

A new star is born

A Multisectoral Macroeconometric Model of UK



Built by

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First an overview of the IO side
before entering the Institutional
accounts

The classical definition of the equations of an econometric model
Cowles Commission Monograph n.10 - 1950
Koopmans - Rubin - Liepnik

BE - Behavior equations – agents' economic decisions

IE -Institutional equations – pattern sets by law or rule

TE -Technical equations - physical relations between input and output

ID -Identities

The equations in IO side of the UK Model

data sources: Eurostat and UKSS

- Households Consumption 10 sectors BE
- Investments 2 macros BE
- Imports 15 sectors BE
- Labor productivity 63 sectors TE
- Wages 2 macro and 63 sectors BE
- Social securities 63 sectors IE
- Indirect taxes on production 63 sectors IE
- Operating Surplus 63 sectors BE
- Production prices 63 sectors BE
- Exports waiting for BTM

Final demand at basic prices

the impact of imports for intermediate consumption on final demand
For an IO model builder these statistics are more informative than the Grubel-Lloyd indexes

	UK	France	Italy	Spain
1 Agriculture	8052	18685	9051	12784
2 Forestry	127	3005	669	338
3 Fishing	785	-210	1038	1577
4 Mining	-7527	-33202	-35597	-30753
5 FoodBev	25836	99388	64323	55000
6 Textiles	3632	277	40123	4683
7 Wood	-2052	-1168	-572	112
8 Paper	-4631	41	3099	1041
9 Printing	813	95	345	39
10 CokePetr	-1699	10701	19398	15143
11 Chemic	2956	9369	-4011	880
12 Pharma	6112	16574	8320	2909
13 RubPlast	-1454	-2755	8732	-371
14 No-Metal	-2045	-1074	6375	3686
15 Metal	-4271	-2694	-3122	2931
16 MetProd	2258	3487	18047	6445
17 Computer	-10526	-241	4557	-1657
18 ElectrGas	-1072	-36	14451	2944
19 Machin	12046	6749	71724	13075
20 Vehicles	22555	39610	22207	31603
21 OtTransp	21162	41170	13469	8783
22 Furniture	5976	6017	25718	3560

Import shares on total resources and their increase in 19 years

PROD_NA/INDUSE	1998	2016/ 2016	1998	2016/ 2016	PROD_NA/INDUSE	1998	2016/ 2016	1998
1 Products of agriculture, hunting and services	0,27	0,32	1,18	13 Rubber and plastic products	0,21	0,36	1,68	
2 Products of forestry, logging and related services	0,08	0,07	0,86	14 Other non-metallic mineral products	0,12	0,22	1,78	
3 Fish and other fishing products	0,11	0,23	2,01	15 Basic metals	0,29	0,52	1,79	
4 Mining and quarrying	0,17	0,39	2,29	16 Fabricated metal products	0,11	0,23	2,11	
5 Food, beverages and tobacco products	0,23	0,34	1,48	17 Computer, electronic and optical products	0,47	0,70	1,49	
6 Textiles, wearing apparel, leather products	0,45	0,74	1,64	18 Electrical equipment	0,33	0,62	1,89	
7 Wood and of products of wood and cork	0,24	0,33	1,39	19 Machinery and equipment n.e.c.	0,36	0,51	1,41	
8 Paper and paper products	0,32	0,37	1,18	20 Motor vehicles, trailers and semi-trailers	0,36	0,55	1,54	
9 Printing and recording services	0,00	0,00	0,66	21 Other transport equipment	0,51	0,50	0,98	
10 Coke and refined petroleum products	0,27	0,49	1,83	22 Furniture and other manufactured goods	0,31	0,56	1,81	
11 Chemicals and chemical products	0,36	0,43	1,19	23 Electricity, gas, steam and air conditioning	0,01	0,01	0,75	
12 Basic pharmaceutical products	0,25	0,57	2,31	24 Sewerage services; sewage sludge; waste collection	0,11	0,11	1,00	

