

# Evaluation of Electricity and Energy Sector Policies in the General Equilibrium Model of the UK Economy

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# Why General Equilibrium?

- Energy (electricity, gas and oil) is an important sector of the economy:
- It is an input in production in almost all industries
- It is final good consumed by households
- It generates revenue for government
- Energy taxes cause distortions in the rest of the sectors
- Has impact on employment, output, prices rental rate, income, welfare and trade



# Basics of a General Equilibrium Model

Market price ( $p$ )  
and wage rate ( $w$ )

such that:

$$Y = C$$

$$LD = LS$$

$$LS + l = L$$

$$KD = K$$

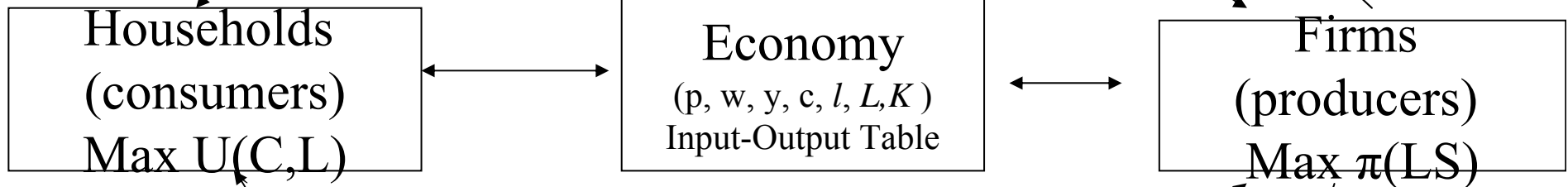
$$\text{Max } \pi = pY - wL - rK$$

$$Y = AK^\alpha L^\beta$$

$$Y \geq 0; L \geq 0; K \geq 0;$$

Wage, rent payment,  $wL, rK$

