This document makes the parameters for the behavioural functions parameters that can be varied as part of the simulation.

Model Derivation--Financial Component

ODE Programs

SystemODEs(x) :=
Functions ← submatrix(x, 2, 2, 1, cols(x) − 1)
Equations ← submatrix(x, 3, rows(x) − 1, 1, cols(x) − 1
for i ∈ 0 .. cols(Functions) − 1
$E_i \leftarrow \frac{d}{dt}Functions_i = \sum Equations^{\langle i \rangle}$
return E

Vars(x) :=
$vars_{raw} \leftarrow$ submatrix(x, 2, 2, 1, cols(x) − 1)
$vars \leftarrow vars_{raw}^{T}$
return vars

Audit(x) :=
Equations ← submatrix(x, 3, rows(x) − 1, 1, cols(x) − 1)
for i ∈ 0 .. rows(Equations) − 1
$Sum_i \leftarrow \sum_{j=0}^{cols(Equations)-1} Equations_{i,j}$
return Sum

NumODEs(n) := (4·n + 3) + (5·n) + 1

NumODEs(4) = 40

Financial Flows Dynamics

$S_1 :=$

"Type"	0	1	1	1	1	1	1	1	1	–1
"Name"	"BR"	"LK1"	"LK2"	"LC1"	"LC2"	"LA1"	"LA2"	"LE1"	"LE2"	"DK1"
"Symbol"	$B_R(t)$	$F_{LK1}(t)$	$F_{LK2}(t)$	$F_{LC1}(t)$	$F_{LC2}(t)$	$F_{LA1}(t)$	$F_{LA2}(t)$	$F_{LE1}(t)$	$F_{LE2}(t)$	$F_{DK1}(t)$
"Compound Interest"	0	A1	A2	A3	A4	A5	A6	A7	A8	0
"Deposit Interest"	0	0	0	0	0	0	0	0	0	B1
"Wages"	0	0	0	0	0	0	0	0	0	–C1
"Household Interest"	0	0	0	0	0	0	0	0	0	0
"Investment Demand for K"	0	0	0	0	0	0	0	0	0	(–E1 + E2) + (E3 + E5 + E
"Intersectoral Demand for C"	0	0	0	0	0	0	0	0	0	–F1
"Intersectoral Demand for A"	0	0	0	0	0	0	0	0	0	–G1
"Intersectoral Demand for E"	0	0	0	0	0	0	0	0	0	–H1
"Consumption K"	0	0	0	0	0	0	0	0	0	$(-I1 + I2) + (I3 + I5 + I7) + \frac{I9}{}$
"Consumption C"	0	0	0	0	0	0	0	0	0	–J1
"Consumption A"	0	0	0	0	0	0	0	0	0	–K1
"Consumption E"	0	0	0	0	0	0	0	0	0	–L1
"Pay Interest"	0	–M1	–M2	–M3	–M4	–M5	–M6	–M7	–M8	–M1
"Repay Loans"	N1 + N2 + N3 + N4 + N5 + N6 + N7 + N8	–N1	–N2	–N3	–N4	–N5	–N6	–N7	–N8	–N1
"Recycle Reserves"	–(O1 + O2 + O3 + O4 + O5 + O6 + O7 + O8)	O1	O2	O3	O4	O5	O6	O7	O8	O1
"New Money"	0	P1	P2	P3	P4	P5	P6	P7	P8	P1

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then horizontally

$$\text{Audit}\left(S_1\right) \rightarrow \begin{pmatrix} A1 + A2 + A3 + A4 + A5 + A6 + A7 + A8 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -M1 - M2 - M3 - M4 - M5 - M6 - M7 - M8 \\ -N1 - N2 - N3 - N4 - N5 - N6 - N7 - N8 \\ O1 + O2 + O3 + O4 + O5 + O6 + O7 + O8 \\ 2 \cdot P1 + 2 \cdot P2 + 2 \cdot P3 + 2 \cdot P4 + 2 \cdot P5 + 2 \cdot P6 + 2 \cdot P7 + 2 \cdot P8 \end{pmatrix}$$

Variables in the financial system

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then horizontally

$$\mathrm{Vars}(S_1) \rightarrow \begin{pmatrix} B_R(t) \\ F_{LK1}(t) \\ F_{LK2}(t) \\ F_{LC1}(t) \\ F_{LC2}(t) \\ F_{LA1}(t) \\ F_{LA2}(t) \\ F_{LE1}(t) \\ F_{LE2}(t) \\ F_{DK1}(t) \\ F_{DK2}(t) \\ F_{DC1}(t) \\ F_{DC2}(t) \\ F_{DA1}(t) \\ F_{DA2}(t) \\ F_{DE1}(t) \\ F_{DE2}(t) \\ H_D(t) \\ B_I(t) \end{pmatrix}$$

$$F_{Loans} := \mathrm{submatrix}(\mathrm{Vars}(S_1), 1, 8, 0, 0) \rightarrow \begin{pmatrix} F_{LK1}(t) \\ F_{LK2}(t) \\ F_{LC1}(t) \\ F_{LC2}(t) \\ F_{LA1}(t) \\ F_{LA2}(t) \\ F_{LE1}(t) \\ F_{LE2}(t) \end{pmatrix}$$

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$$F_{Deposits} := \text{submatrix}\left(\text{Vars}\left(S_1\right), 9, 16, 0, 0\right) \rightarrow \begin{pmatrix} F_{DK1}(t) \\ F_{DK2}(t) \\ F_{DC1}(t) \\ F_{DC2}(t) \\ F_{DA1}(t) \\ F_{DA2}(t) \\ F_{DE1}(t) \\ F_{DE2}(t) \end{pmatrix}$$

$$NonF_{Deposits} := \text{submatrix}\left(\text{Vars}\left(S_1\right), 17, 18, 0, 0\right) \rightarrow \begin{pmatrix} H_D(t) \\ B_I(t) \end{pmatrix}$$

Actions (rows) in financial table

Compound Interest (row A)

$$\begin{pmatrix} A1 \\ A2 \\ A3 \\ A4 \\ A5 \\ A6 \\ A7 \\ A8 \end{pmatrix} := r_L \cdot F_{Loans} \rightarrow \begin{pmatrix} r_L \cdot F_{LK1}(t) \\ r_L \cdot F_{LK2}(t) \\ r_L \cdot F_{LC1}(t) \\ r_L \cdot F_{LC2}(t) \\ r_L \cdot F_{LA1}(t) \\ r_L \cdot F_{LA2}(t) \\ r_L \cdot F_{LE1}(t) \\ r_L \cdot F_{LE2}(t) \end{pmatrix}$$

Interest on Firm Deposits (B)

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then horizontally

$$\begin{pmatrix} B1 \\ B2 \\ B3 \\ B4 \\ B5 \\ B6 \\ B7 \\ B8 \end{pmatrix} := \overrightarrow{\left(r_D\left(F_{Deposits}\right)\cdot F_{Deposits}\right)} \rightarrow \begin{pmatrix} F_{DK1}(t)\cdot r_D\left(F_{DK1}(t)\right) \\ F_{DK2}(t)\cdot r_D\left(F_{DK2}(t)\right) \\ F_{DC1}(t)\cdot r_D\left(F_{DC1}(t)\right) \\ F_{DC2}(t)\cdot r_D\left(F_{DC2}(t)\right) \\ F_{DA1}(t)\cdot r_D\left(F_{DA1}(t)\right) \\ F_{DA2}(t)\cdot r_D\left(F_{DA2}(t)\right) \\ F_{DE1}(t)\cdot r_D\left(F_{DE1}(t)\right) \\ F_{DE2}(t)\cdot r_D\left(F_{DE2}(t)\right) \end{pmatrix}$$

(C) Wages

The monetary flow to pay wages in this integrated model are determined by the level of employment and the money wage, which are specified below in the production component of the model

$$\begin{pmatrix} C1 \\ C2 \\ C3 \\ C4 \\ C5 \\ C6 \\ C7 \\ C8 \end{pmatrix} := W_M(t)\cdot \begin{pmatrix} L_{K1}(t) \\ L_{K2}(t) \\ L_{C1}(t) \\ L_{C2}(t) \\ L_{A1}(t) \\ L_{A2}(t) \\ L_{E1}(t) \\ L_{E2}(t) \end{pmatrix} \rightarrow \begin{pmatrix} L_{K1}(t)\cdot W_M(t) \\ L_{K2}(t)\cdot W_M(t) \\ L_{C1}(t)\cdot W_M(t) \\ L_{C2}(t)\cdot W_M(t) \\ L_{A1}(t)\cdot W_M(t) \\ L_{A2}(t)\cdot W_M(t) \\ L_{E1}(t)\cdot W_M(t) \\ L_{E2}(t)\cdot W_M(t) \end{pmatrix}$$

(D) Interest Payments to workers

$$D1 := r_D\left(H_D(t)\right)\cdot H_D(t)$$

(E-H) Investment and Intersectoral Demand

Investment--purchases of capital goods from the capital goods sector--are determined by expectations of profit, which are a nonlinear extrapolation of current profits in each sector. Intersectoral demand--purchases of the output of other sectors needed to produce output in a given sector--are proportional to labour employed.

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then horizontally

Investment

$$\begin{pmatrix} E1 \\ E2 \\ E3 \\ E4 \\ E5 \\ E6 \\ E7 \\ E8 \end{pmatrix} := \overrightarrow{\left[F_{Deposits} \div \begin{pmatrix} \tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m) \\ \tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m) \\ \tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m) \\ \tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m) \\ \tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m) \\ \tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m) \\ \tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m) \\ \tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m) \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \frac{F_{DK1}(t)}{\tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m)} \\ \frac{F_{DK2}(t)}{\tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m)} \\ \frac{F_{DC1}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} \\ \frac{F_{DC2}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} \\ \frac{F_{DA1}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} \\ \frac{F_{DA2}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} \\ \frac{F_{DE1}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} \\ \frac{F_{DE2}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} \end{pmatrix}$$

Intersectoral demand for C

$$\begin{pmatrix} F1 \\ F2 \\ F3 \\ F4 \\ F5 \\ F6 \\ F7 \\ F8 \end{pmatrix} := \overrightarrow{\left[\begin{pmatrix} \sigma_{KC} \\ \sigma_{KC} \\ \sigma_{CC} \\ \sigma_{CC} \\ \sigma_{AC} \\ \sigma_{AC} \\ \sigma_{EC} \\ \sigma_{EC} \end{pmatrix} \cdot \begin{pmatrix} C1 \\ C2 \\ C3 \\ C4 \\ C5 \\ C6 \\ C7 \\ C8 \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \sigma_{KC} \cdot L_{K1}(t) \cdot W_M(t) \\ \sigma_{KC} \cdot L_{K2}(t) \cdot W_M(t) \\ \sigma_{CC} \cdot L_{C1}(t) \cdot W_M(t) \\ \sigma_{CC} \cdot L_{C2}(t) \cdot W_M(t) \\ \sigma_{AC} \cdot L_{A1}(t) \cdot W_M(t) \\ \sigma_{AC} \cdot L_{A2}(t) \cdot W_M(t) \\ \sigma_{EC} \cdot L_{E1}(t) \cdot W_M(t) \\ \sigma_{EC} \cdot L_{E2}(t) \cdot W_M(t) \end{pmatrix}$$

Lay pages vertically to p. 37

then horizontally

Intersectoral demand for A

$$\begin{pmatrix} G1 \\ G2 \\ G3 \\ G4 \\ G5 \\ G6 \\ G7 \\ G8 \end{pmatrix} := \overrightarrow{\left[\begin{pmatrix} \sigma_{KA} \\ \sigma_{KA} \\ \sigma_{CA} \\ \sigma_{CA} \\ \sigma_{AA} \\ \sigma_{AA} \\ \sigma_{EA} \\ \sigma_{EA} \end{pmatrix} \cdot \begin{pmatrix} C1 \\ C2 \\ C3 \\ C4 \\ C5 \\ C6 \\ C7 \\ C8 \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \sigma_{KA} \cdot L_{K1}(t) \cdot W_M(t) \\ \sigma_{KA} \cdot L_{K2}(t) \cdot W_M(t) \\ \sigma_{CA} \cdot L_{C1}(t) \cdot W_M(t) \\ \sigma_{CA} \cdot L_{C2}(t) \cdot W_M(t) \\ \sigma_{AA} \cdot L_{A1}(t) \cdot W_M(t) \\ \sigma_{AA} \cdot L_{A2}(t) \cdot W_M(t) \\ \sigma_{EA} \cdot L_{E1}(t) \cdot W_M(t) \\ \sigma_{EA} \cdot L_{E2}(t) \cdot W_M(t) \end{pmatrix}$$

Intersectoral demand for E

$$\begin{pmatrix} H1 \\ H2 \\ H3 \\ H4 \\ H5 \\ H6 \\ H7 \\ H8 \end{pmatrix} := \overrightarrow{\left[\begin{pmatrix} \sigma_{KE} \\ \sigma_{KE} \\ \sigma_{CE} \\ \sigma_{CE} \\ \sigma_{AE} \\ \sigma_{AE} \\ \sigma_{EE} \\ \sigma_{EE} \end{pmatrix} \cdot \begin{pmatrix} C1 \\ C2 \\ C3 \\ C4 \\ C5 \\ C6 \\ C7 \\ C8 \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \sigma_{KE} \cdot L_{K1}(t) \cdot W_M(t) \\ \sigma_{KE} \cdot L_{K2}(t) \cdot W_M(t) \\ \sigma_{CE} \cdot L_{C1}(t) \cdot W_M(t) \\ \sigma_{CE} \cdot L_{C2}(t) \cdot W_M(t) \\ \sigma_{AE} \cdot L_{A1}(t) \cdot W_M(t) \\ \sigma_{AE} \cdot L_{A2}(t) \cdot W_M(t) \\ \sigma_{EE} \cdot L_{E1}(t) \cdot W_M(t) \\ \sigma_{EE} \cdot L_{E2}(t) \cdot W_M(t) \end{pmatrix}$$

Consumption is financed by a lagged flow of funds out of relevant sectoral accounts

Consumption of K

$$\begin{pmatrix} I1 \\ I2 \\ I3 \\ I4 \\ I5 \\ I6 \\ I7 \\ I8 \end{pmatrix} := \overrightarrow{\left[F_{Deposits} \div \begin{pmatrix} \tau_{KKC} \\ \tau_{KKC} \\ \tau_{KCC} \\ \tau_{KCC} \\ \tau_{KAC} \\ \tau_{KAC} \\ \tau_{KEC} \\ \tau_{KEC} \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \frac{F_{DK1}(t)}{\tau_{KKC}} \\ \frac{F_{DK2}(t)}{\tau_{KKC}} \\ \frac{F_{DC1}(t)}{\tau_{KCC}} \\ \frac{F_{DC2}(t)}{\tau_{KCC}} \\ \frac{F_{DA1}(t)}{\tau_{KAC}} \\ \frac{F_{DA2}(t)}{\tau_{KAC}} \\ \frac{F_{DE1}(t)}{\tau_{KEC}} \\ \frac{F_{DE2}(t)}{\tau_{KEC}} \end{pmatrix}$$

$$\begin{pmatrix} I9 \\ I10 \end{pmatrix} := \overrightarrow{\left[NonF_{Deposits} \div \begin{pmatrix} \tau_{KWC} \\ \tau_{KBC} \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \frac{H_D(t)}{\tau_{KWC}} \\ \frac{B_I(t)}{\tau_{KBC}} \end{pmatrix}$$

Consumption of C

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then horizontally

$$\begin{pmatrix} J1 \\ J2 \\ J3 \\ J4 \\ J5 \\ J6 \\ J7 \\ J8 \end{pmatrix} := \left[F_{Deposits} \div \begin{pmatrix} \tau_{CKC} \\ \tau_{CKC} \\ \tau_{CCC} \\ \tau_{CCC} \\ \tau_{CAC} \\ \tau_{CAC} \\ \tau_{CEC} \\ \tau_{CEC} \end{pmatrix} \right] \rightarrow \begin{pmatrix} \frac{F_{DK1}(t)}{\tau_{CKC}} \\ \frac{F_{DK2}(t)}{\tau_{CKC}} \\ \frac{F_{DC1}(t)}{\tau_{CCC}} \\ \frac{F_{DC2}(t)}{\tau_{CCC}} \\ \frac{F_{DA1}(t)}{\tau_{CAC}} \\ \frac{F_{DA2}(t)}{\tau_{CAC}} \\ \frac{F_{DE1}(t)}{\tau_{CEC}} \\ \frac{F_{DE2}(t)}{\tau_{CEC}} \end{pmatrix}$$

$$\begin{pmatrix} J9 \\ J10 \end{pmatrix} := \left[NonF_{Deposits} \div \begin{pmatrix} \tau_{CWC} \\ \tau_{CBC} \end{pmatrix} \right] \rightarrow \begin{pmatrix} \frac{H_D(t)}{\tau_{CWC}} \\ \frac{B_I(t)}{\tau_{CBC}} \end{pmatrix}$$

Consumption of A

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then horizontally

$$\begin{pmatrix} K1 \\ K2 \\ K3 \\ K4 \\ K5 \\ K6 \\ K7 \\ K8 \end{pmatrix} := \overrightarrow{\left[F_{Deposits} \div \begin{pmatrix} \tau_{CKA} \\ \tau_{CKA} \\ \tau_{CCA} \\ \tau_{CCA} \\ \tau_{CAA} \\ \tau_{CAA} \\ \tau_{CEA} \\ \tau_{CEA} \end{pmatrix} \right]}$$

$$\begin{pmatrix} K9 \\ K10 \end{pmatrix} := \overrightarrow{\left[NonF_{Deposits} \div \begin{pmatrix} \tau_{CWA} \\ \tau_{CBA} \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \frac{H_D(t)}{\tau_{CWA}} \\ \frac{B_I(t)}{\tau_{CBA}} \end{pmatrix}$$

Consumption of E

$$\begin{pmatrix} L1 \\ L2 \\ L3 \\ L4 \\ L5 \\ L6 \\ L7 \\ L8 \end{pmatrix} := \overrightarrow{\left[F_{Deposits} \div \begin{pmatrix} \tau_{CKE} \\ \tau_{CKE} \\ \tau_{CCE} \\ \tau_{CCE} \\ \tau_{CAE} \\ \tau_{CAE} \\ \tau_{CEE} \\ \tau_{CEE} \end{pmatrix} \right]}$$

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then horizontally

$$\begin{pmatrix} L9 \\ L10 \end{pmatrix} := \left[\overrightarrow{NonF_{Deposits} \div \begin{pmatrix} \tau_{CWE} \\ \tau_{CBE} \end{pmatrix}} \right] \rightarrow \begin{pmatrix} \frac{H_D(t)}{\tau_{CWE}} \\ \frac{B_I(t)}{\tau_{CBE}} \end{pmatrix}$$

(M) Pay interest

$$\begin{pmatrix} M1 \\ M2 \\ M3 \\ M4 \\ M5 \\ M6 \\ M7 \\ M8 \end{pmatrix} := \begin{pmatrix} A1 \\ A2 \\ A3 \\ A4 \\ A5 \\ A6 \\ A7 \\ A8 \end{pmatrix} \rightarrow \begin{pmatrix} r_L \cdot F_{LK1}(t) \\ r_L \cdot F_{LK2}(t) \\ r_L \cdot F_{LC1}(t) \\ r_L \cdot F_{LC2}(t) \\ r_L \cdot F_{LA1}(t) \\ r_L \cdot F_{LA2}(t) \\ r_L \cdot F_{LE1}(t) \\ r_L \cdot F_{LE2}(t) \end{pmatrix}$$

