An Empirically Calibrated IO-SFC Model for Assessing Green Transition Policies in Italy

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Introduction

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JUST2CE A Just Transition to Circular Economy
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  - Foreign sector: stylised foreign sector instead of a two-area model.
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  - Ecosystem: GHG emissions only instead of a fully developed environmental block.

Reclass. Balance-Sheet of Italy in 2021

	Workers	Rentiers	Firms	Government	Banks	Central bank	Foreign	Total
Cash and reserves	130.44	70.24	0.00	0.00	10.82	-211.5	0.00	0.00
Deposits	1656.88	1355.62	0.00	0.00	-3012.50	0.00	0.00	0.00
Loans	-572.61	-190.87	-871.9	0.00	1635.39	0.00	0.00	0.00
Advances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T-bills	34.99	198.27	0.00	-2678.4	1366.29	211.5	867.34	0.00
Domestic securities	686.26	6041.83	-6728.1	0.00	0.00	0.00	0.00	0.00
Foreign securities	0.00	867.34	0.00	0.00	0.00	0.00	-867.34	0.00
Capital stock	0.00	0.00	7600.00	0.00	0.00	0.00	0.00	7600.00
Net financial wealth	-1935.96	-8342.43	0.00	2678.4	0.00	0.00	0.00	-7600.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Reclass. Transactions-Flow Matrix in 2021

	Workers	Rentiers	Firms		Government	Banks	Central bank	Foreign	Total
			Current	*Capital*					
Consumption	-407.94	-622.18	1030.12	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.00	0.00	357.21	-357.21	0.00	0.00	0.00	0.00	0.00
Government spending	0.00	0.00	394.72	0.00	-394.72	0.00	0.00	0.00	0.00
Export	0.00	0.00	582.19	0.00	0.00	0.00	0.00	-582.19	0.00
Import	0.00	0.00	-582.19	0.00	0.00	0.00	0.00	582.19	0.00
[Value added]			[1782.05]						
Wages	624.62	32.88	-657.50	0.00	0.00	0.00	0.00	0.00	0.00
Deprec. / Amort.	0.00	0.00	-357.21	357.21	0.00	0.00	0.00	0.00	0.00
Firms profit	0.00	653.34	-653.34	0.00	0.00	0.00	0.00	0.00	0.00
Banks profit	0.00	38.19	0.00	0.00	0.00	-38.19	0.00	0.00	0.00
Tax revenue	-218.74	-200.65	0.00	0.00	419.39	0.00	0.00	0.00	0.00
Interests on reserves	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interests on deposits	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interests on loans	-8.59	-2.86	-13.08	0.00	0.00	24.53	0.00	0.00	0.00
Interests on advances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interests on T-bills	0.35	1.98	0.00	0.00	-26.78	13.66	2.11	8.67	0.00
Interests on domestic sec.s	10.29	90.63	-100.92	0.00	0.00	0.00	0.00	0.00	0.00
Interests on foreign sec.s	0.00	8.67	0.00	0.00	0.00	0.00	0.00	-8.67	0.00
Seigniorage income	0.00	0.00	0.00	0.00	2.11	0.00	-2.11	0.00	0.00
Change in cash and reserves	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Change in deposits	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Change in loans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Change in advances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Change in T-bills	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Change in domestic sec.s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Change in foreign sec.s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Technical Coefficients from IO Table