Supply of L and K



$$\text{Max } U = c^\phi l^{1-\phi}$$

$$l + LS = 1$$

$$p(1+t_c)c = w(1-t_l)LS + r(1-t_k)K + \pi$$

$$c \geq 0; l \geq 0; LS \geq 0$$

Supply of Goods

$$R = pt_c c + wt_l LS + rt_k K$$

Government  
and ROW

$$G = R$$

$$VX = VM$$

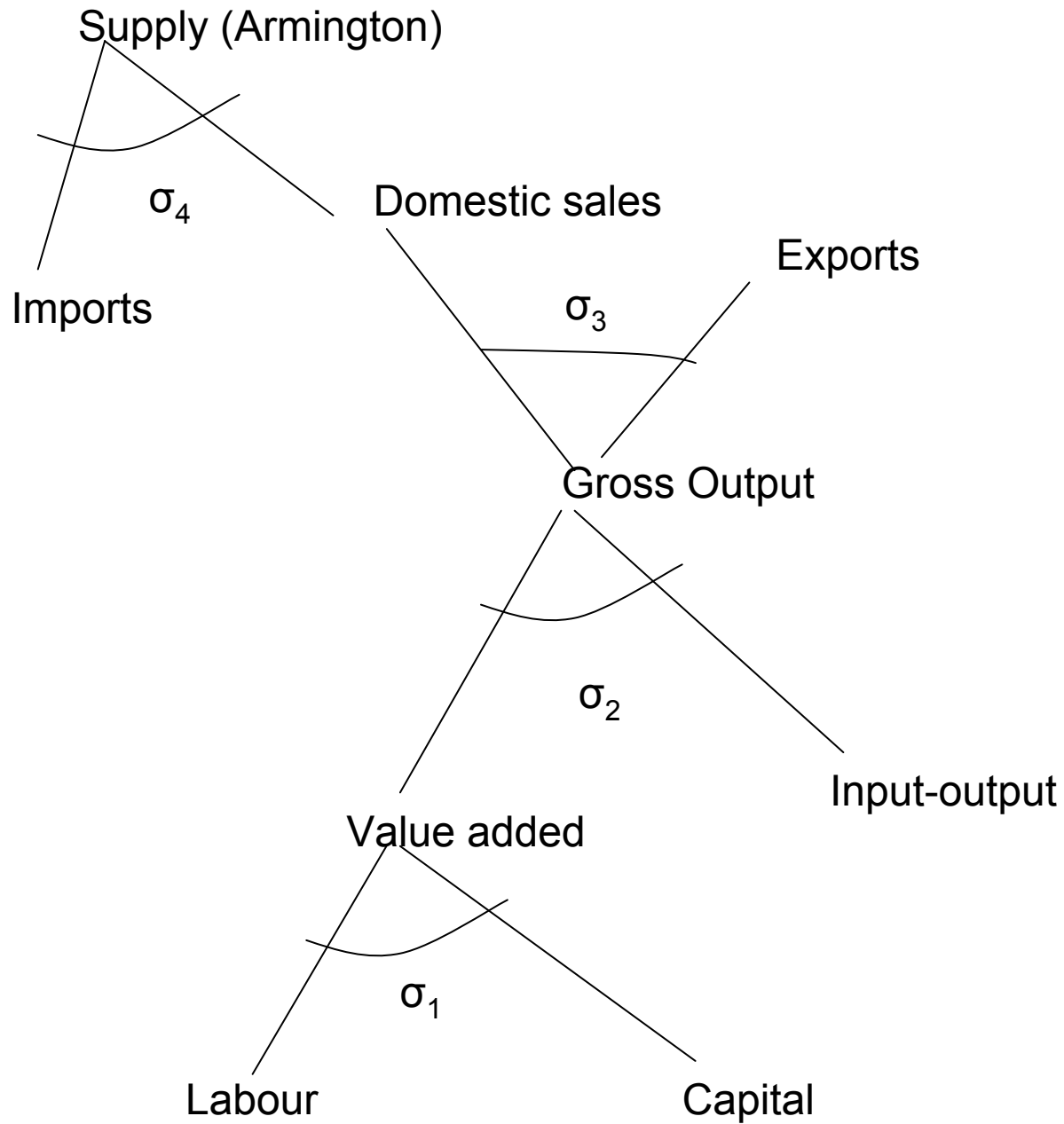


# Structure of the Current GE model

- A representative consumer maximises utility subject to its budget constraint
- Eleven production firms maximise profit subject to technology constraints
- Supply structure is nested at four different levels
- Prices change in goods, labour and capital market until demand and supply are equal
- Backward and forward linkages of the electricity sector are captured by the input-output table of the UK economy
- VAT, and taxes on capital and labour income distort the allocations of resources in the economy



