 end;
162
163 steady(maxit = 1000, solve_algo = 3);
164
165
166 %
167 %-----
168 % 5. Impulse response function
169 %-----
170
171
172 shocks;
173
174 var err_yo;
175 stderr .1;
176
177 end;
178
179
180 stoch_simul(order=1, irf=100, irf_plot_threshold=0)
181           c_aho c_aro c_bo c_aht c_art c_bt l_h
182           l_r l y_t y_o p_t w pi n_a n_b r_star;
183
184
185 model_diagnostics;

```