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The imports equations in UK model

no soft constraints

Sec	Product	const	lpp	imptime	RHO	RSQ
2	Products of forestry, logging and relate	-2.109	-0.5034	-0.04533	0.4167	0.3077
5	Food, beverages and tobacco products	-1.365	-0.7127	0.02697	0.5522	0.7673
7	Wood and products of wood and cork	-1.108	-0.7491	0.00200	0.3222	0.9101
8	Paper and paper products	-1.066	-0.2203	0.00650	0.5440	0.4975
10	Coke and refined petroleum products	-1.324	-0.5348	0.05616	0.3722	0.8135
11	Chemicals and chemical products	-0.996	-0.2877	0.02008	0.6298	0.6044
14	Other non-metallic products	-2.074	-0.0166	0.04458	0.5313	0.9300
15	Basic metals	-1.138	-0.1610	0.04891	0.1903	0.8445
16	Fabricated metal products	-1.935	-0.4257	0.03485	0.1213	0.9645
17	Computer, electronic and optical product	-0.263	-0.7014	-0.01734	0.3825	0.5302
18	Electrical equipment	-1.001	-0.2444	0.05768	-0.0828	0.9845
19	Machinery and equipment n.e.c.	-0.876	-0.2705	0.02436	0.6879	0.8898
20	Motor vehicles, trailers and semi-trailer	-0.790	-0.1920	0.01891	0.4598	0.8839
21	Other transport equipment	-0.773	-0.4743	0.00080	0.1620	0.5090
22	Furniture and other manufactured goods	-0.982	-0.4750	0.04472	0.5182	0.9455

From the IO model to the Institutional accounts

- The real side and the price side of a multisectoral Inforum type model is a an identity-centered model.
- In forecasting and policy analysis, the multisectoral Inforum model turns out to be identity-constrained based
- Some sectoral endogenous variables under the IO accounting constraints are then poured into the Institutional accounts where new balancing constraints pop up.

Macrovariables 'generated' in the IO side used to feed Institutional accounts

- Wages
- Social contributions
- Indirect taxes on production
- Subsidies
- Gross Operating Surplus
- Value added
- Value added is lacking in Imputed rents of owner-occupied dwellings

Gross Operational Surplus

Imputed rents of owner-occupied dwellings shares

Country	share	year
UK	22,3	2015
France	15,7	2015
Italy	14,3	2014
Austria	12,3	2015
Spain	15,9	2015
Germany	NA	NA

Moving from value added to income

- The distribution of value added is accomplished in two steps (two accounts)
- 1st step - Generation of income account
- The allocation of the value added reproduces that presented by industries in the columns of the use tables. The allocation of primary income is done from the point of view of the source sectors
- The balancing item is **Gross Operating Surplus** (Net Operating Surplus + Mixed Income)

Institutional sectors Gross Operating Surplus

- The allocation of the GOS recorded in the IO table among Institutional Sectors takes place in the kitchen of the Statistical Office.
- In default of any criteria to 'model' the allocation of the GOS to each institutional sector, in the computation of (not only) the Households' income, the Households' GOS is computed as a share of that of the economy.

The Gross Operation Surplus Institutional Sectors Shares

year	Corporations	Financial	Government	Households	Total
2010	0,59	0,10	0,05	0,27	1,00
2011	0,49	0,09	0,04	0,38	1,00
2012	0,48	0,09	0,04	0,39	1,00
2013	0,48	0,09	0,04	0,39	1,00
2014	0,49	0,08	0,04	0,39	1,00
2015	0,49	0,07	0,04	0,40	1,00
2016	0,49	0,07	0,04	0,40	1,00

Moving from value added to income

- 2nd step – Allocation of primary income account

The open item is Gross Operational Surplus

Here Institutional sectors are considered as recipients of primary income while in the previous account they are considered producer of primary income

This account hosts an item not coming from the IO framework:

Property income

The balancing item is

Gross Income

Households' Gross Income

$$\begin{aligned} & \text{Gross Operating Surplus} \\ + & \text{Compensation of employees} \\ & + \text{Property income (R)} \\ & - \text{Property income (U)} \\ = & \text{Households' Gross Income} \end{aligned}$$

Where does **property income** (D.4) come from?