(N) Repay Loans

Lay pages vertically to p. 37

then horizontally

$$\begin{pmatrix} N1 \\ N2 \\ N3 \\ N4 \\ N5 \\ N6 \\ N7 \\ N8 \end{pmatrix} := \overrightarrow{\left[F_{Loans} \div \begin{pmatrix} \tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m) \\ \tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m) \\ \tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m) \\ \tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m) \\ \tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m) \\ \tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m) \\ \tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m) \\ \tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m) \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \frac{F_{LK1}(t)}{\tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m)} \\ \frac{F_{LK2}(t)}{\tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m)} \\ \frac{F_{LC1}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} \\ \frac{F_{LC2}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} \\ \frac{F_{LA1}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} \\ \frac{F_{LA2}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} \\ \frac{F_{LE1}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} \\ \frac{F_{LE2}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} \end{pmatrix}$$

(O) Recycle Reserves

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then horizontally

$$\begin{pmatrix} O1 \\ O2 \\ O3 \\ O4 \\ O5 \\ O6 \\ O7 \\ O8 \end{pmatrix} := \overrightarrow{\left[B_R(t) \div \begin{pmatrix} \tau_{RR}(pr_K(t), rr_0, rr_\tau, rr_s, rr_m) \\ \tau_{RR}(pr_K(t), rr_0, rr_\tau, rr_s, rr_m) \\ \tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m) \\ \tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m) \\ \tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m) \\ \tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m) \\ \tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m) \\ \tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m) \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \frac{B_R(t)}{\tau_{RR}(pr_K(t), rr_0, rr_\tau, rr_s, rr_m)} \\ \frac{B_R(t)}{\tau_{RR}(pr_K(t), rr_0, rr_\tau, rr_s, rr_m)} \\ \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)} \\ \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)} \\ \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)} \\ \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)} \\ \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)} \\ \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)} \end{pmatrix}$$

(P) New Money

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then horizontally

$$\begin{pmatrix} P1 \\ P2 \\ P3 \\ P4 \\ P5 \\ P6 \\ P7 \\ P8 \end{pmatrix} := \overrightarrow{\left[F_{Loans} \div \begin{pmatrix} \tau_{NM}(pr_K(t), nm_0, nm_\tau, nm_s, nm_m) \\ \tau_{NM}(pr_K(t), nm_0, nm_\tau, nm_s, nm_m) \\ \tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m) \\ \tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m) \\ \tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m) \\ \tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m) \\ \tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m) \\ \tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m) \end{pmatrix} \right]} \rightarrow \begin{pmatrix} \frac{F_{LK1}(t)}{\tau_{NM}(pr_K(t), nm_0, nm_\tau, nm_s, nm_m)} \\ \frac{F_{LK2}(t)}{\tau_{NM}(pr_K(t), nm_0, nm_\tau, nm_s, nm_m)} \\ \frac{F_{LC1}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} \\ \frac{F_{LC2}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} \\ \frac{F_{LA1}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} \\ \frac{F_{LA2}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} \\ \frac{F_{LE1}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} \\ \frac{F_{LE2}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} \end{pmatrix}$$

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then horizontally

$S_1 :=$

"Type"	0	1	1	1	1	1	1	1	1	−1
"Name"	"BR"	"LK1"	"LK2"	"LC1"	"LC2"	"LA1"	"LA2"	"LE1"	"LE2"	"DK1"
"Symbol"	$B_R(t)$	$F_{LK1}(t)$	$F_{LK2}(t)$	$F_{LC1}(t)$	$F_{LC2}(t)$	$F_{LA1}(t)$	$F_{LA2}(t)$	$F_{LE1}(t)$	$F_{LE2}(t)$	$F_{DK1}(t)$
"Compound Interest"	0	A1	A2	A3	A4	A5	A6	A7	A8	0
"Deposit Interest"	0	0	0	0	0	0	0	0	0	B1
"Wages"	0	0	0	0	0	0	0	0	0	−C1
"Household Interest"	0	0	0	0	0	0	0	0	0	0
"Investment Demand for K"	0	0	0	0	0	0	0	0	0	(−E1 + E2) + (E3 + E5 + E
"Intersectoral Demand for C"	0	0	0	0	0	0	0	0	0	−F1
"Intersectoral Demand for A"	0	0	0	0	0	0	0	0	0	−G1
"Intersectoral Demand for E"	0	0	0	0	0	0	0	0	0	−H1
"Consumption K"	0	0	0	0	0	0	0	0	0	$(-I1 + I2) + (I3 + I5 + I7) + \frac{I9}{}$
"Consumption C"	0	0	0	0	0	0	0	0	0	−J1
"Consumption A"	0	0	0	0	0	0	0	0	0	−K1
"Consumption E"	0	0	0	0	0	0	0	0	0	−L1
"Pay Interest"	0	−M1	−M2	−M3	−M4	−M5	−M6	−M7	−M8	−M1
"Repay Loans"	N1 + N2 + N3 + N4 + N5 + N6 + N7 + N8	−N1	−N2	−N3	−N4	−N5	−N6	−N7	−N8	−N1
"Recycle Reserves"	−(O1 + O2 + O3 + O4 + O5 + O6 + O7 + O8)	O1	O2	O3	O4	O5	O6	O7	O8	O1
"New Money"	0	P1	P2	P3	P4	P5	P6	P7	P8	P1

FinancialODEs := SystemODEs(S_1)

$$\text{FinancialODEs}_0 \rightarrow \frac{d}{dt}B_R(t) = \frac{F_{LA1}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LA2}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LC1}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LC2}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LE1}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{}{\tau_{RL}(pr}$$

$$\text{FinancialODEs}_1 \to \frac{d}{dt}F_{LK1}(t) = \frac{F_{LK1}(t)}{\tau_{NM}(pr_K(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LK1}(t)}{\tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_K(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\text{FinancialODEs}_2 \to \frac{d}{dt}F_{LK2}(t) = \frac{F_{LK2}(t)}{\tau_{NM}(pr_K(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LK2}(t)}{\tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_K(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\text{FinancialODEs}_3 \to \frac{d}{dt}F_{LC1}(t) = \frac{F_{LC1}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LC1}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\text{FinancialODEs}_4 \to \frac{d}{dt}F_{LC2}(t) = \frac{F_{LC2}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LC2}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\text{FinancialODEs}_5 \to \frac{d}{dt}F_{LA1}(t) = \frac{F_{LA1}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LA1}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\text{FinancialODEs}_6 \to \frac{d}{dt}F_{LA2}(t) = \frac{F_{LA2}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LA2}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\text{FinancialODEs}_7 \to \frac{d}{dt}F_{LE1}(t) = \frac{F_{LE1}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LE1}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\text{FinancialODEs}_8 \to \frac{d}{dt}F_{LE2}(t) = \frac{F_{LE2}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LE2}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\text{FinancialODEs}_9 \to \frac{d}{dt}F_{DK1}(t) = \frac{F_{DA1}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} - r_L \cdot F_{LK1}(t) + \frac{F_{DC1}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} + \frac{F_{DE1}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{DK1}(t)}{\tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m)} +$$

$$\text{FinancialODEs}_{10} \to \frac{d}{dt}F_{DK2}(t) = \frac{F_{DA2}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} - r_L \cdot F_{LK2}(t) + \frac{F_{DC2}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} + \frac{F_{DE2}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} + \frac{F_{DK1}(t)}{\tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m)} -$$

$$\text{FinancialODEs}_{11} \to \frac{d}{dt}F_{DC1}(t) = \frac{F_{LC1}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DC1}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LC1}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LC1}(t) + \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{C1}(t) \cdot V$$

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then horizontally

$$\text{FinancialODEs}_{12} \to \frac{d}{dt}F_{DC2}(t) = \frac{F_{LC2}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DC2}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LC2}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LC2}(t) + \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{C2}(t) \cdot W$$

$$\text{FinancialODEs}_{13} \to \frac{d}{dt}F_{DA1}(t) = \frac{F_{LA1}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DA1}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LA1}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LA1}(t) + \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{A1}(t) \cdot W$$

$$\text{FinancialODEs}_{14} \to \frac{d}{dt}F_{DA2}(t) = \frac{F_{LA2}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DA2}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LA2}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LA2}(t) + \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{A2}(t) \cdot W$$

$$\text{FinancialODEs}_{15} \to \frac{d}{dt}F_{DE1}(t) = \frac{F_{LE1}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DE1}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LE1}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LE1}(t) + \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{E1}(t) \cdot W$$

$$\text{FinancialODEs}_{16} \to \frac{d}{dt}F_{DE2}(t) = \frac{F_{LE2}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DE2}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LE2}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LE2}(t) + \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{E2}(t) \cdot W$$

$$\text{FinancialODEs}_{17} \to \frac{d}{dt}H_D(t) = L_{A1}(t) \cdot W_M(t) + L_{A2}(t) \cdot W_M(t) + L_{C1}(t) \cdot W_M(t) + L_{C2}(t) \cdot W_M(t) + L_{E1}(t) \cdot W_M(t) + L_{E2}(t) \cdot W_M(t) + L_{K1}(t) \cdot W_M(t) + L_{K2}(t) \cdot W_M(t) - \frac{H_D(t)}{\tau_{CWA}} - \frac{H_D(t)}{\tau_{CWC}} - \frac{H_D}{\tau_{CW}}$$

$$\text{FinancialODEs}_{18} \to \frac{d}{dt}B_I(t) = r_L \cdot F_{LA1}(t) + r_L \cdot F_{LA2}(t) + r_L \cdot F_{LC1}(t) + r_L \cdot F_{LC2}(t) + r_L \cdot F_{LE1}(t) + r_L \cdot F_{LE2}(t) + r_L \cdot F_{LK1}(t) + r_L \cdot F_{LK2}(t) - \frac{B_I(t)}{\tau_{CBA}} - \frac{B_I(t)}{\tau_{CBC}} - \frac{B_I(t)}{\tau_{CBE}} - \frac{B_I(t)}{\tau_{KBC}} - F_{DA1}(t) \cdot r_D(F_I$$

Model Derivation--Financial Component

Production Component

A first step is to define the rate of profit at the sectoral level, which determines several of the financial flows above

$$\text{Profit} = \text{Price} \cdot \text{Output} - (\text{Wages} + \text{IntermediateGoods}) - \text{NetInterest}$$

$$\text{RateofProfit} = \frac{\text{Profit}}{\text{ValueOfCapital}}$$

In this 4 sector model there are 4 rates of profit (replicated in each of the two halves of each sector)

$$\text{Profit}(t) := \begin{pmatrix} \text{pr}_K(t) \\ \text{pr}_C(t) \\ \text{pr}_A(t) \\ \text{pr}_E(t) \end{pmatrix} \rightarrow \begin{pmatrix} \text{pr}_K(t) \\ \text{pr}_C(t) \\ \text{pr}_A(t) \\ \text{pr}_E(t) \end{pmatrix}$$

Because I spell out quantities, prices etc for each half sector, I need to make these profit calculations (which are in terms of an overall sector since this is a ratio) with the sectors specified.

$$\text{Prices}(t) := \begin{pmatrix} P_K(t) \\ P_C(t) \\ P_A(t) \\ P_E(t) \end{pmatrix}$$

$$\text{Output}(t) := \begin{pmatrix} Q_{K1}(t) + Q_{K2}(t) \\ Q_{C1}(t) + Q_{C2}(t) \\ Q_{A1}(t) + Q_{A2}(t) \\ Q_{E1}(t) + Q_{E2}(t) \end{pmatrix} \rightarrow \begin{pmatrix} Q_{K1}(t) + Q_{K2}(t) \\ Q_{C1}(t) + Q_{C2}(t) \\ Q_{A1}(t) + Q_{A2}(t) \\ Q_{E1}(t) + Q_{E2}(t) \end{pmatrix}$$

$$\overrightarrow{(\text{Prices}(t) \cdot \text{Output}(t))} \rightarrow \begin{bmatrix} P_K(t) \cdot (Q_{K1}(t) + Q_{K2}(t)) \\ P_C(t) \cdot (Q_{C1}(t) + Q_{C2}(t)) \\ P_A(t) \cdot (Q_{A1}(t) + Q_{A2}(t)) \\ P_E(t) \cdot (Q_{E1}(t) + Q_{E2}(t)) \end{bmatrix}$$

$$\text{Wages}(t) := W_M(t) \cdot \begin{pmatrix} L_{K1}(t) + L_{K2}(t) \\ L_{C1}(t) + L_{C2}(t) \\ L_{A1}(t) + L_{A2}(t) \\ L_{E1}(t) + L_{E2}(t) \end{pmatrix} \rightarrow \begin{bmatrix} W_M(t) \cdot (L_{K1}(t) + L_{K2}(t)) \\ W_M(t) \cdot (L_{C1}(t) + L_{C2}(t)) \\ W_M(t) \cdot (L_{A1}(t) + L_{A2}(t)) \\ W_M(t) \cdot (L_{E1}(t) + L_{E2}(t)) \end{bmatrix}$$

$$\overrightarrow{(\text{Prices}(t) \cdot \text{Output}(t))} - \text{Wages}(t) \rightarrow \begin{bmatrix} P_K(t) \cdot (Q_{K1}(t) + Q_{K2}(t)) - W_M(t) \cdot (L_{K1}(t) + L_{K2}(t)) \\ P_C(t) \cdot (Q_{C1}(t) + Q_{C2}(t)) - W_M(t) \cdot (L_{C1}(t) + L_{C2}(t)) \\ P_A(t) \cdot (Q_{A1}(t) + Q_{A2}(t)) - W_M(t) \cdot (L_{A1}(t) + L_{A2}(t)) \\ P_E(t) \cdot (Q_{E1}(t) + Q_{E2}(t)) - W_M(t) \cdot (L_{E1}(t) + L_{E2}(t)) \end{bmatrix}$$

$$\text{NetInterest}(t) := r_L \cdot \begin{pmatrix} F_{LK1}(t) + F_{LK2}(t) \\ F_{LC1}(t) + F_{LC2}(t) \\ F_{LA1}(t) + F_{LA2}(t) \\ F_{LE1}(t) + F_{LE2}(t) \end{pmatrix} - \overrightarrow{\left[r_D \left(\begin{pmatrix} F_{DK1}(t) + F_{DK2}(t) \\ F_{DC1}(t) + F_{DC2}(t) \\ F_{DA1}(t) + F_{DA2}(t) \\ F_{DE1}(t) + F_{DE2}(t) \end{pmatrix} \cdot \begin{pmatrix} F_{DK1}(t) + F_{DK2}(t) \\ F_{DC1}(t) + F_{DC2}(t) \\ F_{DA1}(t) + F_{DA2}(t) \\ F_{DE1}(t) + F_{DE2}(t) \end{pmatrix} \right) \right]} \rightarrow \begin{bmatrix} r_L \cdot (F_{LK1}(t) + F_{LK2}(t)) - r_D (F_{DK1}(t) + F_{DK2}(t)) \cdot (F_{DK1}(t) + F_{DK2}(t)) \\ r_L \cdot (F_{LC1}(t) + F_{LC2}(t)) - r_D (F_{DC1}(t) + F_{DC2}(t)) \cdot (F_{DC1}(t) + F_{DC2}(t)) \\ r_L \cdot (F_{LA1}(t) + F_{LA2}(t)) - r_D (F_{DA1}(t) + F_{DA2}(t)) \cdot (F_{DA1}(t) + F_{DA2}(t)) \\ r_L \cdot (F_{LE1}(t) + F_{LE2}(t)) - r_D (F_{DE1}(t) + F_{DE2}(t)) \cdot (F_{DE1}(t) + F_{DE2}(t)) \end{bmatrix}$$

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then horizontally

$$\overrightarrow{(\text{Prices}(t)\cdot\text{Output}(t))} - \text{Wages}(t) - \text{NetInterest}(t) \rightarrow \begin{bmatrix} r_D\left(F_{DK1}(t)+F_{DK2}(t)\right)\cdot\left(F_{DK1}(t)+F_{DK2}(t)\right) - r_L\cdot\left(F_{LK1}(t)+F_{LK2}(t)\right) - W_M(t)\cdot\left(L_{K1}(t)+L_{K2}(t)\right) + P_K(t)\cdot\left(Q_{K1}(t)+Q_{K2}(t)\right) \\ r_D\left(F_{DC1}(t)+F_{DC2}(t)\right)\cdot\left(F_{DC1}(t)+F_{DC2}(t)\right) - r_L\cdot\left(F_{LC1}(t)+F_{LC2}(t)\right) - W_M(t)\cdot\left(L_{C1}(t)+L_{C2}(t)\right) + P_C(t)\cdot\left(Q_{C1}(t)+Q_{C2}(t)\right) \\ r_D\left(F_{DA1}(t)+F_{DA2}(t)\right)\cdot\left(F_{DA1}(t)+F_{DA2}(t)\right) - r_L\cdot\left(F_{LA1}(t)+F_{LA2}(t)\right) - W_M(t)\cdot\left(L_{A1}(t)+L_{A2}(t)\right) + P_A(t)\cdot\left(Q_{A1}(t)+Q_{A2}(t)\right) \\ r_D\left(F_{DE1}(t)+F_{DE2}(t)\right)\cdot\left(F_{DE1}(t)+F_{DE2}(t)\right) - r_L\cdot\left(F_{LE1}(t)+F_{LE2}(t)\right) - W_M(t)\cdot\left(L_{E1}(t)+L_{E2}(t)\right) + P_E(t)\cdot\left(Q_{E1}(t)+Q_{E2}(t)\right) \end{bmatrix}$$

$$\text{ValueOfCapital}(t) := P_K(t)\cdot\left[\begin{pmatrix} K_{K1}(t) \\ K_{C1}(t) \\ K_{A1}(t) \\ K_{E1}(t) \end{pmatrix} + \begin{pmatrix} K_{K2}(t) \\ K_{C2}(t) \\ K_{A2}(t) \\ K_{E2}(t) \end{pmatrix}\right] \rightarrow \begin{bmatrix} P_K(t)\cdot\left(K_{K1}(t)+K_{K2}(t)\right) \\ P_K(t)\cdot\left(K_{C1}(t)+K_{C2}(t)\right) \\ P_K(t)\cdot\left(K_{A1}(t)+K_{A2}(t)\right) \\ P_K(t)\cdot\left(K_{E1}(t)+K_{E2}(t)\right) \end{bmatrix}$$

$$\frac{\overrightarrow{(\text{Prices}(t)\cdot\text{Output}(t))} - \text{Wages}(t) - \text{NetInterest}(t)}{\text{ValueOfCapital}(t)} \rightarrow \begin{bmatrix} \dfrac{r_D\left(F_{DK1}(t)+F_{DK2}(t)\right)\cdot\left(F_{DK1}(t)+F_{DK2}(t)\right) - r_L\cdot\left(F_{LK1}(t)+F_{LK2}(t)\right) - W_M(t)\cdot\left(L_{K1}(t)+L_{K2}(t)\right) + P_K(t)\cdot\left(Q_{K1}(t)+Q_{K2}(t)\right)}{P_K(t)\cdot\left(K_{K1}(t)+K_{K2}(t)\right)} \\ \dfrac{r_D\left(F_{DC1}(t)+F_{DC2}(t)\right)\cdot\left(F_{DC1}(t)+F_{DC2}(t)\right) - r_L\cdot\left(F_{LC1}(t)+F_{LC2}(t)\right) - W_M(t)\cdot\left(L_{C1}(t)+L_{C2}(t)\right) + P_C(t)\cdot\left(Q_{C1}(t)+Q_{C2}(t)\right)}{P_K(t)\cdot\left(K_{C1}(t)+K_{C2}(t)\right)} \\ \dfrac{r_D\left(F_{DA1}(t)+F_{DA2}(t)\right)\cdot\left(F_{DA1}(t)+F_{DA2}(t)\right) - r_L\cdot\left(F_{LA1}(t)+F_{LA2}(t)\right) - W_M(t)\cdot\left(L_{A1}(t)+L_{A2}(t)\right) + P_A(t)\cdot\left(Q_{A1}(t)+Q_{A2}(t)\right)}{P_K(t)\cdot\left(K_{A1}(t)+K_{A2}(t)\right)} \\ \dfrac{r_D\left(F_{DE1}(t)+F_{DE2}(t)\right)\cdot\left(F_{DE1}(t)+F_{DE2}(t)\right) - r_L\cdot\left(F_{LE1}(t)+F_{LE2}(t)\right) - W_M(t)\cdot\left(L_{E1}(t)+L_{E2}(t)\right) + P_E(t)\cdot\left(Q_{E1}(t)+Q_{E2}(t)\right)}{P_K(t)\cdot\left(K_{E1}(t)+K_{E2}(t)\right)} \end{bmatrix}$$