Code	A	B	C*	C19	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
A	0.0698	0.0014	0.0220	0.0007	0.0166	0.0024	0.0006	0.0062	0.0014	0.0223	0.0006	0.0003	0.0001	0.0015	0.0057	0.0015	0.0007	0.0010	0.0046	0.0030
B	0.0002	0.0104	0.0009	0.0655	0.0059	0.0010	0.0014	0.0008	0.0015	0.0008	0.0001	0.0001	0.0001	0.0002	0.0002	0.0004	0.0003	0.0009	0.0005	0.0003
C*	0.1033	0.0569	0.2647	0.0289	0.0317	0.0686	0.1150	0.0435	0.0591	0.1342	0.0442	0.0135	0.0091	0.0525	0.0771	0.0157	0.0085	0.0736	0.0509	0.0527
C19	0.0138	0.0216	0.0032	0.0562	0.0046	0.0043	0.0048	0.0031	0.0238	0.0008	0.0002	0.0005	0.0001	0.0005	0.0012	0.0006	0.0008	0.0004	0.0010	0.0012
D	0.0213	0.0200	0.0165	0.0107	0.3398	0.0317	0.0044	0.0123	0.0170	0.0259	0.0084	0.0038	0.0010	0.0092	0.0018	0.0182	0.0108	0.0154	0.0113	0.0544
E	0.0069	0.0492	0.0112	0.0058	0.0080	0.1266	0.0113	0.0049	0.0067	0.0148	0.0040	0.0008	0.0006	0.0026	0.0043	0.0417	0.0024	0.0049	0.0067	0.0049
F	0.0116	0.0129	0.0078	0.0033	0.0055	0.0150	0.1861	0.0099	0.0150	0.0065	0.0106	0.0041	0.0176	0.0164	0.0136	0.0159	0.0042	0.0131	0.0092	0.0050
G	0.0712	0.0602	0.0824	0.0994	0.0344	0.0306	0.0319	0.0612	0.0530	0.0703	0.0399	0.0274	0.0039	0.0283	0.0400	0.0096	0.0064	0.0370	0.0340	0.0251
H	0.0202	0.0570	0.0324	0.0699	0.0395	0.0493	0.0212	0.0654	0.1710	0.0176	0.0103	0.0061	0.0011	0.0113	0.0258	0.0132	0.0062	0.0115	0.0130	0.0113
I	0.0020	0.0094	0.0035	0.0264	0.0053	0.0043	0.0127	0.0039	0.0128	0.0033	0.0046	0.0010	0.0011	0.0047	0.0143	0.0037	0.0087	0.0041	0.0017	0.0067
J	0.0022	0.0640	0.0123	0.0043	0.0126	0.0226	0.0089	0.0256	0.0171	0.0213	0.1431	0.0303	0.0018	0.0329	0.0198	0.0128	0.0053	0.0101	0.0345	0.0194
K	0.0139	0.0148	0.0159	0.0051	0.0177	0.0156	0.0216	0.0455	0.0230	0.0197	0.0196	0.2118	0.0358	0.0174	0.0235	0.0231	0.0049	0.0109	0.0241	0.0297
L	0.0010	0.0160	0.0091	0.0010	0.0058	0.0118	0.0104	0.0479	0.0204	0.0514	0.0272	0.0242	0.0083	0.0196	0.0166	0.0109	0.0103	0.0180	0.0280	0.0237
M	0.0119	0.0407	0.0317	0.0127	0.0199	0.0354	0.0652	0.0627	0.0365	0.0209	0.0679	0.0295	0.0120	0.1223	0.0819	0.0305	0.0181	0.0277	0.0643	0.0353
N	0.0064	0.0316	0.0179	0.0152	0.0085	0.0653	0.0490	0.0302	0.0338	0.0190	0.0318	0.0087	0.0062	0.0282	0.0499	0.0508	0.0128	0.0229	0.0364	0.0163
O	0.0021	0.0173	0.0049	0.0337	0.0020	0.0412	0.0050	0.0046	0.0055	0.0059	0.0059	0.0014	0.0008	0.0034	0.0048	0.0159	0.0023	0.0039	0.0211	0.0028
P	0.0000	0.0023	0.0012	0.0003	0.0006	0.0017	0.0015	0.0024	0.0023	0.0006	0.0029	0.0006	0.0000	0.0026	0.0037	0.0038	0.0101	0.0035	0.0026	0.0071
Q	0.0008	0.0031	0.0007	0.0022	0.0002	0.0053	0.0010	0.0004	0.0008	0.0005	0.0009	0.0004	0.0001	0.0068	0.0138	0.0024	0.0066	0.0902	0.0160	0.0010
R	0.0003	0.0044	0.0028	0.0212	0.0010	0.0021	0.0038	0.0027	0.0021	0.0094	0.0168	0.0004	0.0005	0.0027	0.0058	0.0011	0.0011	0.0019	0.1302	0.0083
S	0.0037	0.0026	0.0013	0.0093	0.0014	0.0082	0.0024	0.0011	0.0019	0.0016	0.0030	0.0007	0.0003	0.0037	0.0109	0.0046	0.0025	0.0079	0.0087	0.0067

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(3) GDP: $Y_n = \mathbf{p}^T \cdot (\mathbf{x} \cdot [\mathbf{I} - \mathbf{A}]) - \mathbf{p}_m^T \cdot \boldsymbol{\psi} \cdot im$

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(8) Working-class consumer price index: $p_w = \mathbf{p}^T \cdot \boldsymbol{\beta}_w$

Households

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(12) Personal loans: $L_w = L_{w,-1} \cdot (1 - \delta_w) + \theta_w \cdot YD_w$

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– Capital and investment decisions

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(19) Firms' net borrowing: $L_f = L_{f,-1} + p_{id} \cdot id - AF - \Pi_u - \Delta E_s$

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(23) Bank advances: $A_d = -B_b$, if $B_b < 0$

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(23) Bank advances: $A_d = -B_b$, if $B_b < 0$

- Bank Profits

Banks and Finance

- Loans and Reserves

(20) Supply of loans: $L_s = L_{s,-1} + \Delta L_f + \Delta L_w + \Delta L_z$

(21) Bank reserves: $H_b = \rho \cdot M_{s,-1}$

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$\Pi_b = PAYM_b^L + PAYM_b^H + PAYM_b^B + PAYM_b^R - PAYM_b^M$