- (a) interest (D.41);
- (b) distributed income of corporations (D.42):
- (c) reinvested earnings on foreign direct investment (D.43);
- (d) other investment income (D.44):
- (e) rents (D.45).
- And in more details, interest (D.41) is divided in (with reference to the Financial Accounts)
- (i) deposits (AF.2);
- (ii) debt securities (AF.3);
- (iii) loans (AF.4);
- (iv) other accounts receivable (AF.8).
- And dividends (D.421) are a form of property income to which owners of shares (AF.5) become entitled as a result of, for example, placing funds at the disposal of corporations.

The property income in Households' account is in fact the 'Hicksian correction'. Here is introduced (estimated) by means of a factor defined as follows

factorD4 =

balance of property income/
(gross operating surplus +
compensation of employees')

year	factorD4
2011	0,160
2012	0,148
2013	0,151
2014	0,162
2015	0,172
2016	0,160
2017	0,152
2018	0,150

Households' Disposable Income

$$\begin{aligned} & \text{Households' Gross Income} \\ & + \text{Social Benefits and other} \\ & + \text{Other current transfers (R)} \\ & - \text{Other current transfers (U)} \\ & - \text{Current taxes on income and wealth} \\ & - \text{net Social Contributions} \\ & = \\ & \text{Disposable Income} \end{aligned}$$

Social benefits and Social contributions

‘Social benefits and other’ comes from the Government account. This item belongs to the set of policy variables; hence,

‘**Social benefits and other**’ is a scenario variable.

Social contributions are the sum of the Employers’ social contribution and Households’ social contributions

- Employers’ social contribution are generated by the IO side
- Households’ social contributions is modelled inside the account.

Households' social contributions

Households' social contributions are related to the Households' income by means of the following factor

Fac =

$\frac{\text{Households' social contributions}}{\text{Households' income}}$

year	fac
2011	0,099
2012	0,088
2013	0,084
2014	0,094
2015	0,085
2016	0,086
2017	0,078
2018	0,078

Income tax and other current transfers are both related to Households' income

Income tax rate – a policy instrument

year	tax rates
2011	0,156
2012	0,149
2013	0,148
2014	0,145
2015	0,145
2016	0,148
2017	0,151
2018	0,151

Other current transfers – a simple factor

year	fac
2.011	0,028
2.012	0,027
2.013	0,027
2.014	0,027
2.015	0,026
2.016	0,026
2.017	0,027
2.018	0,027