Now intermediate goods purchases. Preferably a matrix equation should be used to derive these. The general inputs are

For one full sector at a time this is $\begin{pmatrix} \sigma_{KC} \\ \sigma_{CC} \\ \sigma_{AC} \\ \sigma_{EC} \end{pmatrix} \begin{pmatrix} \sigma_{KA} \\ \sigma_{CA} \\ \sigma_{AA} \\ \sigma_{EA} \end{pmatrix} \begin{pmatrix} \sigma_{KE} \\ \sigma_{CE} \\ \sigma_{AE} \\ \sigma_{EE} \end{pmatrix}$

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then horizontally

In matrix form (there are no intermediate purchases from the capital goods sector, since that's where investment goods are purchased) this is

$$M1 := \text{augment}\left[\begin{pmatrix}0\\0\\0\\0\end{pmatrix}, \begin{pmatrix}\sigma_{KC}\\\sigma_{CC}\\\sigma_{AC}\\\sigma_{EC}\end{pmatrix}, \begin{pmatrix}\sigma_{KA}\\\sigma_{CA}\\\sigma_{AA}\\\sigma_{EA}\end{pmatrix}, \begin{pmatrix}\sigma_{KE}\\\sigma_{CE}\\\sigma_{AE}\\\sigma_{EE}\end{pmatrix}\right] \rightarrow \begin{pmatrix}0 & \sigma_{KC} & \sigma_{KA} & \sigma_{KE}\\0 & \sigma_{CC} & \sigma_{CA} & \sigma_{CE}\\0 & \sigma_{AC} & \sigma_{AA} & \sigma_{AE}\\0 & \sigma_{EC} & \sigma_{EA} & \sigma_{EE}\end{pmatrix}$$

As a matrix this is

$$\text{IntermediateGoods}(t) := M1 \cdot \text{Wages}(t) \rightarrow \begin{bmatrix}\sigma_{KA}\cdot W_M(t)\cdot\left(L_{A1}(t)+L_{A2}(t)\right)+\sigma_{KC}\cdot W_M(t)\cdot\left(L_{C1}(t)+L_{C2}(t)\right)+\sigma_{KE}\cdot W_M(t)\cdot\left(L_{E1}(t)+L_{E2}(t)\right)\\\sigma_{CA}\cdot W_M(t)\cdot\left(L_{A1}(t)+L_{A2}(t)\right)+\sigma_{CC}\cdot W_M(t)\cdot\left(L_{C1}(t)+L_{C2}(t)\right)+\sigma_{CE}\cdot W_M(t)\cdot\left(L_{E1}(t)+L_{E2}(t)\right)\\\sigma_{AA}\cdot W_M(t)\cdot\left(L_{A1}(t)+L_{A2}(t)\right)+\sigma_{AC}\cdot W_M(t)\cdot\left(L_{C1}(t)+L_{C2}(t)\right)+\sigma_{AE}\cdot W_M(t)\cdot\left(L_{E1}(t)+L_{E2}(t)\right)\\\sigma_{EA}\cdot W_M(t)\cdot\left(L_{A1}(t)+L_{A2}(t)\right)+\sigma_{EC}\cdot W_M(t)\cdot\left(L_{C1}(t)+L_{C2}(t)\right)+\sigma_{EE}\cdot W_M(t)\cdot\left(L_{E1}(t)+L_{E2}(t)\right)\end{bmatrix}$$

$$\text{RateofProfit} = \frac{\text{Profit}}{\text{ValueOfCapital}} = \frac{\text{Price}\cdot\text{Output} - (\text{Wages} + \text{IntermediateGoods}) - \text{NetInterest}}{\text{ValueOfCapital}}$$

$$\text{RateOfProfit}(t) := \left[\frac{\overrightarrow{\overrightarrow{(\text{Prices}(t)\cdot\text{Output}(t))} - \text{Wages}(t) - \text{IntermediateGoods}(t) - \text{NetInterest}(t)}}{\text{ValueOfCapital}(t)}\right] \rightarrow \begin{bmatrix}-\dfrac{r_L\cdot\left(F_{LK1}(t)+F_{LK2}(t)\right)-r_D\left(F_{DK1}(t)+F_{DK2}(t)\right)\cdot\left(F_{DK1}(t)+F_{DK2}(t)\right)+W_M(t)\cdot\left(L_{K1}(t)+\right.}{}\\-\dfrac{r_L\cdot\left(F_{LC1}(t)+F_{LC2}(t)\right)-r_D\left(F_{DC1}(t)+F_{DC2}(t)\right)\cdot\left(F_{DC1}(t)+F_{DC2}(t)\right)+W_M(t)\cdot\left(L_{C1}(t)+\right.}{}\\-\dfrac{r_L\cdot\left(F_{LA1}(t)+F_{LA2}(t)\right)-r_D\left(F_{DA1}(t)+F_{DA2}(t)\right)\cdot\left(F_{DA1}(t)+F_{DA2}(t)\right)+W_M(t)\cdot\left(L_{A1}(t)+\right.}{}\\-\dfrac{r_L\cdot\left(F_{LE1}(t)+F_{LE2}(t)\right)-r_D\left(F_{DE1}(t)+F_{DE2}(t)\right)\cdot\left(F_{DE1}(t)+F_{DE2}(t)\right)+W_M(t)\cdot\left(L_{E1}(t)+\right.}{}\end{bmatrix}$$

Lay pages vertically to p. 37

then horizontally

$$\text{InitialRateOfProfit} := \text{RateOfProfit(t) substitute, t = 0} \rightarrow \begin{bmatrix} -\dfrac{L_{K1}(0)\cdot W_M(0) - P_K(0)\cdot Q_{K2}(0) - P_K(0)\cdot Q_{K1}(0) + L_{K2}(0)\cdot W_M(0) + r_L\cdot F_{LK1}(0) + r_L\cdot F_{LK2}(0) - F_{DK1}(0)\cdot r_D\left(F_{DK1}(0) + F_{DK2}(0)\right.}{} \\ -\dfrac{L_{C1}(0)\cdot W_M(0) - P_C(0)\cdot Q_{C2}(0) - P_C(0)\cdot Q_{C1}(0) + L_{C2}(0)\cdot W_M(0) + r_L\cdot F_{LC1}(0) + r_L\cdot F_{LC2}(0) - F_{DC1}(0)\cdot r_D\left(F_{DC1}(0) + F_{DC2}(0)\right.}{} \\ -\dfrac{L_{A1}(0)\cdot W_M(0) - P_A(0)\cdot Q_{A2}(0) - P_A(0)\cdot Q_{A1}(0) + L_{A2}(0)\cdot W_M(0) + r_L\cdot F_{LA1}(0) + r_L\cdot F_{LA2}(0) - F_{DA1}(0)\cdot r_D\left(F_{DA1}(0) + F_{DA2}(0)\right.}{} \\ -\dfrac{L_{E1}(0)\cdot W_M(0) - P_E(0)\cdot Q_{E2}(0) - P_E(0)\cdot Q_{E1}(0) + L_{E2}(0)\cdot W_M(0) + r_L\cdot F_{LE1}(0) + r_L\cdot F_{LE2}(0) - F_{DE1}(0)\cdot r_D\left(F_{DE1}(0) + F_{DE2}(0)\right.}{} \end{bmatrix}$$

Production Component

Behavioural Factors

All behaviour in this model is represented by nonlinear (exponential) functions that extrapolate current conditions forward, in keeping with Keynes's observation that in the context of fundamental uncertainty, expectations of the future tend to be projections forward of current conditions. The basic function used is a generalised exponential function that takes as arguments and (x,y) pair, the slope of the function at (x.y), and a minimum value to go from a functional input (the rate of employment for example in the case of wage setting) to a functional output (the rate of change of money wages).

In this version of the model all functional inputs are expressed in terms of percentages.

$$\text{genexp}\left(x, x_{val}, y_{val}, s_{val}, \min\right) \equiv \left[\left(y_{val} - \min\right)\cdot e^{\frac{s_{val}}{y_{val}-\min}\cdot\left(x - x_{val}\right)} + \min\right] \qquad \Xi\Xi := -.1, -0.09 .. 1.10$$

Phillips Curve relation

Inputs are the unemployment rate (x) and rate of change of money wages in percent per year at that point (y), a slope of the function at that point, and the maximum rate of fall of money wages in %/year. Since an exponential function can take any value as an input, an employment figure of greater than 100% is possible.

$$u_0 := 92\% \quad u_s := 1 \quad u_m := -4\% \qquad P_h\left(\lambda, u_0, u_s, u_m\right) := \text{genexp}\left(\lambda, u_0, 0, u_s, u_m\right)$$

Profit Rate investment time lag function

This takes a percent rate of profit (x) and time lag in years for doubling of the capital stock (y), the slope of the function at that point and a minimum time lag for doubling, and returns the time lag in years for doubling capital stock now.

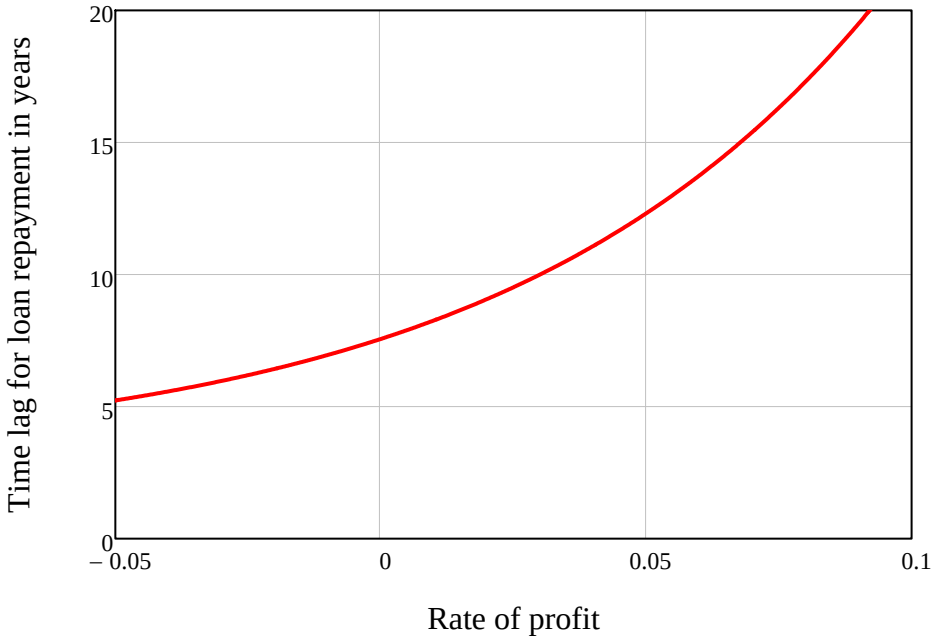
$$inv_0 := 3\% \; inv_\tau := 7 \; inv_s := -200 \; inv_m := 5 \qquad \tau_{pr}\left(pr, inv_0, inv_\tau, inv_s, inv_m\right) := \text{genexp}\left(pr, inv_0, inv_\tau, inv\right.$$

Behavioural Graphs

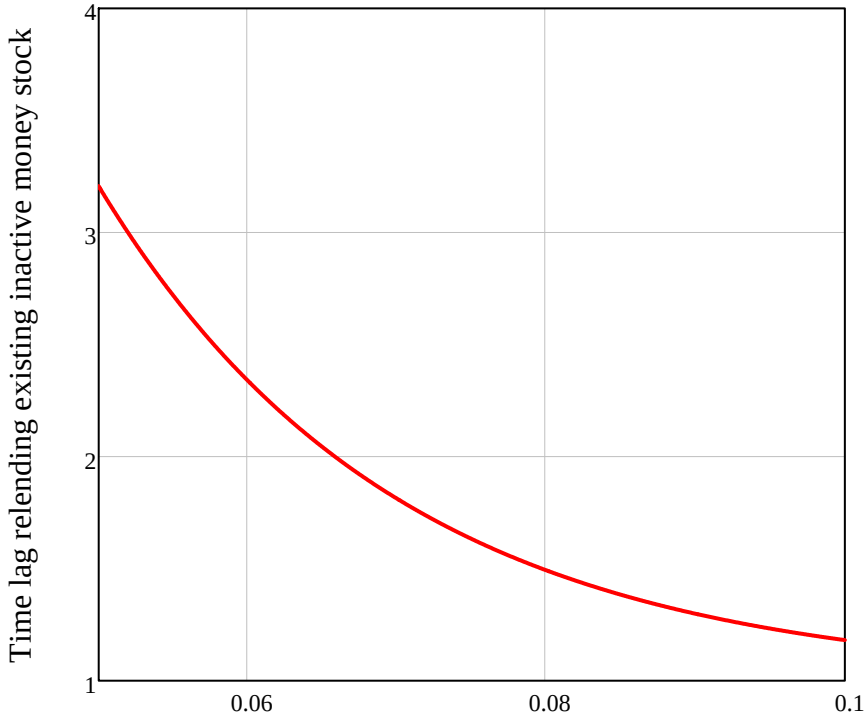
Wage Change Function

Investment time lag as function of rate of pro

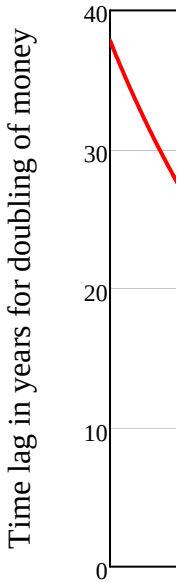
Loan repayment time lag as function of rate of profit



Money relending as function of rate of profit



Lag



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then horizontally

Behavioural Graphs

Parameters

Depreciation rate

$\gamma := 2\%$

Parameters Financial System

Interest Rates

$r_L := 5\%$

$r_D(x) := \text{if}\left(x > 0, 1\%, r_L\right)$ To allow for overdrafts since the outflows from FD accounts are no longer related to their existing levels but wages, etc.

Intermediate good purchases

$$\begin{pmatrix}\sigma_{KC}\\ \sigma_{CC}\\ \sigma_{AC}\\ \sigma_{EC}\end{pmatrix} := \begin{pmatrix}0.02\\ 0.05\\ 0.02\\ 0.03\end{pmatrix} \qquad \begin{pmatrix}\sigma_{KA}\\ \sigma_{CA}\\ \sigma_{AA}\\ \sigma_{EA}\end{pmatrix} := \begin{pmatrix}0.03\\ 0.02\\ 0.04\\ 0.05\end{pmatrix} \qquad \begin{pmatrix}\sigma_{KE}\\ \sigma_{CE}\\ \sigma_{AE}\\ \sigma_{EE}\end{pmatrix} := \begin{pmatrix}0.05\\ 0.02\\ 0.03\\ 0.04\end{pmatrix}$$

Consumption time lags

Capital Goods

$$\begin{pmatrix}\tau_{KKC}\\ \tau_{KCC}\\ \tau_{KAC}\\ \tau_{KEC}\end{pmatrix} := \begin{pmatrix}4\\ 4\\ 4\\ 4\end{pmatrix} \qquad \begin{pmatrix}\tau_{KWC}\\ \tau_{KBC}\end{pmatrix} := \begin{pmatrix}\infty\\ 4\end{pmatrix}$$

Consumer Goods

$$\begin{pmatrix}\tau_{CKC}\\ \tau_{CCC}\\ \tau_{CAC}\\ \tau_{CEC}\end{pmatrix} := \begin{pmatrix}3\\ 3\\ 3\\ 3\end{pmatrix} \qquad \begin{pmatrix}\tau_{CWC}\\ \tau_{CBC}\end{pmatrix} := \begin{pmatrix}\frac{1}{104}\\ 3\end{pmatrix}$$

Agriculture

$$\begin{pmatrix}\tau_{CKA}\\ \tau_{CCA}\\ \tau_{CAA}\\ \tau_{CEA}\end{pmatrix} := \begin{pmatrix}10\\ 10\\ 10\\ 10\end{pmatrix} \qquad \begin{pmatrix}\tau_{CWA}\\ \tau_{CBA}\end{pmatrix} := \begin{pmatrix}\frac{1}{52}\\ 10\end{pmatrix}$$

Energy

$$\begin{pmatrix}\tau_{CKE}\\ \tau_{CCE}\\ \tau_{CAE}\\ \tau_{CEE}\end{pmatrix} := \begin{pmatrix}4\\ 4\\ 4\\ 4\end{pmatrix} \qquad \begin{pmatrix}\tau_{CWE}\\ \tau_{CBE}\end{pmatrix} := \begin{pmatrix}\frac{1}{78}\\ 4\end{pmatrix}$$

Labour Productivity

$\alpha := 1\%$

Accelerator

$$\begin{pmatrix} v_K \\ v_C \\ v_A \\ v_E \end{pmatrix} := \begin{pmatrix} 3 \\ 3 \\ 3 \\ 3 \end{pmatrix}$$

Price setting lags

$$\begin{pmatrix} \tau_{PK} \\ \tau_{PC} \\ \tau_{PA} \\ \tau_{PE} \end{pmatrix} := \begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \end{pmatrix}$$

Quantity production lags

$$\begin{pmatrix} \tau_{QK} \\ \tau_{QC} \\ \tau_{QA} \\ \tau_{QE} \end{pmatrix} := \begin{pmatrix} \frac{1}{4} \\ \frac{1}{4} \\ \frac{1}{4} \\ \frac{1}{4} \end{pmatrix}$$

Labour employment lags

$$\begin{pmatrix} \tau_{LK} \\ \tau_{LC} \\ \tau_{LA} \\ \tau_{LE} \end{pmatrix} := \begin{pmatrix} \frac{1}{12} \\ \frac{1}{12} \\ \frac{1}{12} \\ \frac{1}{12} \end{pmatrix}$$

Population growth

$\beta := 1\%$

Parameters

Initial Conditions

Financial system

$Loan := 10000$

$B_{R0} := 10000$

$$S_W := \begin{pmatrix} \frac{1}{12} \\ \frac{1}{3} \\ \frac{1}{3} \\ \frac{1}{4} \end{pmatrix}$$

Sector weights in initial conditions

$\sum S_W = 1$

Capital goods

$F_{LK10} := \frac{S_{W_0}}{2} \cdot Loan = 416.667$

$F_{DK10} := F_{LK10}$

$F_{LK20} := \frac{S_{W_0}}{2} \cdot Loan = 416.667$

$F_{DK20} := F_{LK20}$

Consumer Goods

$F_{LC10} := \frac{S_{W_1}}{2} \cdot Loan = 1.667 \times 10^3$

$F_{DC10} := F_{LC10}$

$F_{LC20} := \frac{S_{W_1}}{2} \cdot Loan = 1.667 \times 10^3$

$F_{DC20} := F_{LC20}$

Agriculture

Energy

$F_{LA10} := \frac{S_{W_2}}{2} \cdot Loan = 1.667 \times 10^3$ $F_{LA20} := \frac{S_{W_2}}{2} \cdot Loan = 1.667 \times 10^3$ $F_{LE10} := \frac{S_{W_3}}{2} \cdot Loan = 1.25 \times 10^3$ $F_{LE20} := \frac{S_{W_3}}{2} \cdot Loan = 1.25 \times 10^3$

