

Appendix B - The complete model

I. Household sector

$$YD = GDP_H + WB - \tau_H + INT_H + T_H + ANN_H \quad (A1)$$

$$ANN_H = DIV_H + PROP_H \quad (A2)$$

$$GDP_H = \beta_H \cdot GDP \quad (A3)$$

$$WB = \omega_T \cdot GDP \quad (A4)$$

$$\omega_L = \frac{INT_H + ANN_H + WB \cdot (1 - \omega_S)}{GDP} \quad (A5)$$

$$\tau_H = \theta_H \cdot WB_{-1} \quad (A6)$$

$$INT_H = INT_H^{RECV} - INT_H^{PAID} \quad (A7)$$

$$INT_H^{RECV} = \iota_{1,0}^H + \iota_{1,1}^H \cdot INT_{H,-1}^{RECV} + \iota_{1,2}^H \cdot r_{BA} + \iota_{1,3}^H \cdot r_{BA,-1} + \iota_{1,4}^H \cdot B_H + \iota_{1,5}^H \cdot B_{H,-1} + \iota_{1,6}^H \cdot B_H \cdot r_{BA} + \iota_{1,7}^H \cdot B_{H,-1} \cdot r_{BA,-1} \quad (A8)$$

$$INT_H^{PAID} = \iota_{2,0}^H + \iota_{2,1}^H \cdot INT_{H,-1}^{PAID} + \iota_{2,2}^H \cdot r_{ECB} + \iota_{2,3}^H \cdot r_{ECB,-1} + \iota_{2,4}^H \cdot L_H + \iota_{2,5}^H \cdot L_{H,-1} + \iota_{2,6}^H \cdot L_H \cdot r_{ECB} + \iota_{2,7}^H \cdot L_{H,-1} \cdot r_{ECB,-1} \quad (A9)$$

$$T_H = \alpha_{H,T} \cdot WB_{-1} \quad (A10)$$

$$PROP_H = \alpha_{H,P} \cdot WB_{-1} \quad (A11)$$

$$C_H = c_0 + c_1 \cdot E(YD) + c_2 \cdot NW_{H,-1} + c_3 \cdot C_{H,-1} \quad (A12)$$

$$NW_H = NW_{H,-1} + YD_H - CONS_H - INV_H + NFUNDS_H + CG_H \quad (A13)$$

$$CG_H = \Delta p_H \cdot \frac{HOUSE_{H,-1}}{p_{H,-1}} + \Delta p_B \cdot \frac{B_{H,-1}}{p_{B,-1}} + \Delta p_V \cdot \frac{V_{H,-1}}{p_{V,-1}} + CG_H^{RES} \quad (A14)$$

$$CG_H^{RES} = CG_H \cdot (1 + \sigma_{CG}^H) \quad (A15)$$

$$NFW_H = NW_H - HOUSE_H + L_H \quad (A16)$$

$$HOUSE_H = (1 - \delta_H^1) \cdot HOUSE_{H,-1} + (1 - \delta_H^2) \cdot INV_H \quad (A17)$$

$$r_V = v_1 \cdot r_{V,-1} + v_2 \cdot \frac{\Delta p_V}{p_{V,-1}} \quad (A18)$$

$$\frac{V_H}{E(NFW_H)} = \lambda_{1,0}^H + \lambda_{1,1}^H \cdot E(r_V) + \lambda_{1,2}^H \cdot \frac{E(YD_H)}{E(NFW_H)} + \lambda_{1,3}^H \cdot E(r_{BA}) \quad (A19)$$

$$\frac{B_H}{E(NFW_H)} = \lambda_{2,0}^H + \lambda_{2,1}^H \cdot E(r_V) + \lambda_{2,2}^H \cdot \frac{E(YD_H)}{E(NFW_H)} + \lambda_{2,3}^H \cdot E(r_{BA}) \quad (A20)$$

$$\frac{D_H}{E(NFW_H)} = \lambda_{3,0}^H + \lambda_{3,1}^H \cdot E(r_V) + \lambda_{3,2}^H \cdot \frac{E(YD_H)}{E(NFW_H)} + \lambda_{3,3}^H \cdot E(r_{BA}) \quad (A21)$$