Nested Structure of production and trade in the GE Model



Analysis



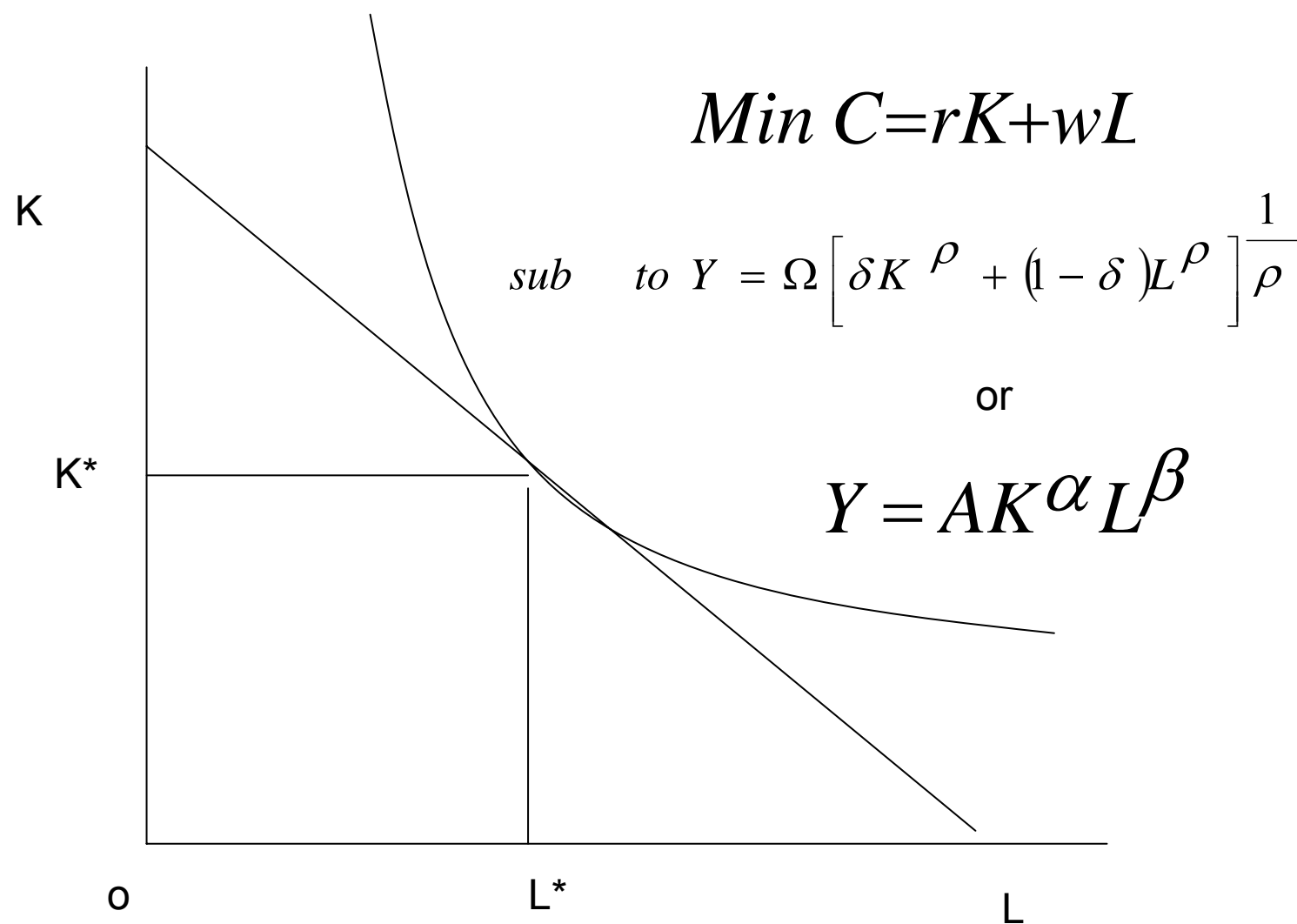
Comparative Static

and

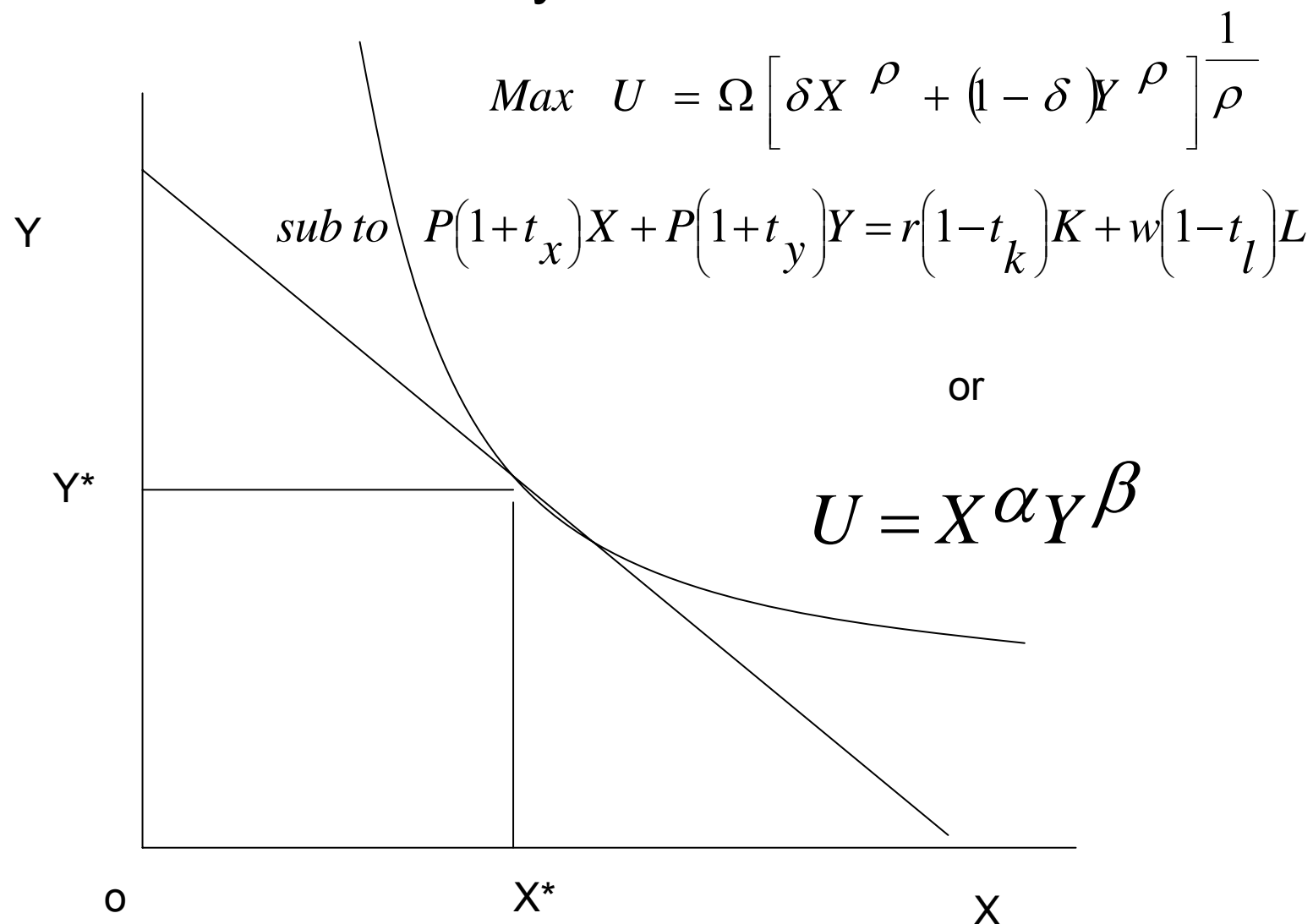
Dynamic



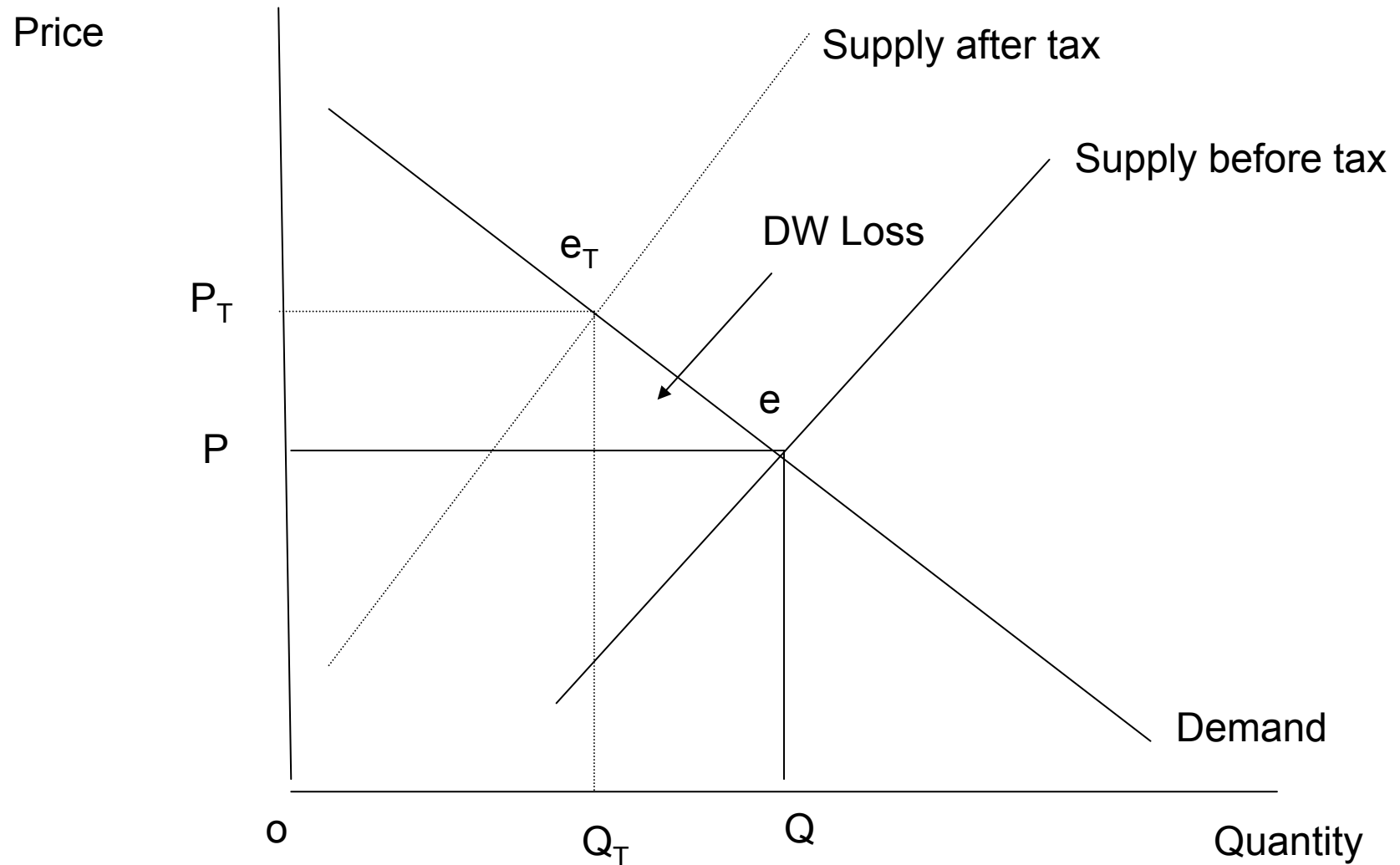
# Firm's Cost Minimisation Problem



# Consumer's Utility Maximisation Problem



## Impact of increase in cost (tax) in price and demand (output)



# Output, Marginal Productivity and Functional Distribution of Income and the Elasticity of Substitution in Production

$$Y = AK^\alpha L^\beta \quad Y = rK + wL \quad \frac{rK}{Y} + \frac{wL}{Y} = 1$$

$$\alpha = \frac{rK}{Y} = \frac{\alpha K^{\alpha-1} L^\beta \cdot K}{Y} \quad \beta = \frac{wL}{Y} = \frac{\beta K^\alpha L^{\beta-1} L}{Y}$$

$$\sigma = \frac{\frac{\Delta(K/L)}{K/L}}{\frac{\Delta(w/r)}{w/r}} = \frac{\frac{\Delta(K/L)}{K/L}}{\Delta\left(\frac{\beta AK^\alpha L^{\beta-1}}{\alpha AK^{\alpha-1} L^\beta}\right)} = \frac{\frac{\Delta(K/L)}{K/L}}{\frac{\beta AK^\alpha L^{\beta-1}}{\alpha AK^{\alpha-1} L^\beta}} = 1$$

$\sigma$  is the elasticity of substitution between capital and labour.



## How does a General Equilibrium Impact Analysis Differ from a Partial Equilibrium Impact Analysis?

- Partial equilibrium analysis focuses on a single market: only electricity or energy sector
- General equilibrium impact takes account of widespread repercussion throughout the economy (e.g. through a stone in pond and see the ripples)
- Knock-on and dynamic effects of policy choices in the energy sector are more powerful than the its first round effects, because of its strong backward and forward linkages.