$F_{DA10} := F_{LK10}$ $F_{DA20} := F_{LK20}$ $F_{DE10} := F_{LC10}$ $F_{DE20} := F_{LC20}$

$$\text{Vars}(S_1)\ \text{substitute}, t = 0 \rightarrow \begin{pmatrix} B_R(0) \\ F_{LK1}(0) \\ F_{LK2}(0) \\ F_{LC1}(0) \\ F_{LC2}(0) \\ F_{LA1}(0) \\ F_{LA2}(0) \\ F_{LE1}(0) \\ F_{LE2}(0) \\ F_{DK1}(0) \\ F_{DK2}(0) \\ F_{DC1}(0) \\ F_{DC2}(0) \\ F_{DA1}(0) \\ F_{DA2}(0) \\ F_{DE1}(0) \\ F_{DE2}(0) \\ H_D(0) \\ B_I(0) \end{pmatrix}$$

Production system

Rates of surplus $\begin{pmatrix} s_K \\ s_C \\ s_A \\ s_E \end{pmatrix} := \begin{pmatrix} 40 \\ 40 \\ 40 \\ 40 \end{pmatrix} \cdot \% = \begin{pmatrix} 0.4 \\ 0.4 \\ 0.4 \\ 0.4 \end{pmatrix}$

Initial productivity $\begin{pmatrix} a_{K0} \\ a_{C0} \\ a_{A0} \\ a_{E0} \end{pmatrix} := \begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \end{pmatrix}$

Price Capital Goods Consumer Goods Agriculture Energy

$P_{K0} := 5$ $P_{C0} := 5$ $P_{A0} := 5$ $P_{E0} := 5$

Initial Capital $K0 := 10000$

$K_{K10} := S_{W_0} \cdot K0$ $K_{K20} := S_{W_0} \cdot K0$ $K_{C10} := S_{W_1} \cdot K0$ $K_{C20} := S_{W_1} \cdot K0$

$K_{A10} := S_{W_2} \cdot K0$ $K_{A20} := S_{W_2} \cdot K0$ $K_{E10} := S_{W_3} \cdot K0$ $K_{E20} := S_{W_3} \cdot K0$

Output

$$Q_{K10} := \frac{K_{K10}}{v_K} \quad Q_{K20} := \frac{K_{K20}}{v_K} \quad Q_{C10} := \frac{K_{C10}}{v_C} \quad Q_{C20} := \frac{K_{C20}}{v_C}$$

$$Q_{A10} := \frac{K_{A10}}{v_A} \quad Q_{A20} := \frac{K_{A20}}{v_A} \quad Q_{E10} := \frac{K_{E10}}{v_E} \quad Q_{E20} := \frac{K_{E20}}{v_E}$$

Labour

$$L_{K10} := \frac{Q_{K10}}{a_{K0}} \quad L_{K20} := \frac{Q_{K20}}{a_{K0}} \quad L_{C10} := \frac{Q_{C10}}{a_{C0}} \quad L_{C20} := \frac{Q_{C20}}{a_{C0}}$$

$$L_{A10} := \frac{Q_{A10}}{a_{A0}} \quad L_{A20} := \frac{Q_{A20}}{a_{A0}} \quad L_{E10} := \frac{Q_{E10}}{a_{E0}} \quad L_{E20} := \frac{Q_{E20}}{a_{E0}}$$

Employment $\lambda_0 := 95\%$

Initial Population $$Pop_0 := \frac{\left(L_{K10} + L_{K20} + L_{C10} + L_{C20} + L_{A10} + L_{A20} + L_{E10} + L_{E20}\right)}{\lambda_0} = 7.018 \times 10^3$$

Wage $W_{M0} := 3$ $Years := 100$ $\frac{W_{M0}}{a_{K0}\cdot(1 - s_K)} = 5$

$$pr_{K0} := -\frac{L_{K10}\cdot W_{M0} - P_{K0}\cdot Q_{K20} - P_{K0}\cdot Q_{K10} + L_{K20}\cdot W_{M0} + r_L\cdot F_{LK10} + r_L\cdot F_{LK20} - F_{DK10}\cdot r_D(F_{DK10} + F_{DK20}) - F_{DK20}\cdot r_D(F_{DK10} + F_{DK20}) + \sigma_{KA}\cdot L_{A10}\cdot W_{M0} + \sigma_{KA}\cdot L_{A20}\cdot W}{P_{K0}\cdot(K_{K10} + K_{K20})}$$

$$pr_{C0} := -\frac{L_{C10}\cdot W_{M0} - P_{C0}\cdot Q_{C20} - P_{C0}\cdot Q_{C10} + L_{C20}\cdot W_{M0} + r_L\cdot F_{LC10} + r_L\cdot F_{LC20} - F_{DC10}\cdot r_D(F_{DC10} + F_{DC20}) - F_{DC20}\cdot r_D(F_{DC10} + F_{DC20}) + \sigma_{CA}\cdot L_{A10}\cdot W_{M0} + \sigma_{CA}\cdot L_{A20}\cdot W_{M0}}{P_{K0}\cdot(K_{C10} + K_{C20})}$$

$$pr_{A0} := -\frac{L_{A10}\cdot W_{M0} - P_{A0}\cdot Q_{A20} - P_{A0}\cdot Q_{A10} + L_{A20}\cdot W_{M0} + r_L\cdot F_{LA10} + r_L\cdot F_{LA20} - F_{DA10}\cdot r_D(F_{DA10} + F_{DA20}) - F_{DA20}\cdot r_D(F_{DA10} + F_{DA20}) + \sigma_{AA}\cdot L_{A10}\cdot W_{M0} + \sigma_{AA}\cdot L_{A20}\cdot W}{P_{K0}\cdot(K_{A10} + K_{A20})}$$

$$pr_{E0} := -\frac{L_{E10}\cdot W_{M0} - P_{E0}\cdot Q_{E20} - P_{E0}\cdot Q_{E10} + L_{E20}\cdot W_{M0} + r_L\cdot F_{LE10} + r_L\cdot F_{LE20} - F_{DE10}\cdot r_D(F_{DE10} + F_{DE20}) - F_{DE20}\cdot r_D(F_{DE10} + F_{DE20}) + \sigma_{EA}\cdot L_{A10}\cdot W_{M0} + \sigma_{EA}\cdot L_{A20}\cdot W_{M0} -}{P_{K0}\cdot(K_{E10} + K_{E20})}$$

Initial Conditions

ODE Simulation

Given

FinancialSystem

$$\frac{d}{dt}B_R(t) = \frac{F_{LA1}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LA2}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LC1}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LC2}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LE1}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LE2}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m}$$

$$\frac{d}{dt}F_{LK1}(t) = \frac{F_{LK1}(t)}{\tau_{NM}(pr_K(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LK1}(t)}{\tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_K(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\frac{d}{dt}F_{LK2}(t) = \frac{F_{LK2}(t)}{\tau_{NM}(pr_K(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LK2}(t)}{\tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_K(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\frac{d}{dt}F_{LC1}(t) = \frac{F_{LC1}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LC1}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\frac{d}{dt}F_{LC2}(t) = \frac{F_{LC2}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LC2}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\frac{d}{dt}F_{LA1}(t) = \frac{F_{LA1}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LA1}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\frac{d}{dt}F_{LA2}(t) = \frac{F_{LA2}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LA2}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\frac{d}{dt}F_{LE1}(t) = \frac{F_{LE1}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LE1}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\frac{d}{dt}F_{LE2}(t) = \frac{F_{LE2}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{LE2}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)}$$

$$\frac{d}{dt}F_{DK1}(t) = \frac{F_{DA1}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} - r_L \cdot F_{LK1}(t) + \frac{F_{DC1}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} + \frac{F_{DE1}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{DK1}(t)}{\tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m)} + \frac{F_{DK2}(t}{\tau_{pr}(pr_K(t), inv_0, inv}$$

$$\frac{d}{dt}F_{DK2}(t) = \frac{F_{DA2}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} - r_L \cdot F_{LK2}(t) + \frac{F_{DC2}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} + \frac{F_{DE2}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} + \frac{F_{DK1}(t)}{\tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{DK2}(t}{\tau_{pr}(pr_K(t), inv_0, inv}$$

$$\frac{d}{dt}F_{DC1}(t) = \frac{F_{LC1}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DC1}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LC1}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LC1}(t) + \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{C1}(t) \cdot W_M(t) + \frac{B_I(t)}{2 \cdot \tau_{CBC}} +$$

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then horizontally

$$\frac{d}{dt}F_{DC2}(t) = \frac{F_{LC2}(t)}{\tau_{NM}(pr_C(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DC2}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LC2}(t)}{\tau_{RL}(pr_C(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LC2}(t) + \frac{B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{C2}(t) \cdot W_M(t) + \frac{B_I(t)}{2 \cdot \tau_{CBC}} +$$

$$\frac{d}{dt}F_{DA1}(t) = \frac{F_{LA1}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DA1}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LA1}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LA1}(t) + \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{A1}(t) \cdot W_M(t) + \frac{B_I(t)}{2 \cdot \tau_{CBA}} -$$

$$\frac{d}{dt}F_{DA2}(t) = \frac{F_{LA2}(t)}{\tau_{NM}(pr_A(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DA2}(t)}{\tau_{pr}(pr_A(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LA2}(t)}{\tau_{RL}(pr_A(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LA2}(t) + \frac{B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{A2}(t) \cdot W_M(t) + \frac{B_I(t)}{2 \cdot \tau_{CBA}} +$$

$$\frac{d}{dt}F_{DE1}(t) = \frac{F_{LE1}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DE1}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LE1}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LE1}(t) + \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{E1}(t) \cdot W_M(t) + \frac{B_I(t)}{2 \cdot \tau_{CBE}} + F -$$

$$\frac{d}{dt}F_{DE2}(t) = \frac{F_{LE2}(t)}{\tau_{NM}(pr_E(t), nm_0, nm_\tau, nm_s, nm_m)} - \frac{F_{DE2}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m)} - \frac{F_{LE2}(t)}{\tau_{RL}(pr_E(t), lr_0, lr_\tau, lr_s, lr_m)} - r_L \cdot F_{LE2}(t) + \frac{B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)} - L_{E2}(t) \cdot W_M(t) + \frac{B_I(t)}{2 \cdot \tau_{CBE}} + F -$$

$$\frac{d}{dt}H_D(t) = L_{A1}(t) \cdot W_M(t) + L_{A2}(t) \cdot W_M(t) + L_{C1}(t) \cdot W_M(t) + L_{C2}(t) \cdot W_M(t) + L_{E1}(t) \cdot W_M(t) + L_{E2}(t) \cdot W_M(t) + L_{K1}(t) \cdot W_M(t) + L_{K2}(t) \cdot W_M(t) - \frac{H_D(t)}{\tau_{CWA}} - \frac{H_D(t)}{\tau_{CWC}} - \frac{H_D(t)}{\tau_{CWE}} - \frac{H_D(t)}{\tau_{KWC}} + H_D($$

$$\frac{d}{dt}B_I(t) = r_L \cdot F_{LA1}(t) + r_L \cdot F_{LA2}(t) + r_L \cdot F_{LC1}(t) + r_L \cdot F_{LC2}(t) + r_L \cdot F_{LE1}(t) + r_L \cdot F_{LE2}(t) + r_L \cdot F_{LK1}(t) + r_L \cdot F_{LK2}(t) - \frac{B_I(t)}{\tau_{CBA}} - \frac{B_I(t)}{\tau_{CBC}} - \frac{B_I(t)}{\tau_{CBE}} - \frac{B_I(t)}{\tau_{KBC}} - F_{DA1}(t) \cdot r_D\left(F_{DA1}(t)\right) - F_{DA2}(t) \cdot r_I$$

Production system

Capital 1

$$K_{K1}(0) = K_{K10}$$

Capital Stock

$$\frac{d}{dt}K_{K1}(t) = \frac{F_{DK1}(t)}{\tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m) \cdot P_K(t)} - \gamma \cdot K_{K1}(t)$$

Output

$$Q_{K1}(0) = Q_{K10}$$

$$\frac{d}{dt}Q_{K1}(t) = \frac{-1}{\tau_{QK}} \cdot \left[Q_{K1}(t) - \frac{1}{v_K} \cdot \left(K_{K1}(t) \right) \right]$$

Capital 2

$$K_{K2}(0) = K_{K20}$$

$$K_{K2}(t) = \frac{F_{DK2}(t)}{\tau_{pr}(pr_K(t), inv_0, inv_\tau, inv_s, inv_m) \cdot P_K(t)} - \gamma \cdot K_{K2}(t)$$

$$Q_{K2}(0) = Q_{K20}$$

$$\frac{d}{dt}Q_{K2}(t) = \frac{-1}{\tau_{QK}} \cdot \left[Q_{K2}(t) - \frac{1}{v_K} \cdot \left(K_{K2}(t) \right) \right]$$

Consumption 1

$$K_{C1}(0) = K_{C10}$$

$$\frac{d}{dt}K_{C1}(t) = \frac{F_{DC1}(t)}{\tau_{pr}(pr_C(t), inv_0, inv_\tau, inv_s, inv_r}$$

$$Q_{C1}(0) = Q_{C10}$$

$$\frac{d}{dt}Q_{C1}(t) = \frac{-1}{\tau_{QC}} \cdot \left[Q_{C1}(t) - \frac{1}{v_C} \cdot \left(K_{C1}(t) \right) \right]$$

Lay pages vertically to p. 37

then horizontally

Employment $L_{K1}(0) = L_{K10}$ $L_{K2}(0) = L_{K20}$ $L_{C1}(0) = L_{C10}$

$$\frac{d}{dt}L_{K1}(t) = \frac{-1}{\tau_{LK}}\cdot\left(L_{K1}(t) - \frac{Q_{K1}(t)}{a_K(t)}\right) \qquad \frac{d}{dt}L_{K2}(t) = \frac{-1}{\tau_{LK}}\cdot\left(L_{K2}(t) - \frac{Q_{K2}(t)}{a_K(t)}\right) \qquad \frac{d}{dt}L_{C1}(t) = \frac{-1}{\tau_{LC}}\cdot\left(L_{C1}(t) - \frac{Q_{C1}(t)}{a_C(t)}\right)$$

Prices $P_K(0) = P_{K0}$ $P_C(0) = P_{C0}$

$$\frac{d}{dt}P_K(t) = \frac{-1}{\tau_{PK}}\cdot\left[P_K(t) - \frac{W_M(t)}{a_K(t)\cdot\left(1 - s_K\right)}\right] \qquad \frac{d}{dt}P_C(t) = \frac{-1}{\tau_{PC}}\cdot\left[P_C(t) - \frac{W_M(t)}{a_C(t)\cdot\left(1 - s_C\right)}\right]$$

Wages $W_M(0) = W_{M0}$ $\frac{d}{dt}W_M(t) = P_h\left(\lambda(t), u_0, u_s, u_m\right)\cdot W_M(t)$

Employment Rate $\lambda(0) = \lambda_0$ $\lambda(t) = \frac{L_{K1}(t) + L_{K2}(t) + L_{C1}(t) + L_{C2}(t) + L_{A1}(t) + L_{A2}(t) + L_{E1}(t) + L_{E2}(t)}{Pop(t)}$

Technical Change $\frac{d}{dt}a_K(t) = \alpha\cdot a_K(t)$ $a_K(0) = a_{K0}$ $\frac{d}{dt}a_C(t) = \alpha\cdot a_C(t)$ $a_C(0)$

Population Growth $\frac{d}{dt}Pop(t) = \beta\cdot Pop(t)$ $Pop(0) = Pop_0$

Aggregate Sectoral Capital Stock

Capital	Consumer	Agriculture	Energy
$K_K(0) = K_{K10} + K_{K20}$	$K_C(0) = K_{C10} + K_{C20}$	$K_A(0) = K_{A10} + K_{A20}$	$K_E(0) = K_{E10} + K_{E20}$
$K_K(t) = K_{K1}(t) + K_{K2}(t)$	$K_C(t) = K_{C1}(t) + K_{C2}(t)$	$K_A(t) = K_{A1}(t) + K_{A2}(t)$	$K_E(t) = K_{E1}(t) + K_{E2}(t)$

Rates of profit

$$pr_K(t) = -\frac{r_L\cdot\left(F_{LK1}(t) + F_{LK2}(t)\right) - r_D\left(F_{DK1}(t) + F_{DK2}(t)\right)\cdot\left(F_{DK1}(t) + F_{DK2}(t)\right) + W_M(t)\cdot\left(L_{K1}(t) + L_{K2}(t)\right) - P_K(t)\cdot\left(Q_{K1}(t) + Q_{K2}(t)\right) + \sigma_{KA}\cdot W_M(t)\cdot\left(L_{A1}(t) + L_{A2}(t)\right) + \sigma_{KC}\cdot W_M(t)\cdot\left(L_C}{P_K(t)\cdot\left(K_{K1}(t) + K_{K2}(t)\right)}$$

$$pr_K(0) = pr_{K0}$$

$$pr_C(t) = -\frac{r_L\cdot\left(F_{LC1}(t) + F_{LC2}(t)\right) - r_D\left(F_{DC1}(t) + F_{DC2}(t)\right)\cdot\left(F_{DC1}(t) + F_{DC2}(t)\right) + W_M(t)\cdot\left(L_{C1}(t) + L_{C2}(t)\right) - P_C(t)\cdot\left(Q_{C1}(t) + Q_{C2}(t)\right) + \sigma_{CA}\cdot W_M(t)\cdot\left(L_{A1}(t) + L_{A2}(t)\right) + \sigma_{CC}\cdot W_M(t)\cdot\left(L_C\right.}{P_K(t)\cdot\left(K_{C1}(t) + K_{C2}(t)\right)}$$

$$pr_C(0) = pr_{C0}$$

$$pr_A(t) = -\frac{r_L\cdot\left(F_{LA1}(t) + F_{LA2}(t)\right) - r_D\left(F_{DA1}(t) + F_{DA2}(t)\right)\cdot\left(F_{DA1}(t) + F_{DA2}(t)\right) + W_M(t)\cdot\left(L_{A1}(t) + L_{A2}(t)\right) - P_A(t)\cdot\left(Q_{A1}(t) + Q_{A2}(t)\right) + \sigma_{AA}\cdot W_M(t)\cdot\left(L_{A1}(t) + L_{A2}(t)\right) + \sigma_{AC}\cdot W_M(t)\cdot\left(L\right.}{P_K(t)\cdot\left(K_{A1}(t) + K_{A2}(t)\right)}$$

$$pr_A(0) = pr_{A0}$$

$$pr_E(t) = -\frac{r_L\cdot\left(F_{LE1}(t) + F_{LE2}(t)\right) - r_D\left(F_{DE1}(t) + F_{DE2}(t)\right)\cdot\left(F_{DE1}(t) + F_{DE2}(t)\right) + W_M(t)\cdot\left(L_{E1}(t) + L_{E2}(t)\right) - P_E(t)\cdot\left(Q_{E1}(t) + Q_{E2}(t)\right) + \sigma_{EA}\cdot W_M(t)\cdot\left(L_{A1}(t) + L_{A2}(t)\right) + \sigma_{EC}\cdot W_M(t)\cdot\left(L_{C1}(t\right.}{P_K(t)\cdot\left(K_{E1}(t) + K_{E2}(t)\right)}$$

$$pr_E(0) = pr_{E0}$$

ODE Simulation

$u_0 := 92\%$ $u_s := 1$ $u_m := -4\%$

$inv_0 := 3\%$ $inv_\tau := 7$ $inv_s := -200$ $inv_m := 5$

$lr_0 := 3\%$ $lr_\tau := 10$ $lr_s := 100$ $lr_m := 3$

$rr_0 := 3\%$ $rr_\tau := 7$ $rr_s := -300$ $rr_m := 1$

$nm_0 := 3\%$ $nm_\tau := 10$ $nm_s := -300$

$$\begin{bmatrix} B_R \\ F_{LK1} \\ F_{LK2} \\ F_{LC1} \\ F_{LC2} \\ F_{LA1} \\ F_{LA2} \\ F_{LE1} \\ F_{LE2} \\ F_{DK1} \\ F_{DK2} \\ F_{DC1} \\ F_{DC2} \\ F_{DA1} \\ F_{DA2} \\ F_{DE1} \\ F_{DE2} \\ H_D \\ B_I \\ K_{K1} \\ K_{K2} \\ K_{C1} \\ K_{C2} \\ K_{A1} \\ K_{A2} \\ K_{E1} \\ K_{E2} \\ Q_{K1} \end{bmatrix}$$

$$\begin{pmatrix} B_{R_S0} \\ F_{LK1_S0} \\ F_{LK2_S0} \\ F_{LC1_S0} \\ F_{LC2_S0} \\ F_{LA1_S0} \\ F_{LA2_S0} \\ F_{LE1_S0} \\ F_{LE2_S0} \\ F_{DK1_S0} \\ F_{DK2_S0} \\ F_{DC1_S0} \\ F_{DC2_S0} \\ F_{DA1_S0} \\ F_{DA2_S0} \\ F_{DE1_S0} \\ F_{DE2_S0} \\ H_{D_S0} \\ B_{I_S0} \\ K_{K1_S0} \\ K_{K2_S0} \\ K_{C1_S0} \\ K_{C2_S0} \\ K_{A1_S0} \\ K_{A2_S0} \\ K_{E1_S0} \\ K_{E2_S0} \\ Q_{K1_S0} \end{pmatrix}$$