$$\frac{OFIN_H}{E(NFW_H)} = \lambda_{4,0}^H + \lambda_{4,1}^H \cdot E(r_V) + \lambda_{4,2}^H \cdot \frac{E(YD_H)}{E(NFW_H)} + \lambda_{4,3}^H \cdot E(r_{BA})$$

$$OFIN_H = NFW_H - D_H - V_H - B_H \quad (A22)$$

$$L_H = L_{H,-1} + \phi_1 \cdot YD_{-1} + \phi_2 \cdot HOUSE_{H,-1} + \phi_3 \cdot INV_{H,-1} \quad (A23)$$

$$INV_H = \vartheta_1 \cdot INV_{H,-1} + \vartheta_2 \cdot L_{H,-1} + \vartheta_3 \cdot HOUSE_{H,-1} + \vartheta_4 \cdot YD_{H,-1} + \vartheta_5 \cdot E(r_H) \quad (A24)$$

$$r_H = \frac{\Delta PROP_H}{PROP_{H,-1}} \quad (A25)$$

$$NL_H = YD + NFUNDS_H - CONS_H - INV_H \quad (A26)$$

$$NFUNDS_H = \alpha_{H,FU} \cdot YD_{H,-1} \quad (A27)$$

II. Non-financial corporations

$$GDP = Y - CONS_{INT} + \tau_P^{NET} \quad (A28)$$

$$GDP_F = \beta_F \cdot GDP \quad (A29)$$

$$CONS_{INT} = c_{INT} \cdot Y \quad (A30)$$

$$K = K_{-1} \cdot (1 + g_K) \quad (A31)$$

$$INV = K_{-1} \cdot (g_K + \delta_K) \quad (A32)$$

$$g_K = \gamma_Y + \gamma_U \cdot E\left(\frac{Y}{K}\right) + \gamma_{\Pi} \cdot E\left(\frac{\Pi_F}{K}\right) - \gamma_Z \cdot r_Z - \gamma_R \cdot r_{L,F} \quad (A33)$$

$$INV_F = \delta_F \cdot INV \quad (A34)$$

$$D_F = (1 + \eta_F) \cdot D_{F,-1} \cdot \frac{GDP}{GDP_{-1}} \quad (A35)$$

$$Y_{AD} = CONS_H + CONS_G + INV + CONS_{INT} + EXP - IMP - \tau_T^{NET} \quad (A36)$$

$$Y = Y_{AD} \quad (A37)$$

$$Y_n = \min(Y_n^L, Y_n^K) \quad (A38)$$

$$\log(Y_n^L) = \nu_0^L + \nu_1^L \cdot \log(N) + \nu_2^L \cdot t$$

$$\log(Y_n^K) = \nu_0^K + \nu_1^K \cdot \log(K) + \nu_2^K \cdot t$$

$$g_n = d(\log(Y_n))$$

$$p_Y = \pi_1^Y \cdot p_{Y,-1} + \pi_2^Y \cdot (Y_n - Y) + \pi_3^Y \cdot \frac{WB}{GDP} + \pi_4^Y \cdot NER \quad (A39)$$

$$p_K = \pi_1^K \cdot p_{K,-1} + \pi_2^K \cdot \frac{GDP}{K} + \pi_3^K \cdot \frac{WB}{GDP} + \pi_4^K \cdot NER \quad (A40)$$

$$g_{PROD} = \rho_1 + \rho_2 \cdot d(\log(INV_F)) + \rho_3 \cdot d(\log(EXP)) + \rho_4 \cdot d(\log(CONS_G)) \quad (A41)$$

$$PROD_L = PROD_{L,-1} \cdot (1 + g_{PROD}) \quad (A42)$$

$$N = \frac{Y}{PROD} \quad (A43)$$

$$IMP = IMP_{-1} \cdot \exp\left(\mu_1 + \mu_2 \cdot \ln\left(\frac{Y}{Y_{-1}}\right) + \mu_3 \cdot (NER - NER_{-1})\right) \quad (A44)$$