other current transfers

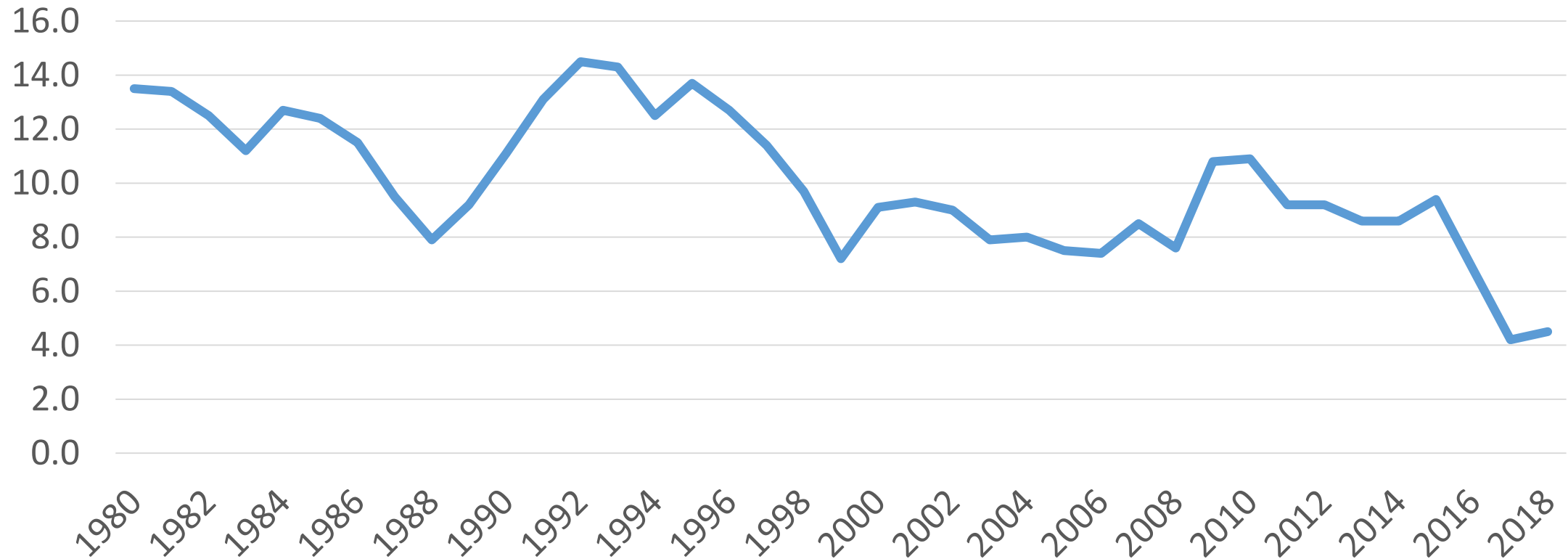
Other Current Transfers D.7

1. Net non-life insurance premiums D.71
2. Non-life insurance claims D.72
3. Current transfer within general government D.73
4. Current international cooperation D.74
5. Miscellaneous current transfers D.75

What next? The use of Disposable income

Modelling the saving ratio

Households' saving ratio



Government accounts

Income account

Gross Operating Surplus
+ Value Added Tax (VAT)
+ Taxes and duties on imports
+ Excises tax on products
+ Property income(R)
- Property Income(U)

=

Income

Disposable income account

Income
+ Taxes on income
+ netSocial contributions
+ Other current transfers(R)
- Other current transfers(U)
- Social Benefits

=

Disposable Income

Government income account

From the real-nominal IO identity based model

Bottom-UP Resources

Taxes on products - (VAT and excises)

- from intermediate consumption matrix of tax rates IE

- from Households' consumption vector of tax rates IE

- from Investment vector of tax rates IE

Tax on production (less subsidies) vector of tax rates IE

Government income account

Property income share in total resources

year	share
2011	-0,18
2012	-0,15
2013	-0,08
2014	-0,12
2015	-0,09
2016	-0,10
2017	-0,11
2018	-0,11

Sector share of gross national income (%)

year	share
2011	11,0
2012	11,5
2013	12,7
2014	12,2
2015	12,6
2016	12,5
2017	12,2
2018	12,2