Lay pages vertically to p. 37 then horizontally

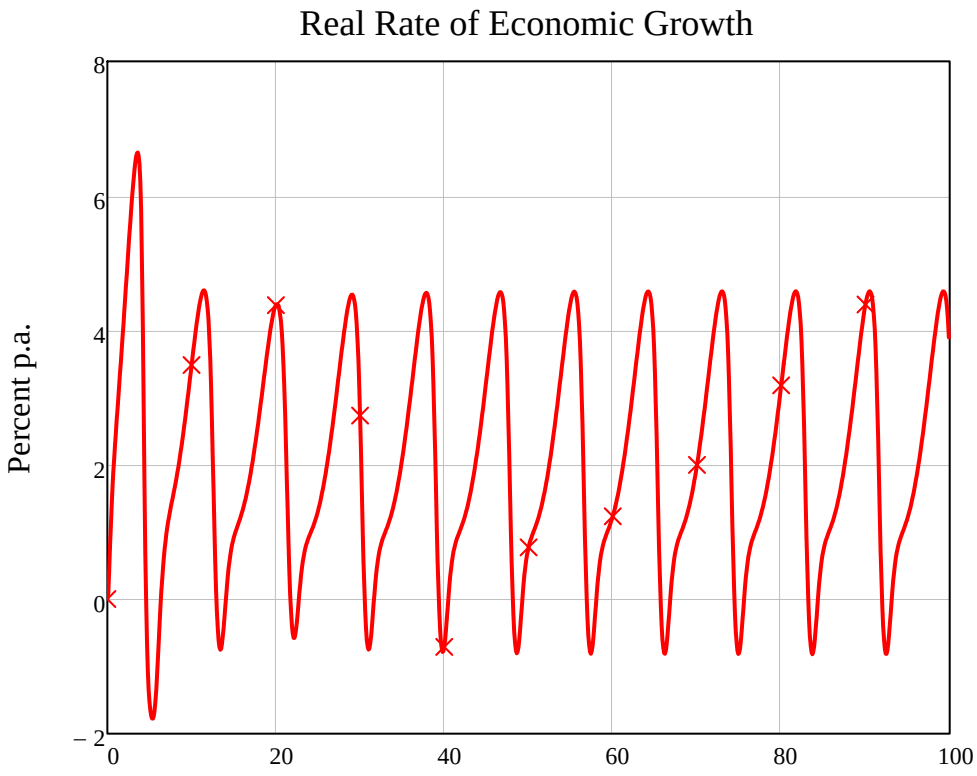
$$\mathrm{Sim}\left(\tau_{PK}, \tau_{PC}, \tau_{PA}, \tau_{PE}, \mathrm{inv}_{\tau}, \mathrm{lr}_{\tau}, \mathrm{rr}_{\tau}, \mathrm{nm}_{\tau}, u_s, \mathrm{inv}_s, \mathrm{lr}_s, \mathrm{rr}_s, \mathrm{nm}_s, u_0, \mathrm{inv}_0, \mathrm{lr}_0, \mathrm{rr}_0, \mathrm{nm}_0\right) := \mathrm{Odesolve}\left(\begin{matrix} Q_{K2} \\ Q_{C1} \\ Q_{C2} \\ Q_{A1} \\ Q_{A2} \\ Q_{E1} \\ Q_{E2} \\ L_{K1} \\ L_{K2} \\ L_{C1} \\ L_{C2} \\ L_{A1} \\ L_{A2} \\ L_{E1} \\ L_{E2} \\ P_K \\ P_C \\ P_A \\ P_E \\ W_M \\ \lambda \\ K_K \\ K_C \\ K_A \\ K_E \\ \mathrm{pr}_K \\ \mathrm{pr}_C \\ \mathrm{pr}_A \end{matrix}, t, \mathrm{Years}\right)$$

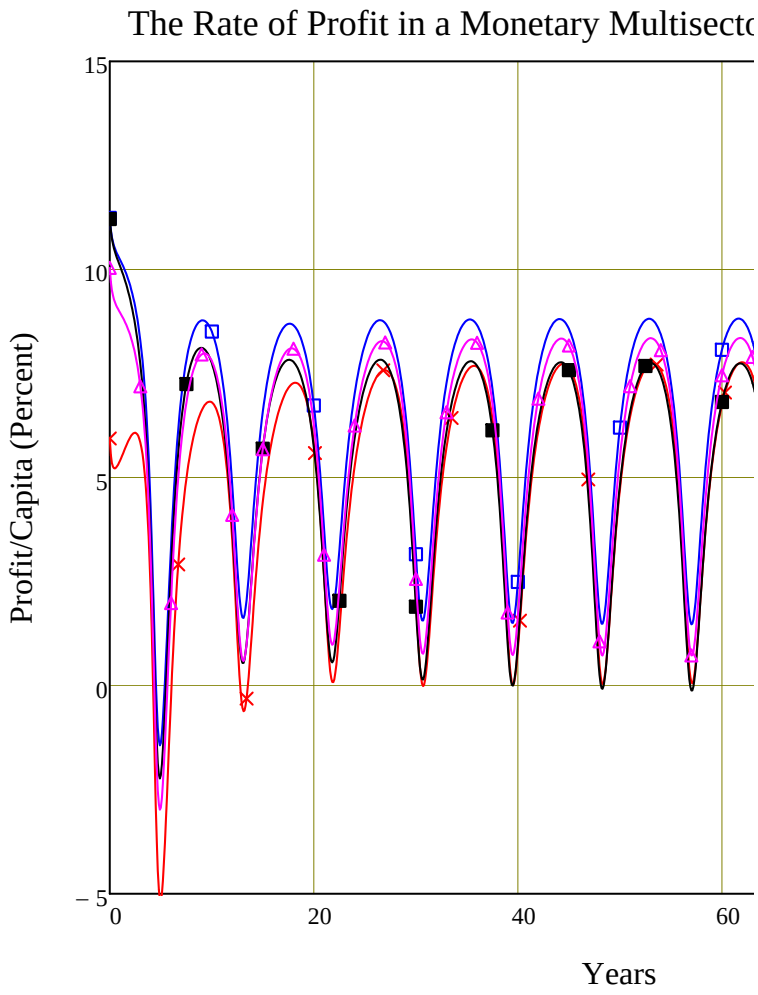
$$\begin{matrix} Q_{K2_S0} \\ Q_{C1_S0} \\ Q_{C2_S0} \\ Q_{A1_S0} \\ Q_{A2_S0} \\ Q_{E1_S0} \\ Q_{E2_S0} \\ L_{K1_S0} \\ L_{K2_S0} \\ L_{C1_S0} \\ L_{C2_S0} \\ L_{A1_S0} \\ L_{A2_S0} \\ L_{E1_S0} \\ L_{E2_S0} \\ P_{K_S0} \\ P_{C_S0} \\ P_{A_S0} \\ P_{E_S0} \\ W_{M_S0} \\ \lambda_S0 \\ K_{K_S0} \\ K_{K_S0} \\ K_{A_S0} \\ K_{E_S0} \\ \mathrm{pr}_{K_S0} \\ \mathrm{pr}_{C_S0} \\ \mathrm{pr}_{A_S0} \end{matrix} := \mathrm{Sim}(\tau$$

Lay pages vertically to p. 37 then horizontally

$$\begin{pmatrix} pr_E \\ a_K \\ a_C \\ a_A \\ a_E \\ Pop \end{pmatrix} \qquad \begin{pmatrix} pr_{E_S0} \\ a_{K_S0} \\ a_{C_S0} \\ a_{A_S0} \\ a_{E_S0} \\ Pop_S0 \end{pmatrix}$$

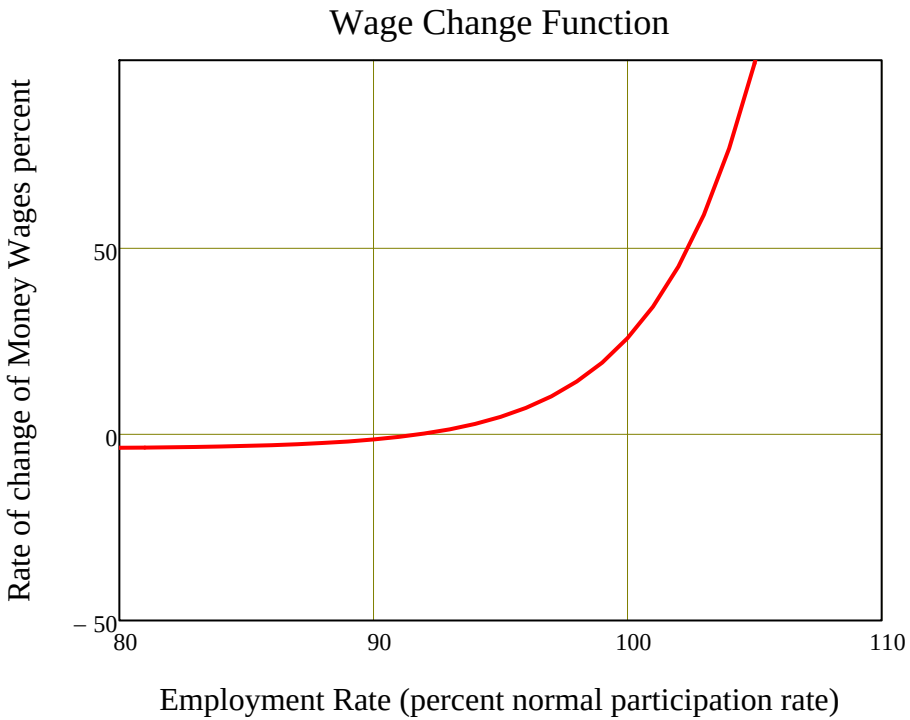
Definition of derived variables Simulation 0

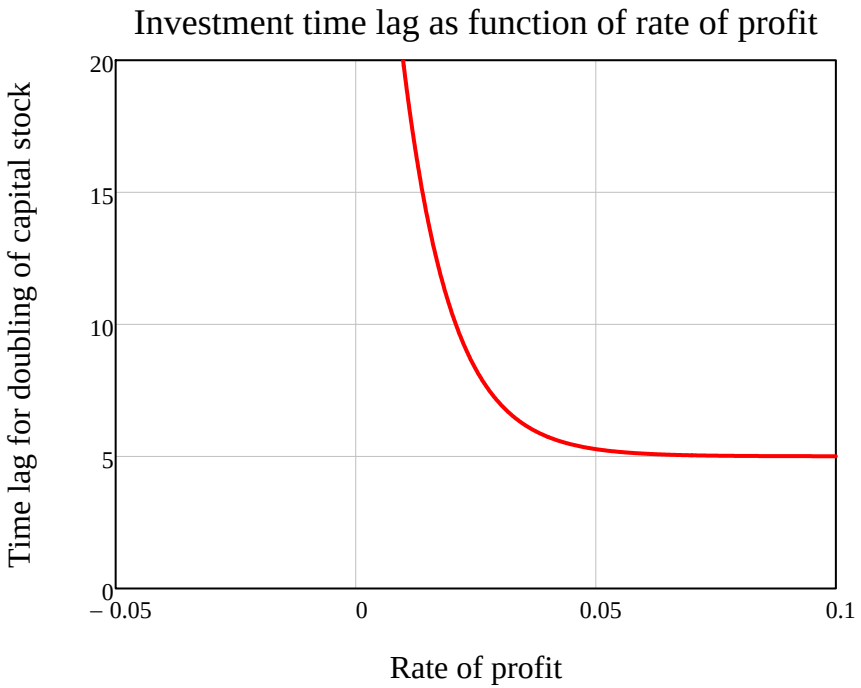


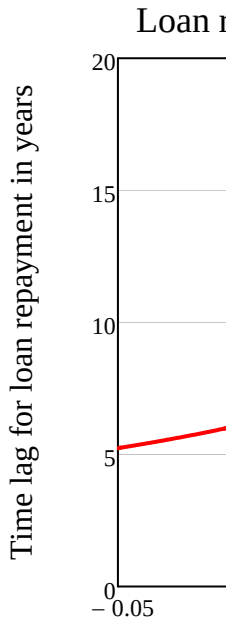


Lay pages vertically to p. 37

then horizontally

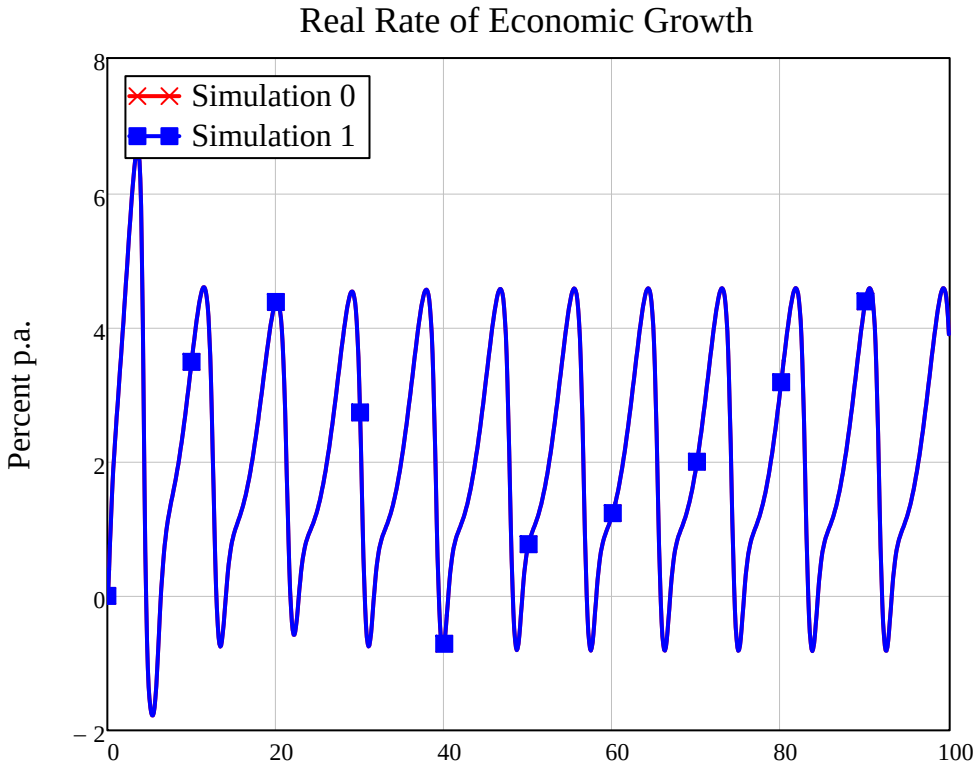


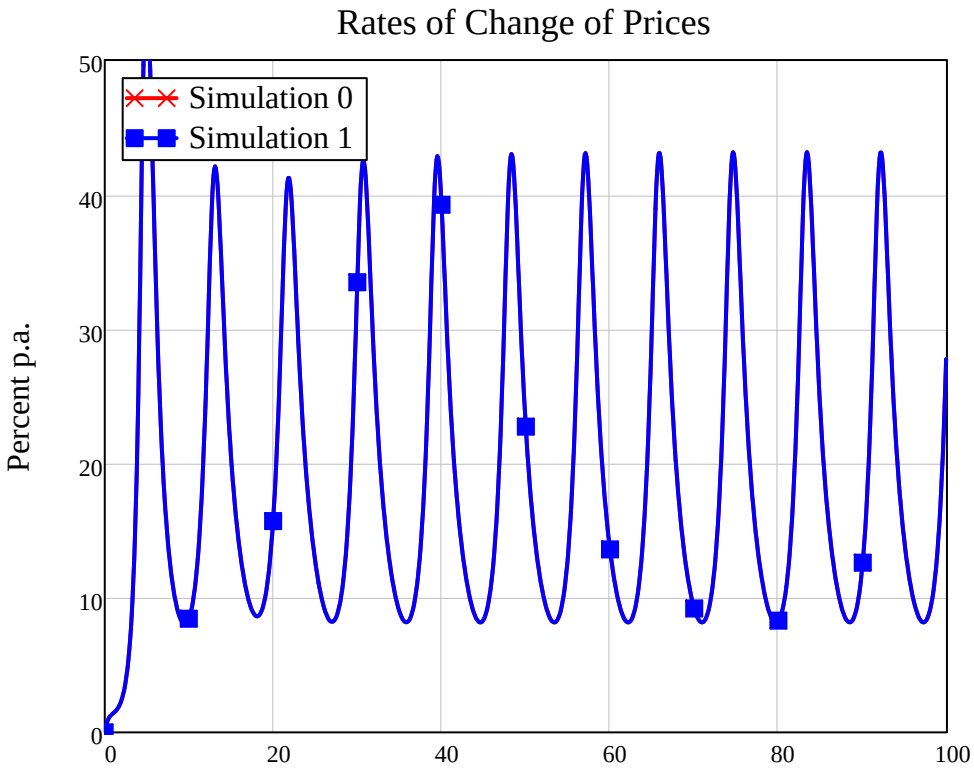




Lay pages vertically to p. 37

then horizontally


Real Rate of Economic Growth
Simulation 0
Simulation 1
Percent p.a.
8
6
4
2
0
– 2
0
20
40
60
80
100


Rates of Change of Prices
Simulation 0
Simulation 1
Percent p.a.
50
40
30
20
10
0
0
20
40
60
80
100

	–1	–1	–1	–1	
	"DK2"	"DC1"	"DC2"	"DA1"	"I
	$F_{DK2}(t)$	$F_{DC1}(t)$	$F_{DC2}(t)$	$F_{DA1}(t)$	F_{I}
	0	0	0	0	
	B2	B3	B4	B5	
	–C2	–C3	–C4	–C5	
	0	0	0	0	
7)	(–E2 + E1) + (E4 + E6 + E8)	–E3	–E4	–E5	
	–F2	(–F3 + F4) + (F1 + F5 + F7)	(–F4 + F3) + (F2 + F6 + F8)	–F5	
	–G2	–G3	–G4	(–G5 + G6) + (G1 + G3 + G7)	(–G6 + G5) +
	–H2	–H3	–H4	–H5	
$\frac{+ I10}{2}$	$(–I2 + I1) + (I4 + I6 + I8) + \frac{I9 + I10}{2}$	–I3	–I4	–I5	
	–J2	$(–J3 + J4) + (J1 + J5 + J7) + \frac{J9 + J10}{2}$	$(–J4 + J3) + (J2 + J6 + J8) + \frac{J9 + J10}{2}$	–J5	
	–K2	–K3	–K4	$(–K5 + K6) + (K1 + K3 + K7) + \frac{K9 + K10}{2}$	$(–K6 + K5) + (K2 +$
	–L2	–L3	–L4	–L5	
	–M2	–M3	–M4	–M5	
	–N2	–N3	–N4	–N5	
	O2	O3	O4	O5	
	P2	P3	P4	P5	