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(27) Total employment: $N = \sum_{j=1}^{20} \mathbf{n}(j)$

Interest Rates and Risk Premia

- Interest rate setting

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(30) Interest payments: $PAYM^L_f = r_{l,-1} \cdot L_{f,-1}$

The Government

– Government Revenues and Expenditures

The Government

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(31) Net taxes paid by workers:

$$T_w = \tau_w^w \cdot WB \cdot (1 - \omega) + \tau_z \cdot PAYM_w^A + \tau_v \cdot V_{w,-1}$$

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(34) Government debt accumulation: $B_s = B_{s,-1} + DEF$

The Central Bank

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Portfolio Equations

– Asset Allocation by Workers

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$$\frac{B_w}{V_w} = \lambda_{10}^w - \lambda_{11}^w \cdot r_m + \lambda_{12}^w \cdot r_b - \lambda_{13}^w \cdot r_e - \lambda_{14}^w \cdot (r_q + r_{cg}) - \lambda_{15}^w \cdot \frac{YD_w}{V_w}$$

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(39) Bank deposits as a buffer stock:
$$M_w = V_w + L_w - H_w - B_w - E_w$$

Foreign Sector

- Trade balance

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(40) Exports: $ln(ex) = \epsilon_0 - \epsilon_1 \cdot ln(\frac{p_x}{p_m}) + \epsilon_2 \cdot ln(y_f)$

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(45) Long-run exchange rate: $xr^* = xr^*_{-1} - \sigma^2_{xr} \cdot CAB$

Price Expectations

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(47) Expected price level (for working class): $p_w^e = p_{w,-1} \cdot (1 + \pi_w^e)$

Environmental Impact

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(48) Sectoral emissions: $\mathbf{emis} = \epsilon \odot \mathbf{x}$

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(48) Sectoral emissions: $\mathbf{emis} = \epsilon \odot \mathbf{x}$

(49) Total emissions: $EMIS = \epsilon^T \cdot \mathbf{x} = \sum_{j=1}^{20} \mathbf{emis}(j)$

Hidden Equation

– Redundant equation

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(36.B) Cash supply: $H_s = H_w + H_z + H_b$