Income accounts

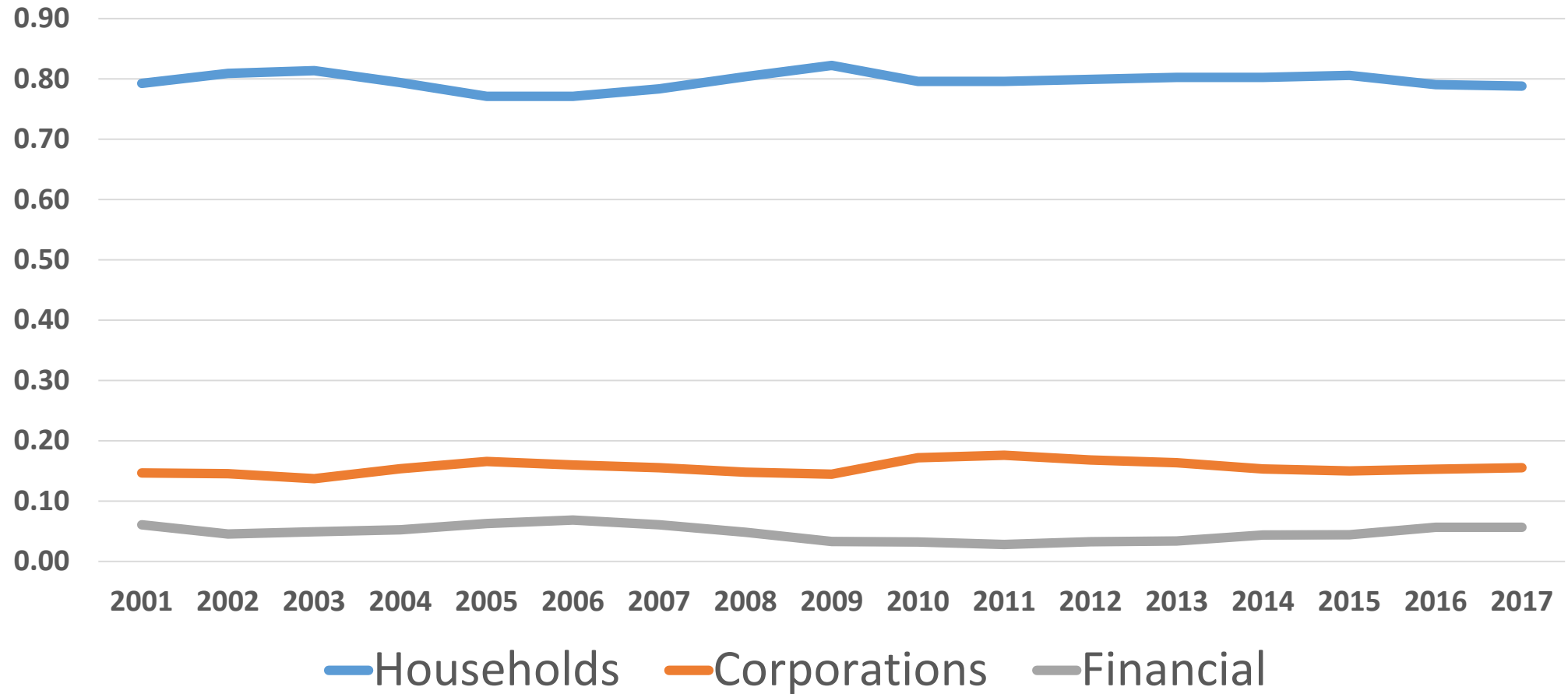
Corporations

$$\begin{aligned} &\text{Gross Operating Surplus} \\ &+ \text{Property income} \\ &- \text{Property income} \\ &= \\ &\text{Income} \end{aligned}$$

Financials

$$\begin{aligned} &\text{Gross Operating Surplus} \\ &+ \text{Property income} \\ &- \text{Property income} \\ &= \\ &\text{Income} \end{aligned}$$

Government tax yields shares



Where does **property income** come from?

After the 'Use of disposable income account'

Accumulation accounts

- 1 Capital account
- 2 Financial account
- 3 Other changes in assets account

Balance sheets

At this point we must take a look down among the institutional accounts

Lawrence Klein in

“Some Potential Linkages for Input-Output Analysis with Flow-of-Funds”, Economic Systems Research, 2003

proposed a research strategy in two steps:

- First: built IO table with liabilities per unit of wealth (flows divided by funds)
- Second: construct system of simultaneous equations, beyond the initial accounting identities, to provide explanations of the entries in FF accounts

Thank you for your attention

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