Lay pages vertically to p. 37

then horizontally

–1	–1	–1	–1		
"DK2"	"DC1"	"DC2"	"DA1"	"I	
$F_{DK2}(t)$	$F_{DC1}(t)$	$F_{DC2}(t)$	$F_{DA1}(t)$	F_{I}	
0	0	0	0		
B2	B3	B4	B5		
–C2	–C3	–C4	–C5	-	
0	0	0	0		
7) (–E2 + E1) + (E4 + E6 + E8)	–E3	–E4	–E5	-	
–F2	(–F3 + F4) + (F1 + F5 + F7)	(–F4 + F3) + (F2 + F6 + F8)	–F5	-	
–G2	–G3	–G4	(–G5 + G6) + (G1 + G3 + G7)	(–G6 + G5) +	
–H2	–H3	–H4	–H5	-	
$\frac{+ I10}{2}$ (–I2 + I1) + (I4 + I6 + I8) + $\frac{I9 + I10}{2}$	–I3	–I4	–I5		
–J2	(–J3 + J4) + (J1 + J5 + J7) + $\frac{J9 + J10}{2}$	(–J4 + J3) + (J2 + J6 + J8) + $\frac{J9 + J10}{2}$	–J5		
–K2	–K3	–K4	(–K5 + K6) + (K1 + K3 + K7) + $\frac{K9 + K10}{2}$	(–K6 + K5) + (K2 +	
–L2	–L3	–L4	–L5	-	
–M2	–M3	–M4	–M5	-	
–N2	–N3	–N4	–N5	-	
O2	O3	O4	O5		
P2	P3	P4	P5		

$$\frac{F_{LE2}(t)}{E(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LK1}(t)}{\tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m)} + \frac{F_{LK2}(t)}{\tau_{RL}(pr_K(t), lr_0, lr_\tau, lr_s, lr_m)} - \frac{2 \cdot B_R(t)}{\tau_{RR}(pr_A(t), rr_0, rr_\tau, rr_s, rr_m)} - \frac{2 \cdot B_R(t)}{\tau_{RR}(pr_C(t), rr_0, rr_\tau, rr_s, rr_m)} - \frac{2 \cdot B_R(t)}{\tau_{RR}(pr_E(t), rr_0, rr_\tau, rr_s, rr_m)} - \frac{2 \cdot E}{\tau_{RR}(pr_K(t), r}$$

Lay pages vertically to p. 37

then horizontally

$$\frac{F_{DK2}(t)}{\tau_{pr}\left(pr_K(t), inv_0, inv_\tau, inv_s, inv_m\right)} - \frac{F_{LK1}(t)}{\tau_{RL}\left(pr_K(t), lr_0, lr_\tau, lr_s, lr_m\right)} + \frac{F_{LK1}(t)}{\tau_{NM}\left(pr_K(t), nm_0, nm_\tau, nm_s, nm_m\right)} + \frac{B_R(t)}{\tau_{RR}\left(pr_K(t), rr_0, rr_\tau, rr_s, rr_m\right)} - L_{K1}(t) \cdot W_M(t) + \frac{B_I(t)}{2 \cdot \tau_{KBC}} + \frac{F_{DA1}(t)}{\tau_{KAC}} + \frac{F_{DC1}(t)}{\tau_{KCC}} + \frac{F_{DE1}}{\tau_{KE}}$$

$$\frac{F_{DK2}(t)}{\tau_{pr}\left(pr_K(t), inv_0, inv_\tau, inv_s, inv_m\right)} - \frac{F_{LK2}(t)}{\tau_{RL}\left(pr_K(t), lr_0, lr_\tau, lr_s, lr_m\right)} + \frac{F_{LK2}(t)}{\tau_{NM}\left(pr_K(t), nm_0, nm_\tau, nm_s, nm_m\right)} + \frac{B_R(t)}{\tau_{RR}\left(pr_K(t), rr_0, rr_\tau, rr_s, rr_m\right)} - L_{K2}(t) \cdot W_M(t) + \frac{B_I(t)}{2 \cdot \tau_{KBC}} + \frac{F_{DA2}(t)}{\tau_{KAC}} + \frac{F_{DC2}(t)}{\tau_{KCC}} + \frac{F_{DE}}{\tau_K}$$

$$W_M(t) + \frac{B_I(t)}{2 \cdot \tau_{CBC}} + \frac{F_{DA1}(t)}{\tau_{CAC}} - \frac{F_{DC1}(t)}{\tau_{CCA}} - \frac{F_{DC1}(t)}{\tau_{CCC}} + \frac{F_{DC2}(t)}{\tau_{CCC}} - \frac{F_{DC1}(t)}{\tau_{CCE}} + \frac{F_{DE1}(t)}{\tau_{CEC}} - \frac{F_{DC1}(t)}{\tau_{KCC}} + \frac{F_{DK1}(t)}{\tau_{CKC}} + \frac{H_D(t)}{2 \cdot \tau_{CWC}} + F_{DC1}(t) \cdot r_D\left(F_{DC1}(t)\right) + \sigma_{AC} \cdot L_{A1}(t) \cdot W_M(t) - \sigma_{CA} \cdot L_{C1}(t) \cdot W_M(t) -$$

Lay pages vertically to p. 37

then horizontally

$$W_M(t) + \frac{B_I(t)}{2\cdot\tau_{CBC}} + \frac{F_{DA2}(t)}{\tau_{CAC}} - \frac{F_{DC2}(t)}{\tau_{CCA}} + \frac{F_{DC1}(t)}{\tau_{CCC}} - \frac{F_{DC2}(t)}{\tau_{CCC}} - \frac{F_{DC2}(t)}{\tau_{CCE}} + \frac{F_{DE2}(t)}{\tau_{CEC}} - \frac{F_{DC2}(t)}{\tau_{KCC}} + \frac{F_{DK2}(t)}{\tau_{CKC}} + \frac{H_D(t)}{2\cdot\tau_{CWC}} + F_{DC2}(t)\cdot r_D\left(F_{DC2}(t)\right) + \sigma_{AC}\cdot L_{A2}(t)\cdot W_M(t) - \sigma_{CA}\cdot L_{C2}(t)\cdot W_M(t) -$$

$$W_M(t) + \frac{B_I(t)}{2\cdot\tau_{CBA}} - \frac{F_{DA1}(t)}{\tau_{CAA}} + \frac{F_{DA2}(t)}{\tau_{CAA}} - \frac{F_{DA1}(t)}{\tau_{CAC}} + \frac{F_{DC1}(t)}{\tau_{CCA}} - \frac{F_{DA1}(t)}{\tau_{CAE}} + \frac{F_{DE1}(t)}{\tau_{CEA}} - \frac{F_{DA1}(t)}{\tau_{KAC}} + \frac{F_{DK1}(t)}{\tau_{CKA}} + \frac{H_D(t)}{2\cdot\tau_{CWA}} + F_{DA1}(t)\cdot r_D\left(F_{DA1}(t)\right) - \sigma_{AA}\cdot L_{A1}(t)\cdot W_M(t) + \sigma_{AA}\cdot L_{A2}(t)\cdot W_M(t)$$

$$W_M(t) + \frac{B_I(t)}{2\cdot\tau_{CBA}} + \frac{F_{DA1}(t)}{\tau_{CAA}} - \frac{F_{DA2}(t)}{\tau_{CAA}} - \frac{F_{DA2}(t)}{\tau_{CAC}} + \frac{F_{DC2}(t)}{\tau_{CCA}} - \frac{F_{DA2}(t)}{\tau_{CAE}} + \frac{F_{DE2}(t)}{\tau_{CEA}} - \frac{F_{DA2}(t)}{\tau_{KAC}} + \frac{F_{DK2}(t)}{\tau_{CKA}} + \frac{H_D(t)}{2\cdot\tau_{CWA}} + F_{DA2}(t)\cdot r_D\left(F_{DA2}(t)\right) + \sigma_{AA}\cdot L_{A1}(t)\cdot W_M(t) - \sigma_{AA}\cdot L_{A2}(t)\cdot W_M(t)$$

$$W_M(t) + \frac{B_I(t)}{2\cdot\tau_{CBE}} + \frac{F_{DA1}(t)}{\tau_{CAE}} - \frac{F_{DE1}(t)}{\tau_{CEA}} + \frac{F_{DC1}(t)}{\tau_{CCE}} - \frac{F_{DE1}(t)}{\tau_{CEC}} - \frac{F_{DE1}(t)}{\tau_{CEE}} + \frac{F_{DE2}(t)}{\tau_{CEE}} - \frac{F_{DE1}(t)}{\tau_{KEC}} + \frac{F_{DK1}(t)}{\tau_{CKE}} + \frac{H_D(t)}{2\cdot\tau_{CWE}} + F_{DE1}(t)\cdot r_D\left(F_{DE1}(t)\right) + \sigma_{AE}\cdot L_{A1}(t)\cdot W_M(t) - \sigma_{EA}\cdot L_{E1}(t)\cdot W_M(t) + \sigma$$

$$W_M(t) + \frac{B_I(t)}{2\cdot\tau_{CBE}} + \frac{F_{DA2}(t)}{\tau_{CAE}} - \frac{F_{DE2}(t)}{\tau_{CEA}} + \frac{F_{DC2}(t)}{\tau_{CCE}} - \frac{F_{DE2}(t)}{\tau_{CEC}} + \frac{F_{DE1}(t)}{\tau_{CEE}} - \frac{F_{DE2}(t)}{\tau_{CEE}} - \frac{F_{DE2}(t)}{\tau_{KEC}} + \frac{F_{DK2}(t)}{\tau_{CKE}} + \frac{H_D(t)}{2\cdot\tau_{CWE}} + F_{DE2}(t)\cdot r_D\left(F_{DE2}(t)\right) + \sigma_{AE}\cdot L_{A2}(t)\cdot W_M(t) - \sigma_{EA}\cdot L_{E2}(t)\cdot W_M(t) + \sigma$$

$$\frac{B_I(t)}{2\cdot\tau_{CWE}} - \frac{H_D(t)}{\tau_{KWC}} + H_D(t)\cdot r_D\left(H_D(t)\right)$$

$$F_{DA1}(t)\right) - F_{DA2}(t)\cdot r_D\left(F_{DA2}(t)\right) - F_{DC1}(t)\cdot r_D\left(F_{DC1}(t)\right) - F_{DC2}(t)\cdot r_D\left(F_{DC2}(t)\right) - F_{DE1}(t)\cdot r_D\left(F_{DE1}(t)\right) - F_{DE2}(t)\cdot r_D\left(F_{DE2}(t)\right) - F_{DK1}(t)\cdot r_D\left(F_{DK1}(t)\right) - F_{DK2}(t)\cdot r_D\left(F_{DK2}(t)\right) - H_D(t)\cdot r_D\left(H_D(t)\right.$$

$$\begin{bmatrix}
\frac{L_{K2}(t)\right) - P_K(t)\cdot\left(Q_{K1}(t) + Q_{K2}(t)\right) + \sigma_{KA}\cdot W_M(t)\cdot\left(L_{A1}(t) + L_{A2}(t)\right) + \sigma_{KC}\cdot W_M(t)\cdot\left(L_{C1}(t) + L_{C2}(t)\right) + \sigma_{KE}\cdot W_M(t)\cdot\left(L_{E1}(t) + L_{E2}(t)\right)}{P_K(t)\cdot\left(K_{K1}(t) + K_{K2}(t)\right)} \\
\frac{L_{C2}(t)\right) - P_C(t)\cdot\left(Q_{C1}(t) + Q_{C2}(t)\right) + \sigma_{CA}\cdot W_M(t)\cdot\left(L_{A1}(t) + L_{A2}(t)\right) + \sigma_{CC}\cdot W_M(t)\cdot\left(L_{C1}(t) + L_{C2}(t)\right) + \sigma_{CE}\cdot W_M(t)\cdot\left(L_{E1}(t) + L_{E2}(t)\right)}{P_K(t)\cdot\left(K_{C1}(t) + K_{C2}(t)\right)} \\
\frac{L_{A2}(t)\right) - P_A(t)\cdot\left(Q_{A1}(t) + Q_{A2}(t)\right) + \sigma_{AA}\cdot W_M(t)\cdot\left(L_{A1}(t) + L_{A2}(t)\right) + \sigma_{AC}\cdot W_M(t)\cdot\left(L_{C1}(t) + L_{C2}(t)\right) + \sigma_{AE}\cdot W_M(t)\cdot\left(L_{E1}(t) + L_{E2}(t)\right)}{P_K(t)\cdot\left(K_{A1}(t) + K_{A2}(t)\right)} \\
\frac{L_{E2}(t)\right) - P_E(t)\cdot\left(Q_{E1}(t) + Q_{E2}(t)\right) + \sigma_{EA}\cdot W_M(t)\cdot\left(L_{A1}(t) + L_{A2}(t)\right) + \sigma_{EC}\cdot W_M(t)\cdot\left(L_{C1}(t) + L_{C2}(t)\right) + \sigma_{EE}\cdot W_M(t)\cdot\left(L_{E1}(t) + L_{E2}(t)\right)}{P_K(t)\cdot\left(K_{E1}(t) + K_{E2}(t)\right)}
\end{bmatrix}$$

Lay pages vertically to p. 37

then horizontally

$$\frac{\left) - F_{DK2}(0)\cdot r_D\left(F_{DK1}(0) + F_{DK2}(0)\right) + \sigma_{KA}\cdot L_{A1}(0)\cdot W_M(0) + \sigma_{KA}\cdot L_{A2}(0)\cdot W_M(0) + \sigma_{KC}\cdot L_{C1}(0)\cdot W_M(0) + \sigma_{KC}\cdot L_{C2}(0)\cdot W_M(0) + \sigma_{KE}\cdot L_{E1}(0)\cdot W_M(0) + \sigma_{KE}\cdot L_{E2}(0)\cdot W_M(0)\right.}{P_K(0)\cdot\left(K_{K1}(0) + K_{K2}(0)\right)}$$

$$\frac{\left) - F_{DC2}(0)\cdot r_D\left(F_{DC1}(0) + F_{DC2}(0)\right) + \sigma_{CA}\cdot L_{A1}(0)\cdot W_M(0) + \sigma_{CA}\cdot L_{A2}(0)\cdot W_M(0) + \sigma_{CC}\cdot L_{C1}(0)\cdot W_M(0) + \sigma_{CC}\cdot L_{C2}(0)\cdot W_M(0) + \sigma_{CE}\cdot L_{E1}(0)\cdot W_M(0) + \sigma_{CE}\cdot L_{E2}(0)\cdot W_M(0)\right.}{P_K(0)\cdot\left(K_{C1}(0) + K_{C2}(0)\right)}$$

$$\frac{\left) - F_{DA2}(0)\cdot r_D\left(F_{DA1}(0) + F_{DA2}(0)\right) + \sigma_{AA}\cdot L_{A1}(0)\cdot W_M(0) + \sigma_{AA}\cdot L_{A2}(0)\cdot W_M(0) + \sigma_{AC}\cdot L_{C1}(0)\cdot W_M(0) + \sigma_{AC}\cdot L_{C2}(0)\cdot W_M(0) + \sigma_{AE}\cdot L_{E1}(0)\cdot W_M(0) + \sigma_{AE}\cdot L_{E2}(0)\cdot W_M(0)\right.}{P_K(0)\cdot\left(K_{A1}(0) + K_{A2}(0)\right)}$$

$$\frac{\left) - F_{DE2}(0)\cdot r_D\left(F_{DE1}(0) + F_{DE2}(0)\right) + \sigma_{EA}\cdot L_{A1}(0)\cdot W_M(0) + \sigma_{EA}\cdot L_{A2}(0)\cdot W_M(0) + \sigma_{EC}\cdot L_{C1}(0)\cdot W_M(0) + \sigma_{EC}\cdot L_{C2}(0)\cdot W_M(0) + \sigma_{EE}\cdot L_{E1}(0)\cdot W_M(0) + \sigma_{EE}\cdot L_{E2}(0)\cdot W_M(0)\right.}{P_K(0)\cdot\left(K_{E1}(0) + K_{E2}(0)\right)}$$

Profit Rate loan repayment time lag

$lr_0 := 3\%$ $lr_\tau := 10$ $lr_s := 100$ $lr_m := 3$

$\tau_{RL}(pr, lr_0, lr_\tau, lr_s, lr_m) := genexp(pr, lr_0, lr_\tau, lr_s, lr_m)$

Profit Rate Reserve relending time lag

$rr_0 := 3\%$ $rr_\tau := 7$ $rr_s := -300$ $rr_m := 1$

$\tau_{RR}(pr, rr_0, rr_\tau, rr_s, rr_m) := genexp(pr, rr_0, rr_\tau, rr_s, rr_m)$

$_s, inv_m)$

Profit Rate New Money Creation time lag

$nm_0 := 3\%$ $nm_\tau := 10$ $nm_s := -300$ $nm_m := 2$

$\tau_{NM}(pr, nm_0, nm_\tau, nm_s, nm_m) := genexp(pr, nm_0, nm_\tau, nm_s, nm_m)$

---

fit

g in new money creation as function of rate of profit

Lay pages vertically to p. 37

then horizontally

$$\frac{\text{M0} + \sigma_{KC}\cdot L_{C10}\cdot W_{M0} + \sigma_{KC}\cdot L_{C20}\cdot W_{M0} + \sigma_{KE}\cdot L_{E10}\cdot W_{M0} + \sigma_{KE}\cdot L_{E20}\cdot W_{M0}}{} = 0.059$$

$$\frac{+ \sigma_{CC}\cdot L_{C10}\cdot W_{M0} + \sigma_{CC}\cdot L_{C20}\cdot W_{M0} + \sigma_{CE}\cdot L_{E10}\cdot W_{M0} + \sigma_{CE}\cdot L_{E20}\cdot W_{M0}}{} = 0.112$$

$$\frac{\text{M0} + \sigma_{AC}\cdot L_{C10}\cdot W_{M0} + \sigma_{AC}\cdot L_{C20}\cdot W_{M0} + \sigma_{AE}\cdot L_{E10}\cdot W_{M0} + \sigma_{AE}\cdot L_{E20}\cdot W_{M0}}{} = 0.112$$

$$\frac{+ \sigma_{EC}\cdot L_{C10}\cdot W_{M0} + \sigma_{EC}\cdot L_{C20}\cdot W_{M0} + \sigma_{EE}\cdot L_{E10}\cdot W_{M0} + \sigma_{EE}\cdot L_{E20}\cdot W_{M0}}{} = 0.1$$

$$\frac{}{)} + \frac{F_{LK1}(t)}{\tau_{RL}\left(pr_K(t), lr_0, lr_\tau, lr_s, lr_m\right)} + \frac{F_{LK2}(t)}{\tau_{RL}\left(pr_K(t), lr_0, lr_\tau, lr_s, lr_m\right)} - \frac{2\cdot B_R(t)}{\tau_{RR}\left(pr_A(t), rr_0, rr_\tau, rr_s, rr_m\right)} - \frac{2\cdot B_R(t)}{\tau_{RR}\left(pr_C(t), rr_0, rr_\tau, rr_s, rr_m\right)} - \frac{2\cdot B_R(t)}{\tau_{RR}\left(pr_E(t), rr_0, rr_\tau, rr_s, rr_m\right)} - \frac{2\cdot B_R(t)}{\tau_{RR}\left(pr_K(t), rr_0, rr_\tau, rr_s, rr_m\right)}$$