$$\Pi_F = GDP_F - (WB - WB_{OTHER}) - \tau_F + T_F + INT_F + NFUNDS_F + PROP_F \quad (A45)$$

$$\Omega = 1 - \omega_L \quad (A46)$$

$$INT_F = r_{D,-1} \cdot D_{F,-1} - r_{L,F} \cdot L_{F,-1} - r_{BA} \cdot (B_{F,-1} - B_{G,F,-1}) + INT_F^{RES} \quad (A47)$$

$$WB_{OTHER} = \omega_O \cdot WB \quad (A48)$$

$$\Pi_{FU} = s_F \cdot \Pi_F \quad (A49)$$

$$DIV_F = (1 - s_F) \cdot \Pi_F \quad (A50)$$

$$\tau_F = \theta_F \cdot \left(GDP_{F,-1} - (WB_{-1} - WB_{OTHER,-1}) - INT_{F,-1} - NFUNDS_{F,-1} - PROP_{F,-1}\right) \quad (A51)$$

$$NFUNDS_F = \alpha_{F,FU} \cdot \Pi_{F,-1} \quad (A52)$$

$$PROP_F = \alpha_{F,O} \cdot \Pi_{F,-1} \quad (A53)$$

$$v_F = v_{F,-1} + \psi \cdot \frac{INV_{F,-1}}{p_{V,-1}} \quad (A54)$$

$$p_V = \frac{V_F}{v_F} \quad (A55)$$

$$L_F = L_{F,-1} - NL_F - NPL - p_V \cdot \Delta v_F \quad (A56)$$

$$NPL = \xi_F \cdot \xi_B \cdot L_{F,-1} \quad (A57)$$

$$NL_F = \Pi_{FU} - INV_F \quad (A58)$$

$$YD_F = \Pi_{FU} - NFUNDS_F \quad (A59)$$

$$NW_F = NW_{F,-1} + YD_F - INV_F + NFUNDS_F + CG_F \quad (A60)$$

$$CG_F = \sigma_{CG}^F \cdot NW_{F,-1} \quad (A61)$$

$$NFW_F = NW_F - HOUSE_F + L_F + V_F + B_F - B_{G,F} \quad (A62)$$

$$HOUSE_F = \nu_{H,F} \cdot NW_F \quad (A63)$$

$$OFIN_F = D_F + V_F - L_F + B_F - B_{G,F} - NW_F + HOUSE_F \quad (A64)$$

III. Government sector

$$NL_G = GOV_{REV} - GOV_{SP} - INT_G \quad (A65)$$

$$INT_G = r_{BA,-1} \cdot B_{G,-1} + INT_G^{RES} \quad (A66)$$

$$GOV_{SP} = CONS_G + INV_G + T_{TOT} + NFUNDS_G \quad (A67)$$

$$GOV_{REV} = GDP_G - WB_G + \tau_{TOT} + PROP_G + DIV_G \quad (A68)$$

$$CONS_G = \alpha_G^C \cdot GDP + \zeta_G \quad (A69)$$

$$INV_G = \alpha_G^I \cdot GDP \quad (A70)$$

$$WB_G = \omega_G \cdot GDP \quad (A71)$$

$$V_G = \alpha_G^V \cdot GDP \quad (A72)$$

$$\tau_{TOT} = \tau_H + \tau_F + \tau_B + \tau_{RoW} \quad (A73)$$

$$T_{TOT} = T_H + T_F + T_B + T_{RoW} \quad (A74)$$

$$GDP_G = \beta_G \cdot GDP \quad (A75)$$

$$PROP_G = \alpha_G^P \cdot GDP \quad (A76)$$

$$NFUNDS_G = \alpha_G^{FU} \cdot GDP \quad (A77)$$

$$b_G = b_{G,-1} - \frac{-NL_G}{p_{B,-1}} + \frac{BOT_{-1}}{p_{B,-1}} \quad (A78)$$

$$p_B = \frac{B_G}{b_G} \quad (A79)$$

$$BOT = p_{B,-1} \cdot \Delta b_G - \left(B_G - B_{G,-1} \cdot \frac{p_B}{p_{B,-1}} \right) \quad (A80)$$