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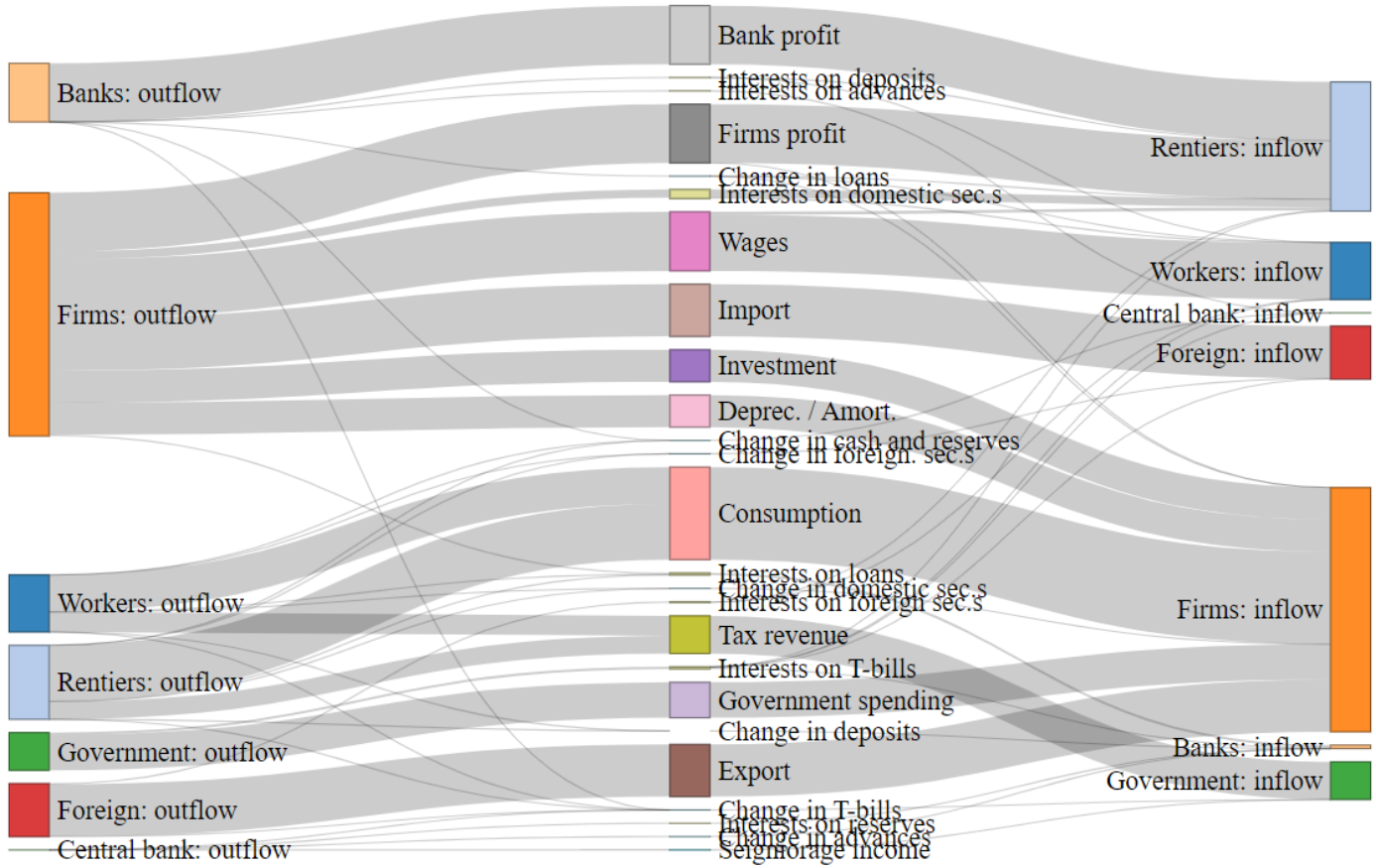
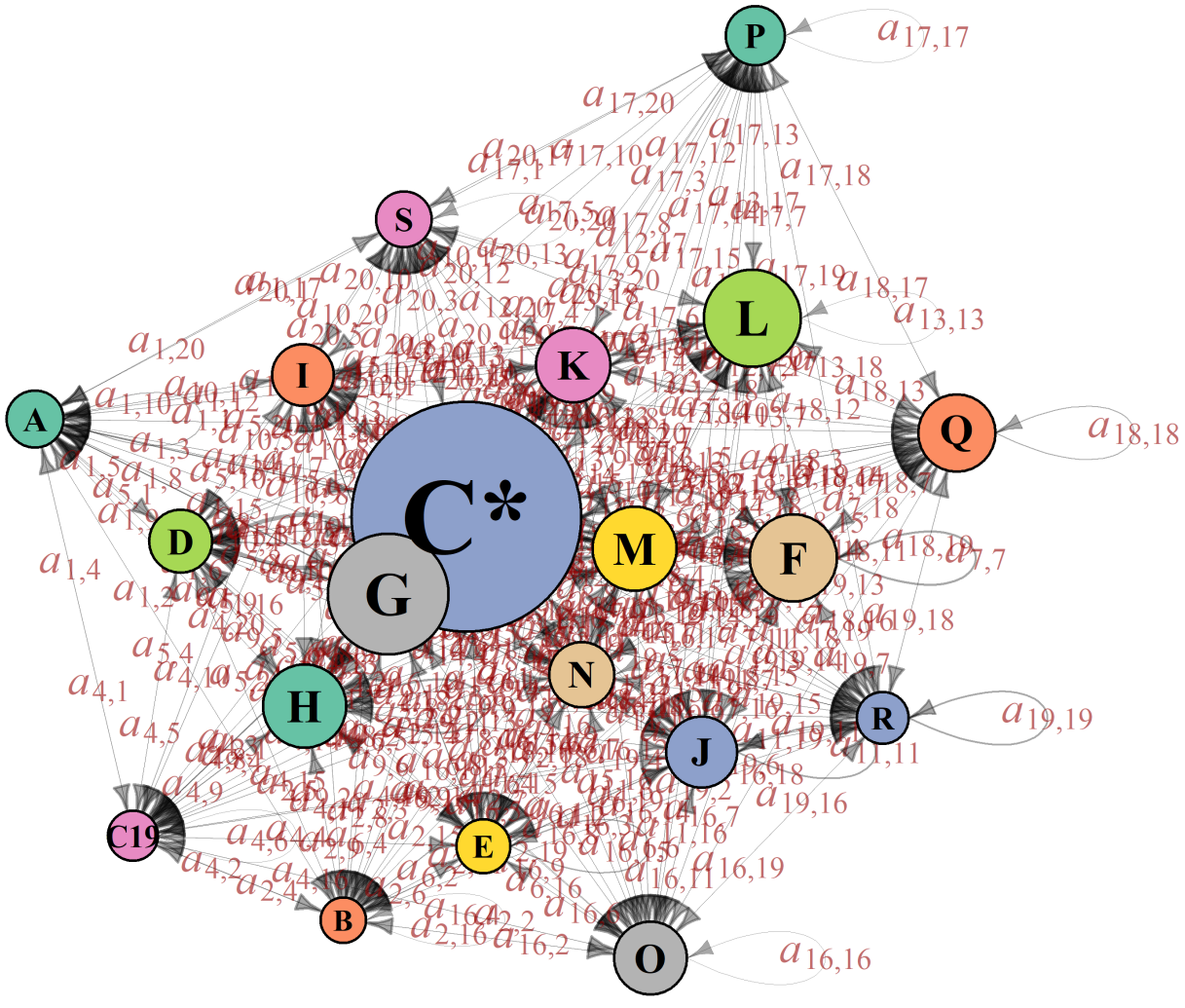
Cross-sector transactions in 2021