Lay pages vertically to p. 37

then horizontally

$$\frac{)}{{}_{\tau},\mathrm{inv_s},\mathrm{inv_m}\right)} - \frac{F_{LK1}(t)}{\tau_{RL}\left(\mathrm{pr_K}(t),\mathrm{lr_0},\mathrm{lr_\tau},\mathrm{lr_s},\mathrm{lr_m}\right)} + \frac{F_{LK1}(t)}{\tau_{NM}\left(\mathrm{pr_K}(t),\mathrm{nm_0},\mathrm{nm_\tau},\mathrm{nm_s},\mathrm{nm_m}\right)} + \frac{B_R(t)}{\tau_{RR}\left(\mathrm{pr_K}(t),\mathrm{rr_0},\mathrm{rr_\tau},\mathrm{rr_s},\mathrm{rr_m}\right)} - L_{K1}(t)\cdot W_M(t) + \frac{B_I(t)}{2\cdot\tau_{KBC}} + \frac{F_{DA1}(t)}{\tau_{KAC}} + \frac{F_{DC1}(t)}{\tau_{KCC}} + \frac{F_{DE1}(t)}{\tau_{KEC}} - \frac{F_{DK1}(t)}{\tau_{CKA}} - \frac{F}{-}$$

$$\frac{)}{{}_{\tau},\mathrm{inv_s},\mathrm{inv_m}\right)} - \frac{F_{LK2}(t)}{\tau_{RL}\left(\mathrm{pr_K}(t),\mathrm{lr_0},\mathrm{lr_\tau},\mathrm{lr_s},\mathrm{lr_m}\right)} + \frac{F_{LK2}(t)}{\tau_{NM}\left(\mathrm{pr_K}(t),\mathrm{nm_0},\mathrm{nm_\tau},\mathrm{nm_s},\mathrm{nm_m}\right)} + \frac{B_R(t)}{\tau_{RR}\left(\mathrm{pr_K}(t),\mathrm{rr_0},\mathrm{rr_\tau},\mathrm{rr_s},\mathrm{rr_m}\right)} - L_{K2}(t)\cdot W_M(t) + \frac{B_I(t)}{2\cdot\tau_{KBC}} + \frac{F_{DA2}(t)}{\tau_{KAC}} + \frac{F_{DC2}(t)}{\tau_{KCC}} + \frac{F_{DE2}(t)}{\tau_{KEC}} - \frac{F_{DK2}(t)}{\tau_{CKA}} - \frac{F}{-}$$

$$\frac{F_{DA1}(t)}{\tau_{CAC}} - \frac{F_{DC1}(t)}{\tau_{CCA}} - \frac{F_{DC1}(t)}{\tau_{CCC}} + \frac{F_{DC2}(t)}{\tau_{CCC}} - \frac{F_{DC1}(t)}{\tau_{CCE}} + \frac{F_{DE1}(t)}{\tau_{CEC}} - \frac{F_{DC1}(t)}{\tau_{KCC}} + \frac{F_{DK1}(t)}{\tau_{CKC}} + \frac{H_D(t)}{2\cdot\tau_{CWC}} + F_{DC1}(t)\cdot r_D\left(F_{DC1}(t)\right) + \sigma_{AC}\cdot L_{A1}(t)\cdot W_M(t) - \sigma_{CA}\cdot L_{C1}(t)\cdot W_M(t) - \sigma_{CC}\cdot L_{C1}(t)\cdot W_M(t$$

Lay pages vertically to p. 37

then horizontally

$$\frac{F_{DA2}(t)}{\tau_{CAC}} - \frac{F_{DC2}(t)}{\tau_{CCA}} + \frac{F_{DC1}(t)}{\tau_{CCC}} - \frac{F_{DC2}(t)}{\tau_{CCC}} - \frac{F_{DC2}(t)}{\tau_{CCE}} + \frac{F_{DE2}(t)}{\tau_{CEC}} - \frac{F_{DC2}(t)}{\tau_{KCC}} + \frac{F_{DK2}(t)}{\tau_{CKC}} + \frac{H_D(t)}{2\cdot\tau_{CWC}} + F_{DC2}(t)\cdot r_D\left(F_{DC2}(t)\right) + \sigma_{AC}\cdot L_{A2}(t)\cdot W_M(t) - \sigma_{CA}\cdot L_{C2}(t)\cdot W_M(t) + \sigma_{CC}\cdot L_{C1}(t)\cdot W_M(t$$

$$\frac{F_{DA1}(t)}{\tau_{CAA}} + \frac{F_{DA2}(t)}{\tau_{CAA}} - \frac{F_{DA1}(t)}{\tau_{CAC}} + \frac{F_{DC1}(t)}{\tau_{CCA}} - \frac{F_{DA1}(t)}{\tau_{CAE}} + \frac{F_{DE1}(t)}{\tau_{CEA}} - \frac{F_{DA1}(t)}{\tau_{KAC}} + \frac{F_{DK1}(t)}{\tau_{CKA}} + \frac{H_D(t)}{2\cdot\tau_{CWA}} + F_{DA1}(t)\cdot r_D\left(F_{DA1}(t)\right) - \sigma_{AA}\cdot L_{A1}(t)\cdot W_M(t) + \sigma_{AA}\cdot L_{A2}(t)\cdot W_M(t) - \sigma_{AC}\cdot L_{A1}(t)\cdot W_M($$

$$\frac{F_{DA1}(t)}{\tau_{CAA}} - \frac{F_{DA2}(t)}{\tau_{CAA}} - \frac{F_{DA2}(t)}{\tau_{CAC}} + \frac{F_{DC2}(t)}{\tau_{CCA}} - \frac{F_{DA2}(t)}{\tau_{CAE}} + \frac{F_{DE2}(t)}{\tau_{CEA}} - \frac{F_{DA2}(t)}{\tau_{KAC}} + \frac{F_{DK2}(t)}{\tau_{CKA}} + \frac{H_D(t)}{2\cdot\tau_{CWA}} + F_{DA2}(t)\cdot r_D\left(F_{DA2}(t)\right) + \sigma_{AA}\cdot L_{A1}(t)\cdot W_M(t) - \sigma_{AA}\cdot L_{A2}(t)\cdot W_M(t) - \sigma_{AC}\cdot L_{A2}(t)\cdot W_M($$

$$\frac{F_{DA1}(t)}{\tau_{CAE}} - \frac{F_{DE1}(t)}{\tau_{CEA}} + \frac{F_{DC1}(t)}{\tau_{CCE}} - \frac{F_{DE1}(t)}{\tau_{CEC}} - \frac{F_{DE1}(t)}{\tau_{CEE}} + \frac{F_{DE2}(t)}{\tau_{CEE}} - \frac{F_{DE1}(t)}{\tau_{KEC}} + \frac{F_{DK1}(t)}{\tau_{CKE}} + \frac{H_D(t)}{2\cdot\tau_{CWE}} + F_{DE1}(t)\cdot r_D\left(F_{DE1}(t)\right) + \sigma_{AE}\cdot L_{A1}(t)\cdot W_M(t) - \sigma_{EA}\cdot L_{E1}(t)\cdot W_M(t) + \sigma_{CE}\cdot L_{C1}(t)\cdot W_M(t) -$$

$$\frac{F_{DA2}(t)}{\tau_{CAE}} - \frac{F_{DE2}(t)}{\tau_{CEA}} + \frac{F_{DC2}(t)}{\tau_{CCE}} - \frac{F_{DE2}(t)}{\tau_{CEC}} + \frac{F_{DE1}(t)}{\tau_{CEE}} - \frac{F_{DE2}(t)}{\tau_{CEE}} - \frac{F_{DE2}(t)}{\tau_{KEC}} + \frac{F_{DK2}(t)}{\tau_{CKE}} + \frac{H_D(t)}{2\cdot\tau_{CWE}} + F_{DE2}(t)\cdot r_D\left(F_{DE2}(t)\right) + \sigma_{AE}\cdot L_{A2}(t)\cdot W_M(t) - \sigma_{EA}\cdot L_{E2}(t)\cdot W_M(t) + \sigma_{CE}\cdot L_{C2}(t)\cdot W_M(t) -$$

$$\cdot r_D\left(H_D(t)\right)$$

$$\left(F_{DA2}(t)\right) - F_{DC1}(t)\cdot r_D\left(F_{DC1}(t)\right) - F_{DC2}(t)\cdot r_D\left(F_{DC2}(t)\right) - F_{DE1}(t)\cdot r_D\left(F_{DE1}(t)\right) - F_{DE2}(t)\cdot r_D\left(F_{DE2}(t)\right) - F_{DK1}(t)\cdot r_D\left(F_{DK1}(t)\right) - F_{DK2}(t)\cdot r_D\left(F_{DK2}(t)\right) - H_D(t)\cdot r_D\left(H_D(t)\right)$$

$$\frac{}{\left(P_K(t)\right)} - \gamma\cdot K_{C1}(t)$$

Consumption 2

$$K_{C2}(0) = K_{C20}$$

$$\frac{d}{dt}K_{C2}(t) = \frac{F_{DC2}(t)}{\tau_{pr}\left(pr_C(t), inv_0, inv_\tau, inv_s, inv_m\right)\cdot\left(P_K(t)\right)} - \gamma\cdot K_{C2}(t)$$

$$Q_{C2}(0) = Q_{C20}$$

$$\frac{d}{dt}Q_{C2}(t) = \frac{-1}{\tau_{QC}}\cdot\left[Q_{C2}(t) - \frac{1}{v_C}\cdot\left(K_{C2}(t)\right)\right]$$

Agriculture 1

$$K_{A1}(0) = K_{A10}$$

$$\frac{d}{dt}K_{A1}(t) = \frac{F_{DA1}(t)}{\tau_{pr}\left(pr_A(t), inv_0, inv_\tau, inv_s, inv_m\right)\cdot\left(P_K(t)\right)} - \gamma\cdot K_{A1}(t)$$

$$Q_{A1}(0) = Q_{A10}$$

$$\frac{d}{dt}Q_{A1}(t) = \frac{-1}{\tau_{QA}}\cdot\left[Q_{A1}(t) - \frac{1}{v_A}\cdot\left(K_{A1}(t)\right)\right]$$

Agriculture 2

$$K_{A2}(0) = K_{A20}$$

$$\frac{d}{dt}K_{A2}(t) = \frac{}{\tau_{pr}\left(pr_A(t), in\right.}$$

$$Q_{A2}(0) = Q_{A20}$$

$$\frac{d}{dt}Q_{A2}(t) = \frac{-1}{\tau_{QA}}\cdot\left[Q_{A2}(t\right.$$

$L_{C2}(0) = L_{C20}$

$\frac{d}{dt}L_{C2}(t) = \frac{-1}{\tau_{LC}}\cdot\left(L_{C2}(t) - \frac{Q_{C2}(t)}{a_C(t)}\right)$

$L_{A1}(0) = L_{A10}$

$\frac{d}{dt}L_{A1}(t) = \frac{-1}{\tau_{LA}}\cdot\left(L_{A1}(t) - \frac{Q_{A1}(t)}{a_A(t)}\right)$

$L_{A2}(0) = L_{A20}$

$\frac{d}{dt}L_{A2}(t) = \frac{-1}{\tau_{LA}}\cdot\left(L_{A2}(t$

$P_A(0) = P_{A0}$

$\frac{d}{dt}P_A(t) = \frac{-1}{\tau_{PA}}\cdot\left[P_A(t) - \frac{W_M(t)}{a_A(t)\cdot\left(1 - s_A\right)}\right]$

$= a_{C0}$

$\frac{d}{dt}a_A(t) = \alpha\cdot a_A(t)$

$a_A(0) = a_{A0}$

$\frac{d}{dt}a_E(t) = \alpha\cdot a_E(t$

$:_1(t) + L_{C2}(t)\right) + \sigma_{KE}\cdot W_M(t)\cdot\left(L_{E1}(t) + L_{E2}(t)\right)$

Lay pages vertically to p. 37

then horizontally

$$:_1(t) + L_{C2}(t)\big) + \sigma_{CE}\cdot W_M(t)\cdot\big(L_{E1}(t) + L_{E2}(t)\big)$$

$$:C1(t) + L_{C2}(t)\big) + \sigma_{AE}\cdot W_M(t)\cdot\big(L_{E1}(t) + L_{E2}(t)\big)$$

$$:) + L_{C2}(t)\big) + \sigma_{EE}\cdot W_M(t)\cdot\big(L_{E1}(t) + L_{E2}(t)\big)$$

Lay pages vertically to p. 37

then horizontally

$$
\begin{pmatrix}
B_{R_S1} \\
F_{LK1_S1} \\
F_{LK2_S1} \\
F_{LC1_S1} \\
F_{LC2_S1} \\
F_{LA1_S1} \\
F_{LA2_S1} \\
F_{LE1_S1} \\
F_{LE2_S1} \\
F_{DK1_S1} \\
F_{DK2_S1} \\
F_{DC1_S1} \\
F_{DC2_S1} \\
F_{DA1_S1} \\
F_{DA2_S1} \\
F_{DE1_S1} \\
F_{DE2_S1} \\
H_{D_S1} \\
B_{I_S1} \\
K_{K1_S1} \\
K_{K2_S1} \\
K_{C1_S1} \\
K_{C2_S1} \\
K_{A1_S1} \\
K_{A2_S1} \\
K_{E1_S1} \\
K_{E2_S1}
\end{pmatrix}
$$

Lay pages vertically to p. 37

then horizontally

$$\tau_{PK}, \tau_{PC}, \tau_{PA}, \tau_{PE}, inv_{\tau}, lr_{\tau}, rr_{\tau}, nm_{\tau}, u_s, inv_s, lr_s, rr_s, nm_s, u_0, inv_0, lr_0, rr_0, nm_0\Big) := \text{Sim}\Big(\tau_{PK}, \tau_{PC}, \tau_{PA}, \tau_{PE}, inv_{\tau}, lr_{\tau}, rr_{\tau}, nm_{\tau}, u_s, inv_s, lr_s, rr_s, nm_s, u_0, inv_0, lr_0, rr_0, nm_0\Big)$$

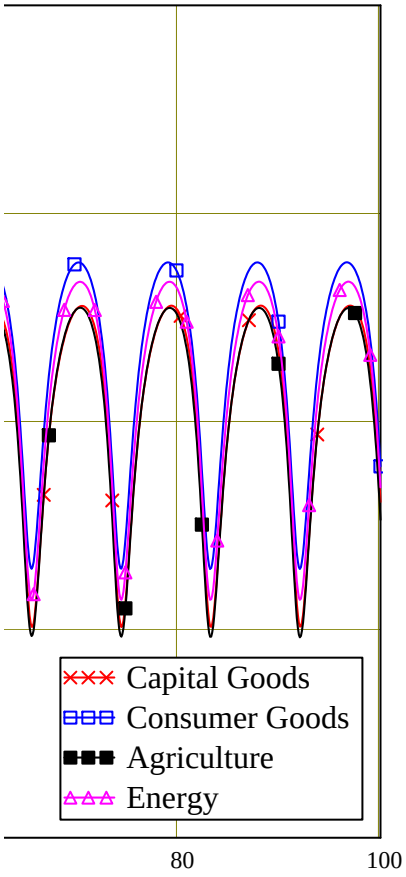
Q_{K1_S1}
Q_{K2_S1}
Q_{C1_S1}
Q_{C2_S1}
Q_{A1_S1}
Q_{A2_S1}
Q_{E1_S1}
Q_{E2_S1}
L_{K1_S1}
L_{K2_S1}
L_{C1_S1}
L_{C2_S1}
L_{A1_S1}
L_{A2_S1}
L_{E1_S1}
L_{E2_S1}
P_{K_S1}
P_{C_S1}
P_{A_S1}
P_{E_S1}
W_{M_S1}
λ_{S1}
K_{K_S1}
K_{K_S1}
K_{A_S1}
K_{E_S1}
pr_{K_S1}
pr_{C_S1}

Lay pages vertically to p. 37

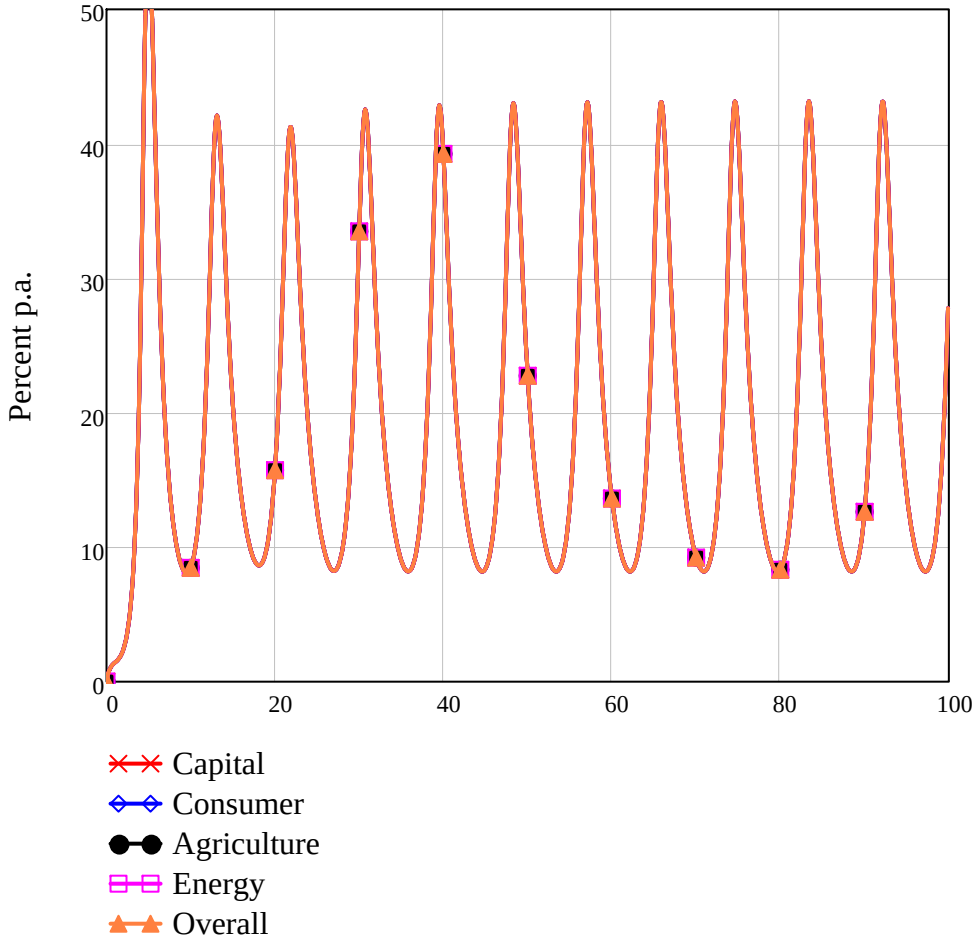
then horizontally

$$\begin{pmatrix} pr_{A_S1} \\ pr_{E_S1} \\ a_{K_S1} \\ a_{C_S1} \\ a_{A_S1} \\ a_{E_S1} \\ Pop_S1 \end{pmatrix}$$