$$\tau_{TOT}^{NET} = \theta_{TOT} \cdot Y \quad (A81)$$

$$L_G = NW_G \cdot \eta_L^G \quad (A82)$$

$$D_G = NW_G \cdot \eta_D^G \quad (A83)$$

$$NW^G = NW_{G,-1} + NL_G + CG_G \quad (A84)$$

$$CG_G = \sigma_{CG}^G \cdot NW_{G,-1} \quad (A85)$$

$$OFIN_G = NW_G - D_G - V_G + L_G - B_G \quad (A86)$$

$$DEB_G = \frac{-NW_G}{GDP}$$

$$DEF_G = \frac{-NL_G}{GDP}$$

IV. Banks and financial intermediaries

$$GDP_B = \beta_B \cdot GDP \quad (A87)$$

$$\begin{aligned} \Pi_B = GDP_B - WB_B - \tau_B + T_B + DIV_B + \\ + PROP_B + INT_B + NFUNDS_B \end{aligned} \quad (A88)$$

$$NL_B = \Pi_B - DIV_B - INV_B \quad (A89)$$

$$WB_B = \omega_B \cdot GDP \quad (A90)$$

$$\tau_B = \theta_B \cdot \Pi_{B,-1} \quad (A91)$$

$$T_B = \alpha_B^T \cdot \Pi_{B,-1} \quad (A92)$$

$$PROP_B = \alpha_B^P \cdot \Pi_B \quad (A93)$$

$$NFUNDS_B = \alpha_B^{FU} \cdot \Pi_B \quad (A94)$$

$$INT_B = \left(INT_H^{PAID} + (-INT_F) \right) + INT_B^{RES} \quad (A95)$$

$$INV_B = \alpha_B^{INV} \cdot INV \quad (A96)$$

$$NW_B = NW_{B,-1} + \Pi_B - INV_B + CG_B \quad (A97)$$

$$CG_B = \sigma_{CG}^B \cdot NW_{B,-1} \quad (A98)$$

$$L_B = L_H + L_F + L_G - L_{RoW} \quad (A99)$$

$$D_B = D_H + D_F + D_G + D_{RoW} \quad (A100)$$

$$NFW_B = NW_B - HOUSE_B \quad (A101)$$

$$HOUSE_B = \nu_{H,B} \cdot NW_B \quad (A102)$$

$$\frac{V_B^{PUR}}{E(NFW_B)} = \lambda_{1,0}^B + \lambda_{1,1}^B \cdot E(r_V) + \lambda_{1,2}^B \cdot \Pi_B + \lambda_{1,3}^B \cdot E(r_{BA}) \quad (A103)$$

$$\frac{B_B}{E(NFW_B)} = \lambda_{2,0}^B + \lambda_{2,1}^B \cdot E(r_V) + \lambda_{2,2}^B \cdot \Pi_B + \lambda_{2,3}^B \cdot E(r_{BA}) \quad (A104)$$

$$OFIN_B = D_B + V_B - L_B + B_B - NW_B + HOUSE_B \quad (A105)$$

V. Foreign sector

$$GDP_{RoW} = GDP - (GDP_H + GDP_F + GDP_G + GDP_B) \quad (A106)$$

$$NL_{RoW} = -(NL_H + NL_F + NL_G + NL_B) \quad (A107)$$

$$\begin{aligned} L_{RoW} = \Phi_L^1 \cdot L_{RoW,-1} + \Phi_L^2 \cdot r_{ECB,-1} + \Phi_L^3 \cdot GDP_{RoW,-1} + \\ + \Phi_L^4 \cdot NER + \Phi_L^5 \cdot (IMP_{-1} + EXP_{-1}) + \Phi_L^6 \cdot (IMP_{-1} - EXP_{-1}) \end{aligned} \quad (A108)$$