Cross-industry interdependencies in 2021



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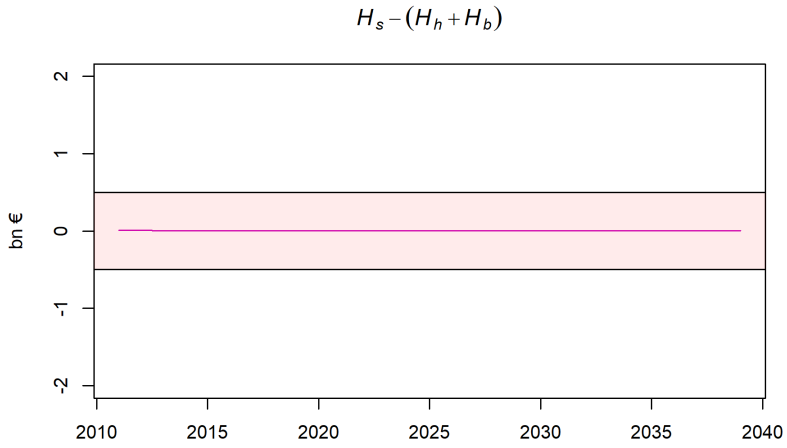
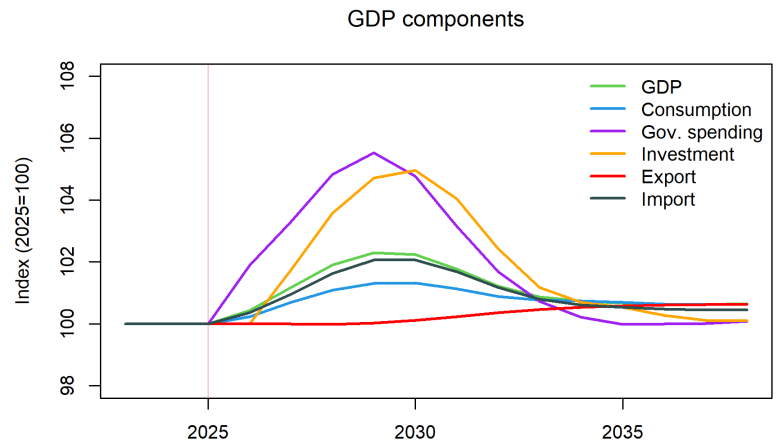
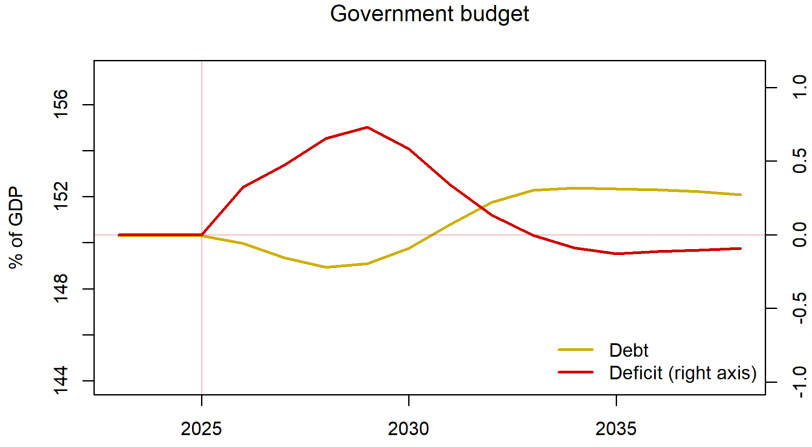
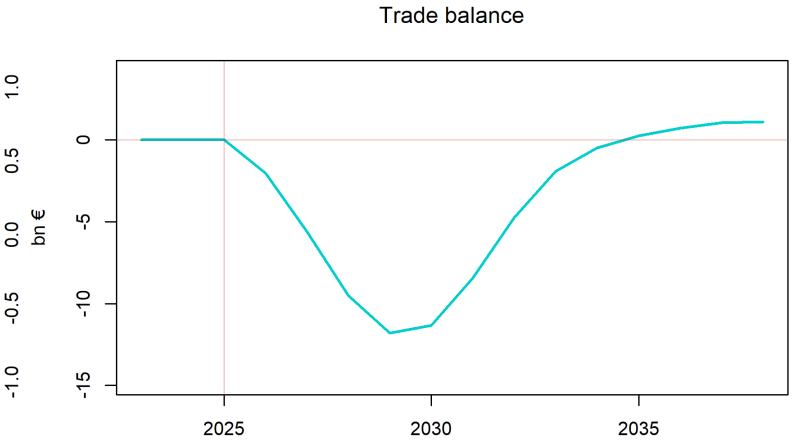
- Sigmoid adjustment of spending (and return to pre-shock level).