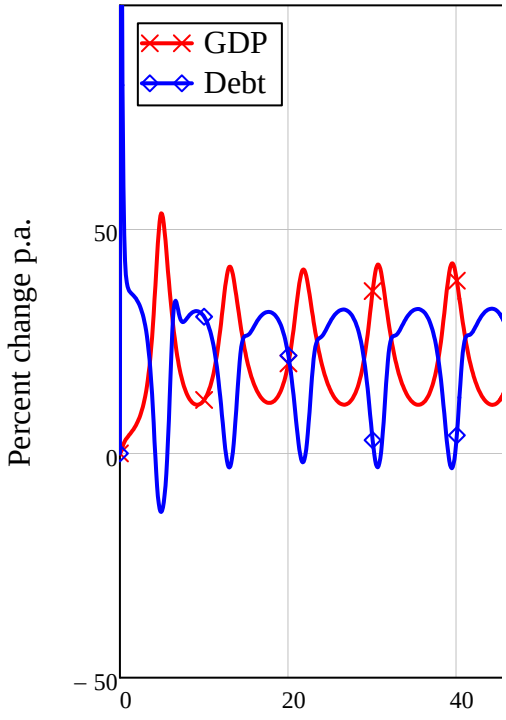
ɔral Model of Production



Rates of Change of Prices

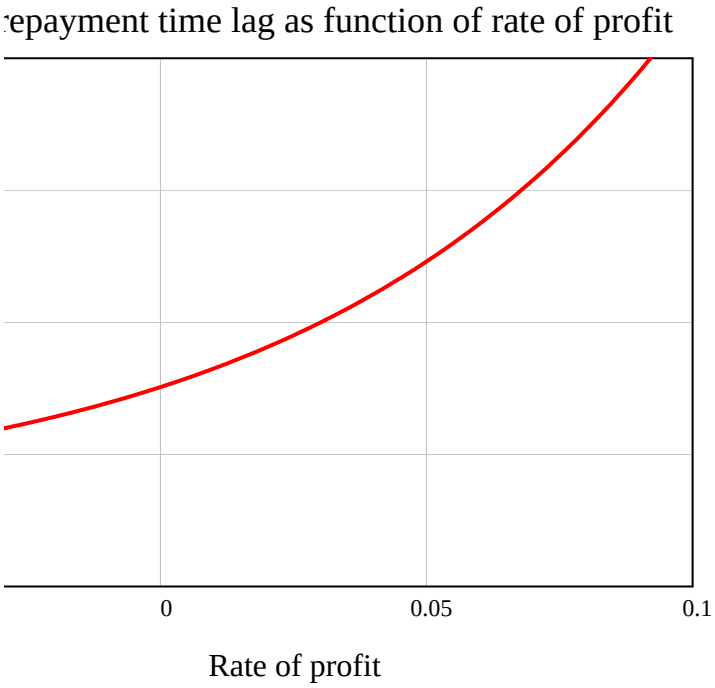


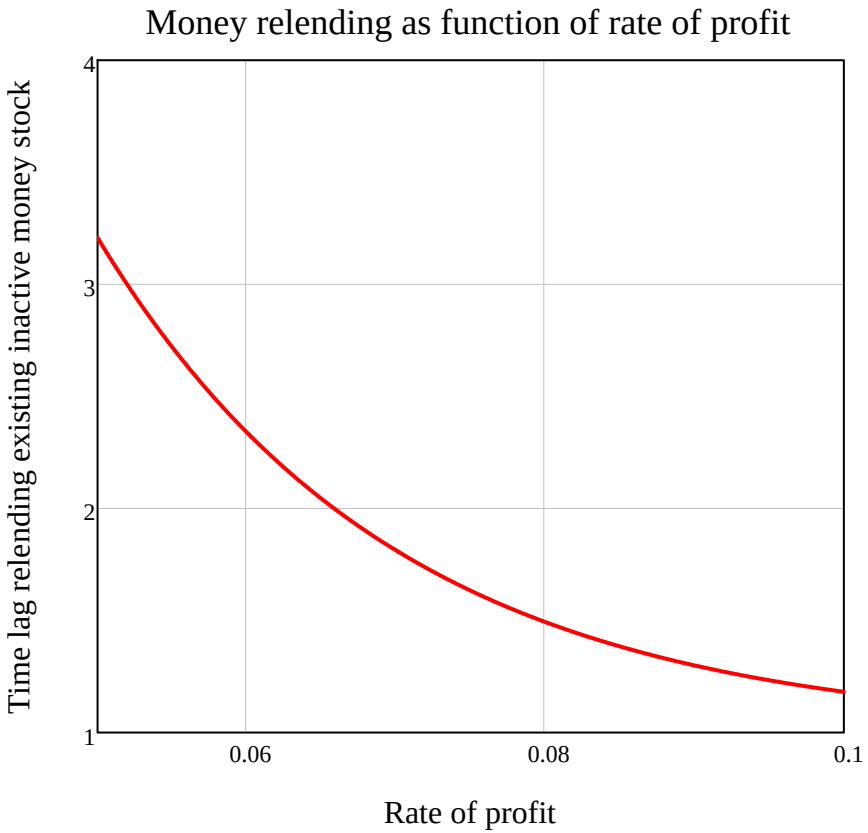
Change in Nominal

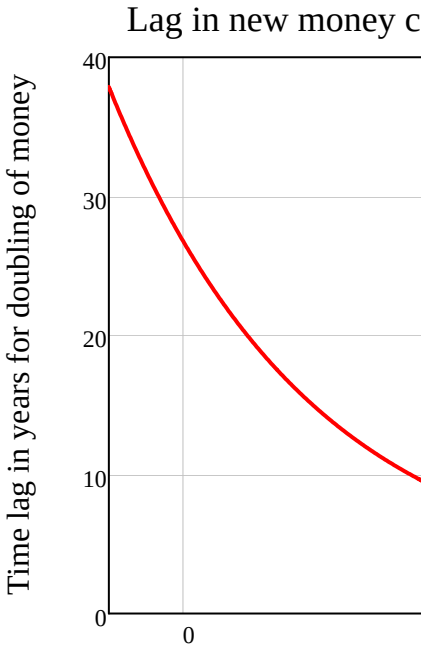


Lay pages vertically to p. 37

then horizontally







Lay pages vertically to p. 37

then horizontally

Simulation Observations
τPK: Halving it slightly reduces the volatility of real output and inflation over time;
τPC,PA & PE: having these substantially increases the volatility of real output and inflation--greater price flexibility means greater volatility

Lay pages vertically to p. 37
then horizontally

–1	–1	–1	–1	0
)A2"	"DE1"	"DE2"	"HD"	"BI"
$_{)A2}(t)$	$F_{DE1}(t)$	$F_{DE2}(t)$	$H_D(t)$	$B_I(t)$
0	0	0	0	0
B6	B7	B8	0	–(B1 + B2 + B3 + B4 + B5 + B6 + E
–C6	–C7	–C8	C1 + C2 + C3 + C4 + C5 + C6 + C7 + C8	0
0	0	0	D1	–D1
–E6	–E7	–E8	0	0
–F6	–F7	–F8	0	0
(G2 + G4 + G8)	–G7	–G8	0	0
–H6	(–H7 + H8) + (H1 + H3 + H5)	(–H8 + H7) + (H2 + H4 + H6)	0	0
–I6	–I7	–I8	–I9	–I10
–J6	–J7	–J8	–J9	–J10
$K4 + K8) + \frac{K9 + K10}{2}$	–K7	–K8	–K9	–K10
–L6	$(–L7 + L8) + (L1 + L3 + L5) + \frac{L9 + L10}{2}$	$(–L8 + L7) + (L2 + L4 + L6) + \frac{L9 + L10}{2}$	–L9	–L10
-M6	–M7	–M8	0	M1 + M2 + M3 + M4 + M5 + M6 + I
–N6	–N7	–N8	0	0
O6	O7	O8	0	0
P6	P7	P8	0	0

Lay pages vertically to p. 37

then horizontally

−1	−1	−1	−1	0
)A2"	"DE1"	"DE2"	"HD"	"BI"
$_{)A2}(t)$	$F_{DE1}(t)$	$F_{DE2}(t)$	$H_D(t)$	$B_I(t)$
0	0	0	0	0
B6	B7	B8	0	−(B1 + B2 + B3 + B4 + B5 + B6 + E
−C6	−C7	−C8	C1 + C2 + C3 + C4 + C5 + C6 + C7 + C8	0
0	0	0	D1	−D1
−E6	−E7	−E8	0	0
−F6	−F7	−F8	0	0
(G2 + G4 + G8)	−G7	−G8	0	0
−H6	(−H7 + H8) + (H1 + H3 + H5)	(−H8 + H7) + (H2 + H4 + H6)	0	0
−I6	−I7	−I8	−I9	−I10
−J6	−J7	−J8	−J9	−J10
$K4 + K8) + \frac{K9 + K10}{2}$	−K7	−K8	−K9	−K10
−L6	$(-L7 + L8) + (L1 + L3 + L5) + \frac{L9 + L10}{2}$	$(-L8 + L7) + (L2 + L4 + L6) + \frac{L9 + L10}{2}$	−L9	−L10
-M6	−M7	−M8	0	M1 + M2 + M3 + M4 + M5 + M6 + I
−N6	−N7	−N8	0	0
O6	O7	O8	0	0
P6	P7	P8	0	0

$$\frac{\}_R(t)}{r_0, rr_\tau, rr_s, rr_m)}$$

Lay pages vertically to p. 37

then horizontally

$$\frac{\dot{}(t)}{C} - \frac{F_{DK1}(t)}{\tau_{CKA}} - \frac{F_{DK1}(t)}{\tau_{CKC}} - \frac{F_{DK1}(t)}{\tau_{CKE}} - \frac{F_{DK1}(t)}{\tau_{KKC}} + \frac{F_{DK2}(t)}{\tau_{KKC}} + \frac{H_D(t)}{2\cdot\tau_{KWC}} + F_{DK1}(t)\cdot r_D\left(F_{DK1}(t)\right) - \sigma_{KA}\cdot L_{K1}(t)\cdot W_M(t) - \sigma_{KC}\cdot L_{K1}(t)\cdot W_M(t) - \sigma_{KE}\cdot L_{K1}(t)\cdot W_M(t)$$

$$\frac{2(t)}{EC} - \frac{F_{DK2}(t)}{\tau_{CKA}} - \frac{F_{DK2}(t)}{\tau_{CKC}} - \frac{F_{DK2}(t)}{\tau_{CKE}} + \frac{F_{DK1}(t)}{\tau_{KKC}} - \frac{F_{DK2}(t)}{\tau_{KKC}} + \frac{H_D(t)}{2\cdot\tau_{KWC}} + F_{DK2}(t)\cdot r_D\left(F_{DK2}(t)\right) - \sigma_{KA}\cdot L_{K2}(t)\cdot W_M(t) - \sigma_{KC}\cdot L_{K2}(t)\cdot W_M(t) - \sigma_{KE}\cdot L_{K2}(t)\cdot W_M(t)$$

$$- \sigma_{CC}\cdot L_{C1}(t)\cdot W_M(t) + \sigma_{CC}\cdot L_{C2}(t)\cdot W_M(t) - \sigma_{CE}\cdot L_{C1}(t)\cdot W_M(t) + \sigma_{EC}\cdot L_{E1}(t)\cdot W_M(t) + \sigma_{KC}\cdot L_{K1}(t)\cdot W_M(t)$$

$$+ \sigma_{CC} \cdot L_{C1}(t) \cdot W_M(t) - \sigma_{CC} \cdot L_{C2}(t) \cdot W_M(t) - \sigma_{CE} \cdot L_{C2}(t) \cdot W_M(t) + \sigma_{EC} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{KC} \cdot L_{K2}(t) \cdot W_M(t)$$

$$- \sigma_{AC} \cdot L_{A1}(t) \cdot W_M(t) + \sigma_{CA} \cdot L_{C1}(t) \cdot W_M(t) - \sigma_{AE} \cdot L_{A1}(t) \cdot W_M(t) + \sigma_{EA} \cdot L_{E1}(t) \cdot W_M(t) + \sigma_{KA} \cdot L_{K1}(t) \cdot W_M(t)$$

$$- \sigma_{AC} \cdot L_{A2}(t) \cdot W_M(t) + \sigma_{CA} \cdot L_{C2}(t) \cdot W_M(t) - \sigma_{AE} \cdot L_{A2}(t) \cdot W_M(t) + \sigma_{EA} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{KA} \cdot L_{K2}(t) \cdot W_M(t)$$

$$\sigma_{CE} \cdot L_{C1}(t) \cdot W_M(t) - \sigma_{EC} \cdot L_{E1}(t) \cdot W_M(t) - \sigma_{EE} \cdot L_{E1}(t) \cdot W_M(t) + \sigma_{EE} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{KE} \cdot L_{K1}(t) \cdot W_M(t)$$

$$\sigma_{CE} \cdot L_{C2}(t) \cdot W_M(t) - \sigma_{EC} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{EE} \cdot L_{E1}(t) \cdot W_M(t) - \sigma_{EE} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{KE} \cdot L_{K2}(t) \cdot W_M(t)$$

$$)$$

$B_R(0) = B_{R0}$

$F_{LK1}(0) = F_{LK10}$

$F_{LK2}(0) = F_{LK20}$

$F_{LC1}(0) = F_{LC10}$

$F_{LC2}(0) = F_{LC20}$

$F_{LA1}(0) = F_{LA10}$

$F_{LA2}(0) = F_{LA20}$

$F_{LE1}(0) = F_{LE10}$

$F_{LE2}(0) = F_{LE20}$

$F_{DK1}(0) = F_{DK10}$

$F_{DK2}(0) = F_{DK20}$

$$\frac{F_{DK1}(t)}{\tau_{CKC}} - \frac{F_{DK1}(t)}{\tau_{CKE}} - \frac{F_{DK1}(t)}{\tau_{KKC}} + \frac{F_{DK2}(t)}{\tau_{KKC}} + \frac{H_D(t)}{2\cdot\tau_{KWC}} + F_{DK1}(t)\cdot r_D\left(F_{DK1}(t)\right) - \sigma_{KA}\cdot L_{K1}(t)\cdot W_M(t) - \sigma_{KC}\cdot L_{K1}(t)\cdot W_M(t) - \sigma_{KE}\cdot L_{K1}(t)\cdot W_M(t)$$

$F_{DC1}(0) = F_{DC10}$

$$\frac{F_{DK2}(t)}{\tau_{CKC}} - \frac{F_{DK2}(t)}{\tau_{CKE}} + \frac{F_{DK1}(t)}{\tau_{KKC}} - \frac{F_{DK2}(t)}{\tau_{KKC}} + \frac{H_D(t)}{2\cdot\tau_{KWC}} + F_{DK2}(t)\cdot r_D\left(F_{DK2}(t)\right) - \sigma_{KA}\cdot L_{K2}(t)\cdot W_M(t) - \sigma_{KC}\cdot L_{K2}(t)\cdot W_M(t) - \sigma_{KE}\cdot L_{K2}(t)\cdot W_M(t)$$

$F_{DC2}(0) = F_{DC20}$

$F_{DA1}(0) = F_{DA10}$

$$) + \sigma_{CC}\cdot L_{C2}(t)\cdot W_M(t) - \sigma_{CE}\cdot L_{C1}(t)\cdot W_M(t) + \sigma_{EC}\cdot L_{E1}(t)\cdot W_M(t) + \sigma_{KC}\cdot L_{K1}(t)\cdot W_M(t)$$

$F_{DA2}(0) = F_{DA20}$

Lay pages vertically to p. 37

then horizontally

$) - \sigma_{CC} \cdot L_{C2}(t) \cdot W_M(t) - \sigma_{CE} \cdot L_{C2}(t) \cdot W_M(t) + \sigma_{EC} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{KC} \cdot L_{K2}(t) \cdot W_M(t)$

$(t) + \sigma_{CA} \cdot L_{C1}(t) \cdot W_M(t) - \sigma_{AE} \cdot L_{A1}(t) \cdot W_M(t) + \sigma_{EA} \cdot L_{E1}(t) \cdot W_M(t) + \sigma_{KA} \cdot L_{K1}(t) \cdot W_M(t)$

$(t) + \sigma_{CA} \cdot L_{C2}(t) \cdot W_M(t) - \sigma_{AE} \cdot L_{A2}(t) \cdot W_M(t) + \sigma_{EA} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{KA} \cdot L_{K2}(t) \cdot W_M(t)$

$\cdot \sigma_{EC} \cdot L_{E1}(t) \cdot W_M(t) - \sigma_{EE} \cdot L_{E1}(t) \cdot W_M(t) + \sigma_{EE} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{KE} \cdot L_{K1}(t) \cdot W_M(t)$

$\cdot \sigma_{EC} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{EE} \cdot L_{E1}(t) \cdot W_M(t) - \sigma_{EE} \cdot L_{E2}(t) \cdot W_M(t) + \sigma_{KE} \cdot L_{K2}(t) \cdot W_M(t)$

$F_{DE1}(0) = F_{DE10}$

$F_{DE2}(0) = F_{DE20}$

$H_D(0) = H_{D0}$

$B_I(0) = B_{I0}$

$\frac{F_{DA2}(t)}{inv_0, inv_\tau, inv_s, inv_m) \cdot (P_K(t))} - \gamma \cdot K_{A2}(t)$

$) - \frac{1}{v_A} \cdot (K_{A2}(t)) \Big]$

Energy 1

$K_{E1}(0) = K_{E10}$

$\frac{d}{dt} K_{E1}(t) = \frac{F_{DE1}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m) \cdot (P_K(t))} - \gamma \cdot K_{E1}(t)$

$Q_{E1}(0) = Q_{E10}$

$\frac{d}{dt} Q_{E1}(t) = \frac{-1}{\tau_{QE}} \cdot \left[Q_{E1}(t) - \frac{1}{v_E} \cdot (K_{E1}(t)) \right]$

Energy 2

$K_{E2}(0) = K_{E20}$

$\frac{d}{dt} K_{E2}(t) = \frac{F_{DE2}(t)}{\tau_{pr}(pr_E(t), inv_0, inv_\tau, inv_s, inv_m) \cdot (P_K(t))} - \gamma \cdot K_{E2}(t)$

$Q_{E2}(0) = Q_{E20}$

$\frac{d}{dt} Q_{E2}(t) = \frac{-1}{\tau_{QE}} \cdot \left[Q_{E2}(t) - \frac{1}{v_E} \cdot (K_{E2}(t)) \right]$

Lay pages vertically to p. 37

then horizontally

$$L_{E1}(0) = L_{E10}$$

$$L_{E2}(0) = L_{E20}$$

$$\frac{d}{dt}L_{E1}(t) = \frac{-1}{\tau_{LE}}\cdot\left(L_{E1}(t) - \frac{Q_{E1}(t)}{a_E(t)}\right)$$

$$\frac{d}{dt}L_{E2}(t) = \frac{-1}{\tau_{LE}}\cdot\left(L_{E2}(t) - \frac{Q_{E2}(t)}{a_E(t)}\right)$$

$$P_E(0) = P_{E0}$$

$$\frac{d}{dt}P_E(t) = \frac{-1}{\tau_{PE}}\cdot\left[P_E(t) - \frac{W_M(t)}{a_E(t)\cdot\left(1 - s_E\right)}\right]$$

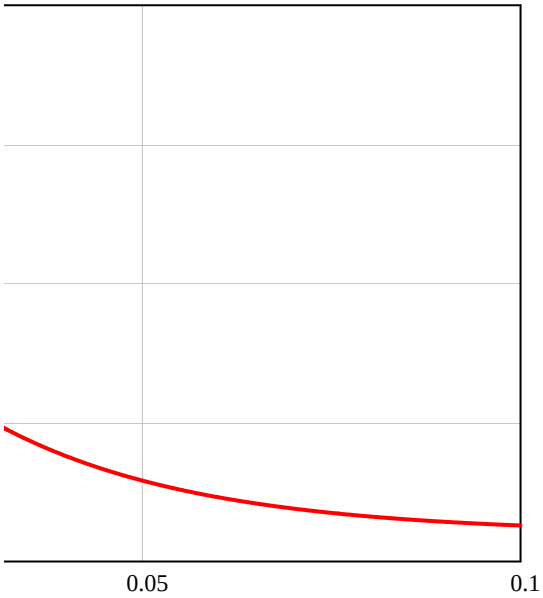
$$a_E(0) = a_{E0}$$

Credit and Nominal GDP

Lay pages vertically to p. 37

then horizontally

reation as function of rate of profit



Rate of profit

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then horizontally