$$D_{RoW} = \Phi_D^1 \cdot L_{RoW,-1} + \Phi_D^2 \cdot GDP_{RoW,-1} + \Phi_D^3 \cdot (IMP_{-1} + EXP_{-1}) + \Phi_D^4 \cdot (IMP_{-1} - EXP_{-1}) + \Phi_D^5 \cdot r_{BA,-1} + \Phi_D^6 \cdot GDP_{-1} \quad (A109)$$

$$EXP = \mu_1^X \cdot EXP_{-1} + \mu_2^X \cdot d(PROD_L) + \mu_3^X \cdot d(IMP) + \mu_4^X \cdot d(NER) \quad (A110)$$

$$B_{RoW} = \Phi_{RoW}^1 \cdot r_Z + \Phi_{RoW}^2 \cdot r_{ECB} + \Phi_{RoW}^3 \cdot r_{BA} + \Phi_{RoW}^4 \cdot NER + \Phi_{RoW}^5 \cdot r_V \quad (A111)$$

$$V_{RoW} = V_H + V_G - (V_F + V_B) \quad (A112)$$

$$INT_{RoW} = INT_H + INT_B - (INT_F + INT_G) \quad (A113)$$

$$T_{RoW} = \alpha_{RoW}^T \cdot GDP \quad (A114)$$

$$\tau_{RoW} = \theta_{RoW} \cdot GDP \quad (A115)$$

VI. Cross-sector holdings and payments

VI.1 Equity & shares issued by NFCs

$$V_F = V_{F,H} + V_{F,G} + V_{F,B} \quad (A116)$$

$$V_{F,B} = \chi_F \cdot V_B^{PUR} \quad (A117)$$

$$V_{F,H} = \chi_F \cdot V_H \quad (A118)$$

$$V_{F,G} = \chi_F \cdot V_G \quad (A119)$$

Note: χ_F = % of NFC equity to total equity.

VI.2 Equity & shares issued by financial sector

$$V_B = V_B^{PUR} - V_B^{ISS} \quad (A120)$$

$$V_B^{ISS} = V_{B,H} + V_{B,G} \quad (A121)$$

$$V_{B,H} = \chi_B \cdot V_H \quad (A122)$$

$$V_{B,G} = \chi_B \cdot V_G \quad (A123)$$

Note: χ_B = % of financial sector's equity to total equity.

VI.3 Equity & shares issued by foreign sector

$$V_{ROW,H} = (1 - \chi_F - \chi_B) \cdot V_H \quad (A124)$$

$$V_{ROW,G} = (1 - \chi_F - \chi_B) \cdot V_G \quad (A125)$$

$$V_{ROW,B} = \chi_B \cdot V_{ROW} \quad (A126)$$

VI.4 Total equity & shares issues

$$V_{TOT} = V_F + V_B^{ISS} + V_{ROW} \quad (A127)$$

VI.5 Dividends received by households

$$DIV_H = DIV_{TOT} - DIV_{F,G} - DIV_{F,B} - DIV_{F,ROW} \quad (A128)$$

$$DIV_{TOT} = DIV_F + (-DIV_B^{PAID}) + (-DIV_{ROW}^{PAID}) \quad (A129)$$

$$DIV_{F,H} = DIV_F - DIV_{F,G} - DIV_{F,B} - DIV_{F,ROW} \quad (A130)$$

$$DIV_{B,H} = -DIV_B^{PAID} - DIV_{B,ROW} \quad (A131)$$

$$DIV_{ROW,H} = -\delta_{ROW}^{DIV} \cdot DIV_H \quad (A132)$$

Note: δ_{ROW}^{DIV} = % of of total dividends paid by foreign sector.

VI.6 Dividends received by government

$$DIV_G = \epsilon_G \cdot \frac{V_G}{V_{TOT}} \quad (A133)$$

$$DIV_{F,G} = \delta_F^{DIV} \cdot DIV_G \quad (A134)$$

$$DIV_{ROW,G} = \delta_{ROW}^{DIV} \cdot DIV_G \quad (A135)$$

$$DIV_{B,G} = \delta_B^{DIV} \cdot DIV_G \quad (A136)$$

Note: δ_F^{DIV} = % of of total dividends paid by NFCs; δ_B^{DIV} = % paid by financial sector.