Selected variables after the shock









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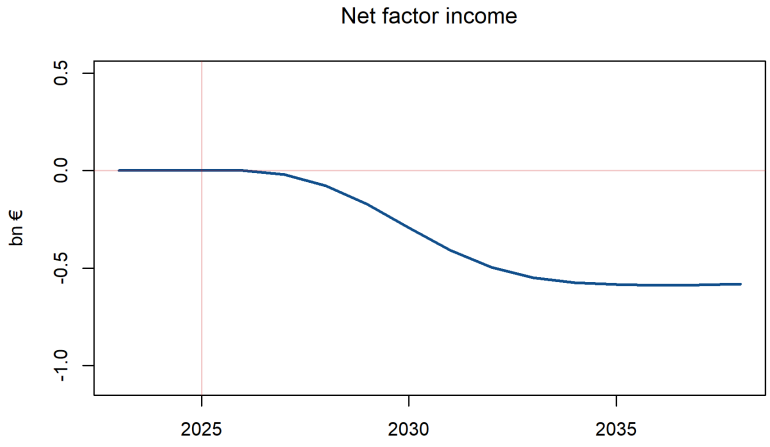

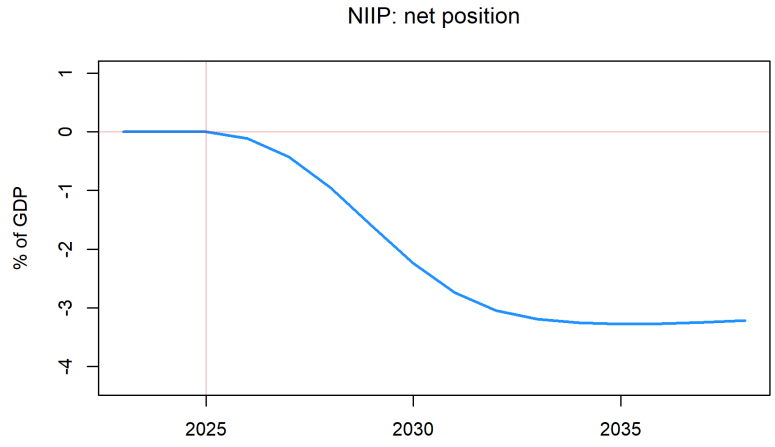

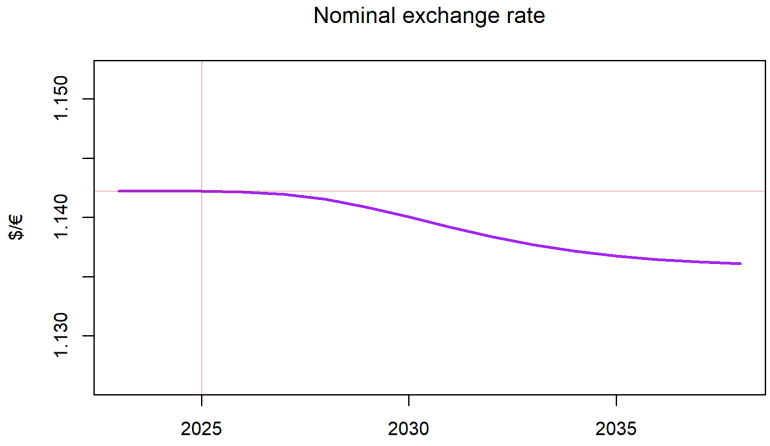

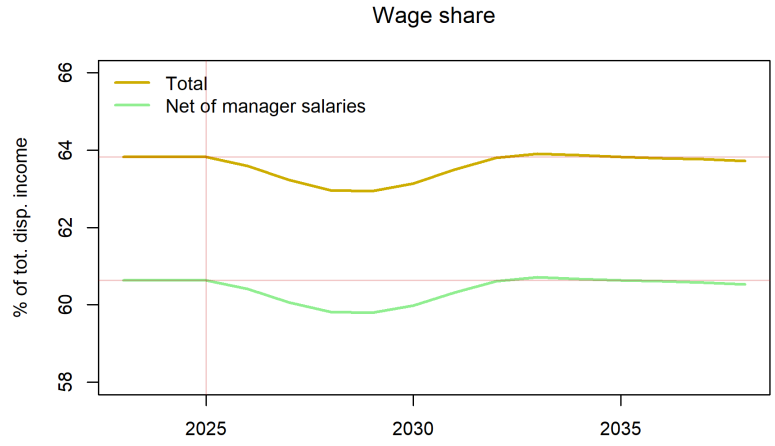

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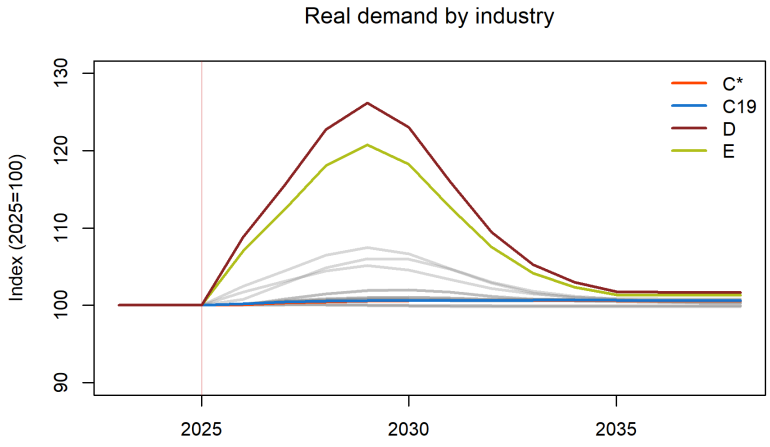