# Analysis of Model Results

- Models Platforms

Comparative Analysis

9,10, and 21 sectors

With policy analysis of

- Gas Model
- Oil Model
- Electricity

Dynamic Analysis

10 and 11 sectors

- Model Scenarios

Sector specific policy

- Labour income tax
- Capital income tax
- Value added tax

Economy wide policy

Variables reported

Employment, output,  
prices, welfare, utility,  
government revenue



## Leontief Coefficients from Input-Output Table Used in the model

	agr	coal	oil	man	elec	gas	con	whol	tran	fin	serv
agr	0.120			0.524			0.001	0.064	0.002	0.005	0.008
coal		0.067		0.073	0.860		0.023	0.027	0.010	0.003	0.004
oil			0.056	0.293		0.204	0.000	0.008	0.012	0.014	
man	0.015	0.001	0.003	0.290	0.003	0.001	0.045	0.062	0.022	0.035	0.022
elec	0.007	0.004	0.004	0.191	0.402	0.001	0.024	0.052	0.024	0.038	0.020
gas	0.001	0.000	0.001	0.139	0.107	0.202	0.005	0.026	0.019	0.025	0.020
con	0.003	0.001	0.011	0.015	0.001	0.000	0.256	0.013	0.007	0.084	0.008
whol	0.009	0.000	0.001	0.119	0.002	0.000	0.013	0.034	0.017	0.025	0.010
tran	0.003	0.001	0.003	0.110	0.002	0.001	0.013	0.211	0.199	0.180	0.035
fin	0.006	0.001	0.008	0.113	0.004	0.003	0.044	0.102	0.052	0.221	0.038
serv	0.005	0.000	0.001	0.034	0.001	0.001	0.003	0.015	0.014	0.067	0.098

## Total Sectoral Supply and Demand (£Million of 2002)

AGR	COAL	OIL	MAN	ELEC	GAS	CON	WHOL	TRAN	FIN	SERV
22477	2328	10632	249646	24108	10257	90432	160816	93221	258625	98297



## Structure of Primary Input and Final Demand By Sectors (£Million 2002)

	Primary inputs										
	AGR	COAL	OIL	MAN	ELEC	GAS	CON	WHOL	TRAN	FIN	SERV
Wage	2952	966	1327	87939	2794	1553	16482	60487	33343	67103	44149
Rents	8363	92	10073	33586	5359	691	18077	28134	15106	92834	19374
intax	-160	47	40	1817	599	446	546	5080	1049	2459	621
otax	300	39	101	1844	698	66	333	1479	2713	5877	2326
Imp	1493	223	609	64065	889	1184	4671	10542	7521	11155	6275
	Finald Demand										
	AGR	COAL	OIL	MAN	ELEC	GAS	CON	WHOL	TRAN	FIN	SERV
Consumption	5791	245	5	65750	6216	5371	5171	103693	19671	85329	55908
Investment	305	-167	824	23105	0	-30	47068	10883	693	8449	1946
Gov. Cons	31	21	0	14236	535	215	4165	8402	2850	8676	17488
Exp	1494	30	6701	109559	31	23	66	19527	7853	19331	4395



## Labour and Capital Share and Tax Rates By Sector

	kshare	lshare	ltrt	ktrt
agr	0.369	0.13	0.006	0.002
coal	0.044	0.463	0.041	0.427
oil	0.604	0.08	0.006	8.15E-04
man	0.115	0.3	0.015	0.039
elec	0.237	0.123	0.08	0.041
gas	0.08	0.18	0.114	0.256
con	0.212	0.193	0.013	0.012
whol	0.171	0.367	0.037	0.08
tran	0.163	0.36	0.039	0.086
fin	0.351	0.254	0.026	0.019
serv	0.202	0.461	0.023	0.053