VI.7 Dividends received by financial sector

$$DIV_B^{RECV} = \epsilon_B \cdot DIV_{TOT} \cdot \frac{V_B^{PUR}}{V_{TOT}} \quad (A137)$$

$$DIV_{F,B} = \delta_F^{DIV} \cdot DIV_B^{RECV} \quad (A138)$$

$$DIV_{ROW,B} = \delta_{ROW}^{DIV} \cdot DIV_B^{RECV} \quad (A139)$$

$$DIV_B^{PAID} = (1 - s_B) \cdot \Pi_B \quad (A140)$$

$$DIV_B = DIV_B^{RECV} + DIV_B^{PAID} \quad (A141)$$

Note: ϵ_B = correction coefficient for dividends received by financial sector.

VI.8 Dividends received by foreign sector

$$DIV_{ROW}^{RECV} = \epsilon_{ROW} \cdot DIV_{TOT} \cdot \frac{V_{ROW}^{PUR}}{V_{TOT}} \quad (A142)$$

$$V_{ROW}^{PUR} = V_{ROW} \text{ for } V_{ROW} > 0 \quad (A143)$$

$$DIV_{F,ROW} = \delta_F^{DIV} \cdot DIV_{ROW}^{RECV} \quad (A144)$$

$$DIV_{B,ROW} = \delta_B^{DIV} \cdot DIV_{ROW}^{RECV} \quad (A145)$$

$$DIV_{ROW}^{PAID} = DIV_{ROW,H} + DIV_{ROW,G} + DIV_{ROW,B} \quad (A146)$$

$$DIV_{ROW} = DIV_{ROW}^{PAID} + DIV_{ROW}^{RECV} \quad (A147)$$

Note: ϵ_{ROW} = correction coefficient for dividends received by foreign sector.

VI.9 *Securities demanded by NFCs*

$$B_F = B_{F,B} + B_{F,H} + B_{F,ROW} \quad (A148)$$

$$B_{F,B} = \rho_F \cdot B_B \quad (A149)$$

$$B_{F,H} = \rho_F \cdot B_H \quad (A150)$$

$$B_{F,ROW} = \rho_F \cdot B_{ROW} \quad (A151)$$

Note: ρ_F = percentage of NFC securities to total securities.

VI.10 *Securities issued by government sector*

$$B_G = B_{G,H} + B_{G,ROW} + B_{G,B} + B_{G,F} \quad (A152)$$

$$B_{G,H} = B_H \cdot (1 - \rho_F) \quad (A153)$$

$$B_{G,ROW} = (1 - \rho_F) \cdot B_{ROW} \quad (A154)$$

$$B_{G,B} = (1 - \rho_F) \cdot B_B \quad (A155)$$

$$B_{G,F} = \rho_{GF} \cdot B_G \quad (A156)$$

Note: ρ_{FG} = net percentage of T-bonds purchased by NFCs.

VI.11 *Interests paid by NFCs*

$$INT_{F,H} = INT_H \cdot \iota_F \quad (A157)$$

$$INT_{F,B} = INT_B \cdot \iota_F \quad (A158)$$

$$INT_{F,ROW} = INT_{ROW} \cdot \iota_F \quad (A159)$$

Note: ι_F = percentage of interest payments made by NFCs to total interests.

VI.12 *Interests paid by government*

$$INT_{G,B} = INT_B - INT_{F,B} \quad (A160)$$

$$INT_{G,H} = INT_H - INT_{F,H} \quad (A161)$$

$$INT_{G,ROW} = INT_{ROW} - INT_{F,ROW} \quad (A162)$$

VII. *Central bank stance and interest rates*

$$r_{ECB} = \bar{r}_{ECB}$$

$$NER = \bar{N}ER$$

$$r_Z = \bar{r}_Z$$

$$r_{L,F} = r_{ECB} + \mu_{L,F} \tag{A163}$$

$$r_{BA} = r_Z \cdot (1 + \mu_A) \tag{A164}$$

$$\mu_A = \frac{SPREAD_A}{r_Z} \tag{A165}$$