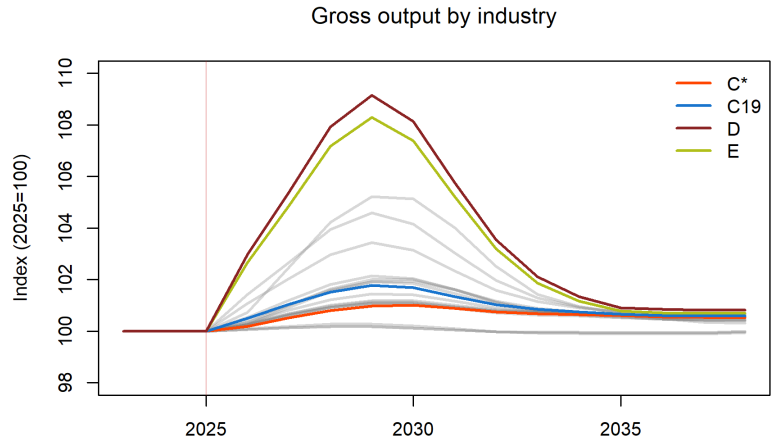

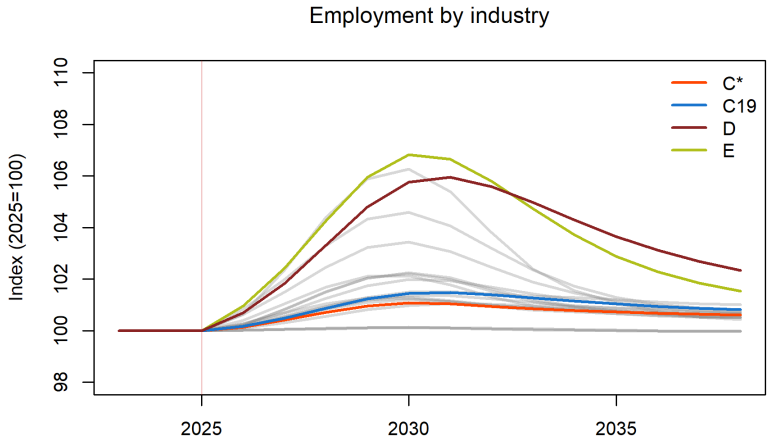

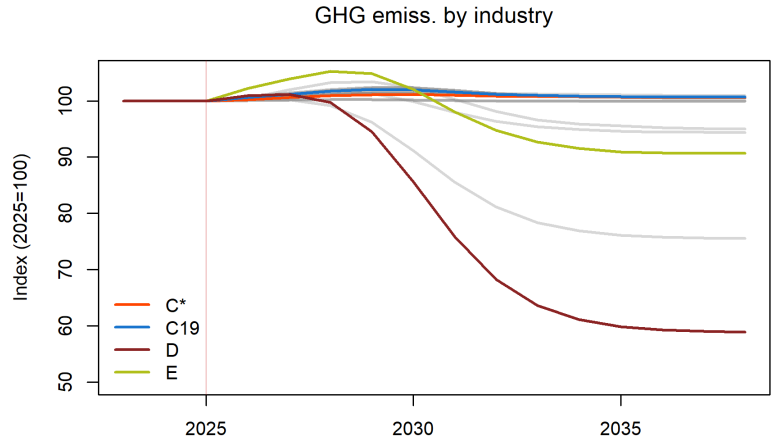

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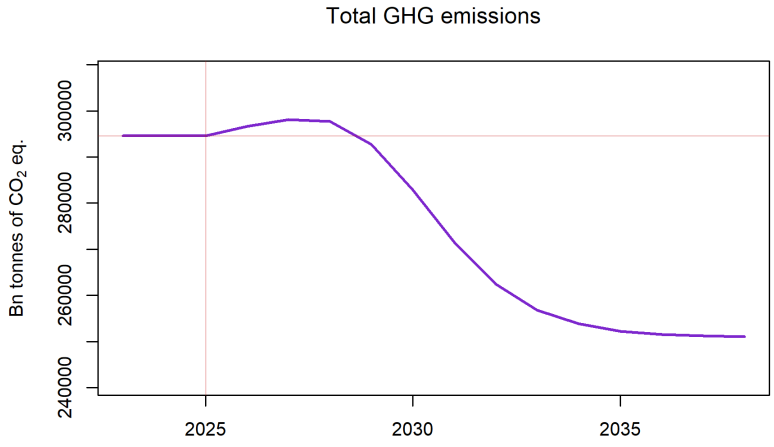

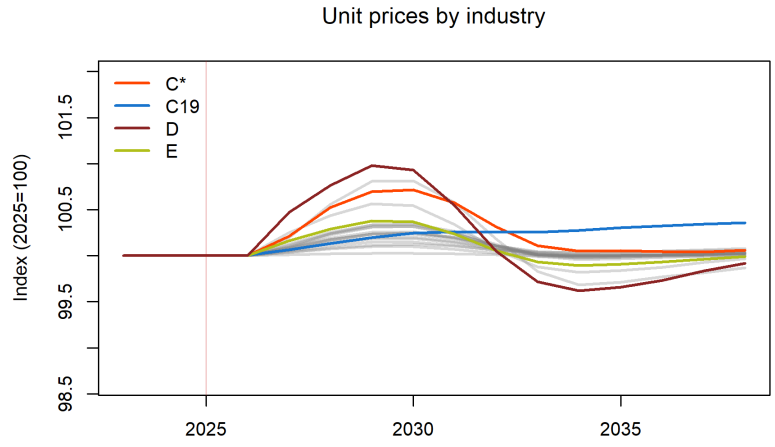

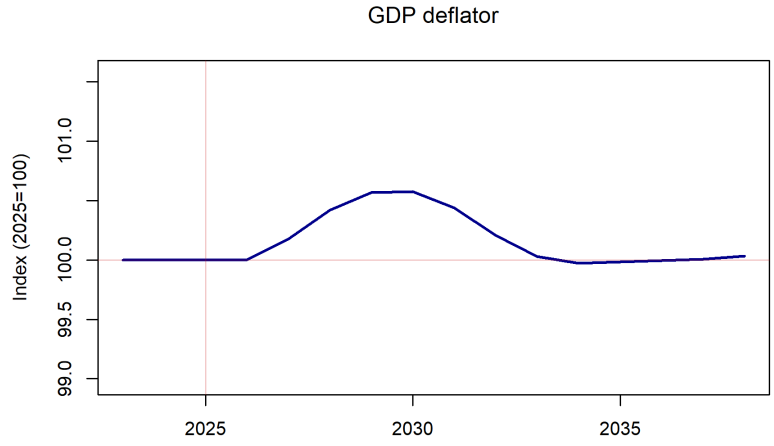

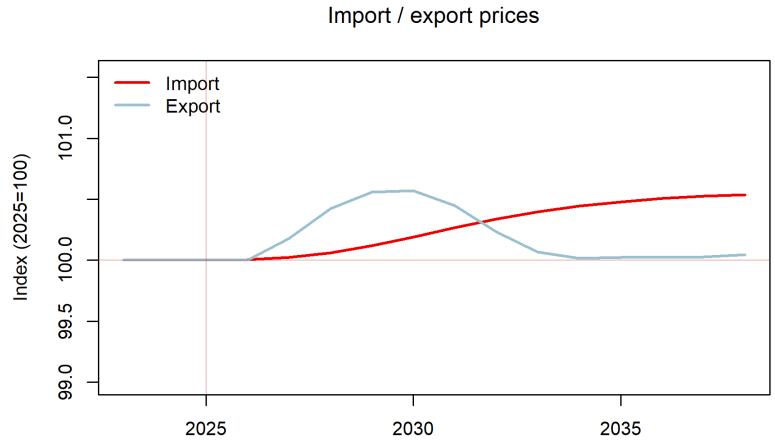

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- The model works smoothly and is watertight. However, IO relations must be carefully double-checked.
- Key message from early experiments: the transition takes time (rebound) and is likely to have uneven effects on different social groups.

Thank you

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