## Impact of Labour Income Taxes in the Electricity Sector (Percentage change relative to the benchmark)

	AGR	COAL	OIL	MAN	ELEC	GAS	CON	WHOL	TRAN	FIN	SERV
EMPL .LB1	-4.24	-0.48	-1.02	1.05	0.40	-4.76	3.66	-2.96	-1.18	-2.10	5.15
EMPL .LB2	-4.22	-2.56	-0.98	1.05	-5.77	-5.05	3.73	-2.91	-1.11	-2.02	5.32
EMPL .LB3	-4.22	-4.38	-0.94	1.04	-10.96	-5.30	3.80	-2.86	-1.04	-1.94	5.46
EMPL .LB4	-4.22	-5.98	-0.90	1.02	-15.39	-5.52	3.86	-2.82	-0.99	-1.88	5.60
EMPL .LB5	-4.22	-7.42	-0.87	1.00	-19.22	-5.72	3.92	-2.79	-0.94	-1.82	5.72
OUTPUT.LB1	-1.37	-0.42	-0.67	0.89	0.14	-3.16	1.73	-2.11	-0.82	-0.99	3.63
OUTPUT.LB2	-1.37	-2.26	-0.72	0.90	-2.14	-3.35	1.77	-2.09	-0.78	-0.96	3.75
OUTPUT.LB3	-1.37	-3.87	-0.77	0.91	-4.13	-3.51	1.80	-2.06	-0.74	-0.93	3.84
OUTPUT.LB4	-1.37	-5.29	-0.81	0.91	-5.88	-3.66	1.83	-2.05	-0.71	-0.91	3.93
OUTPUT.LB5	-1.38	-6.57	-0.85	0.90	-7.46	-3.80	1.85	-2.03	-0.68	-0.89	4.01
PRICE .LB1		1.64	0.99	1.78	-2.15	0.92	2.86	1.14	1.53	1.01	3.02
PRICE .LB2		1.67	0.95	1.83	2.73	0.86	2.88	1.13	1.52	0.99	3.02
PRICE .LB3		1.70	0.92	1.87	7.40	0.81	2.90	1.12	1.51	0.98	3.01
PRICE .LB4		1.75	0.89	1.91	11.90	0.76	2.92	1.12	1.50	0.97	3.01
PRICE .LB5		1.80	0.87	1.96	16.25	0.72	2.94	1.12	1.50	0.96	3.01



## Impact of capital income tax in the electricity sector (Percentage change relative to the benchmark)

	AGR	COAL	OIL	MAN	ELEC	GAS	CON	WHOL	TRAN	FIN	SERV
EMPL .CP1	-4.25	-1.66	-1.00	1.05	-3.13	-4.94	3.71	-2.94	-1.14	-2.06	5.26
EMPL .CP2	-4.32	-1.69	-1.02	1.07	-3.18	-5.02	3.78	-2.99	-1.16	-2.10	5.35
EMPL .CP3	-4.38	-1.71	-1.03	1.09	-3.23	-5.09	3.83	-3.03	-1.18	-2.12	5.42
EMPL .CP4	-4.42	-1.73	-1.04	1.10	-3.26	-5.14	3.87	-3.06	-1.19	-2.15	5.48
EMPL .CP5	-4.46	-1.75	-1.05	1.11	-3.29	-5.19	3.91	-3.09	-1.20	-2.17	5.53
OUTPUT.CP1	-1.37	-1.47	-0.70	0.90	-1.15	-3.28	1.76	-2.11	-0.80	-0.98	3.71
OUTPUT.CP2	-1.40	-1.49	-0.71	0.92	-1.17	-3.33	1.79	-2.14	-0.81	-0.99	3.77
OUTPUT.CP3	-1.42	-1.51	-0.72	0.93	-1.19	-3.38	1.81	-2.17	-0.82	-1.01	3.83
OUTPUT.CP4	-1.43	-1.53	-0.73	0.94	-1.20	-3.41	1.83	-2.19	-0.83	-1.02	3.87
OUTPUT.CP5	-1.44	-1.54	-0.74	0.95	-1.21	-3.44	1.85	-2.21	-0.84	-1.03	3.90
PRICE .CP1		1.66	0.97	1.81	0.55	0.89	2.88	1.14	1.53	1.00	3.03
PRICE .CP2		1.69	0.99	1.85	0.56	0.90	2.93	1.16	1.55	1.02	3.08
PRICE .CP3		1.71	1.00	1.87	0.57	0.91	2.97	1.17	1.58	1.03	3.12
PRICE .CP4		1.73	1.01	1.89	0.58	0.92	3.00	1.19	1.59	1.05	3.16
PRICE .CP5		1.75	1.02	1.91	0.58	0.93	3.03	1.20	1.61	1.06	3.19



## Impact of increase in value added tax in the electricity sector (Percentage change relative to the benchmark)

	AGR	COAL	OIL	MAN	ELEC	GAS	CON	WHOL	TRAN	FIN	SERV
EMPL .VT1	-4.24	-1.24	-0.98	1.03	-1.85	-4.86	3.68	-2.94	-1.15	-2.06	5.21
EMPL .VT2	-4.17	-4.12	-1.08	1.14	-10.39	-5.27	3.80	-2.90	-1.10	-2.03	5.43
EMPL .VT3	-4.11	-6.52	-1.16	1.23	-17.17	-5.61	3.89	-2.87	-1.06	-2.00	5.61
EMPL .VT4	-4.06	-8.57	-1.23	1.30	-22.67	-5.90	3.97	-2.84	-1.03	-1.99	5.76
EMPL .VT5	-4.01	-10.32	-1.29	1.35	-27.23	-6.15	4.03	-2.82	-1.00	-1.97	5.88
OUTPUT.VT1	-1.37	-1.09	-0.69	0.89	-0.68	-3.22	1.74	-2.10	-0.80	-0.97	3.67
OUTPUT.VT2	-1.34	-3.65	-0.74	0.97	-3.93	-3.50	1.80	-2.07	-0.76	-0.95	3.83
OUTPUT.VT3	-1.32	-5.79	-0.77	1.03	-6.65	-3.73	1.84	-2.04	-0.73	-0.93	3.96
OUTPUT.VT4	-1.30	-7.61	-0.81	1.09	-8.97	-3.92	1.88	-2.01	-0.70	-0.92	4.06
OUTPUT.VT5	-1.29	-9.19	-0.84	1.13	-10.97	-4.09	1.91	-1.99	-0.68	-0.91	4.15
PRICE .VT1		1.70	0.98	1.81	1.06	0.90	2.87	1.14	1.52	1.00	3.01
PRICE .VT2		1.37	0.89	1.76	-2.41	0.80	2.87	1.12	1.51	1.01	3.05
PRICE .VT3		1.10	0.81	1.72	-5.24	0.71	2.87	1.11	1.50	1.01	3.08
PRICE .VT4		0.86	0.74	1.69	-7.61	0.64	2.86	1.10	1.50	1.01	3.10
PRICE .VT5		0.66	0.68	1.66	-9.63	0.58	2.86	1.09	1.49	1.02	3.12
RENTAL.VT1	-2.34	0.72	0.98	3.04	0.10	-2.97	5.74	-1.01	0.82	-0.11	7.30
RENTAL.VT2	-2.26	-2.21	0.89	3.16	-8.61	-3.38	5.87	-0.96	0.87	-0.07	7.53
RENTAL.VT3	-2.19	-4.65	0.82	3.25	-15.51	-3.73	5.97	-0.92	0.92	-0.04	7.72
RENTAL.VT4	-2.13	-6.73	0.75	3.33	-21.12	-4.02	6.06	-0.89	0.96	-0.02	7.88
RENTAL.VT5	-2.08	-8.52	0.70	3.39	-25.76	-4.27	6.13	-0.86	0.99	0.00	8.01



## Sensitivity of welfare to Labour and Capital Income Taxes and VAT in Electricity (Percentage change relative to the benchmark)

	Welfare Impacts to labour input tax in the electricity sector				
	LB1	LB2	LB3	LB4	LB5
WELFARE	-7.862	-7.963	-8.058	-8.147	-8.231
UTIL	-7.841	-7.942	-8.037	-8.125	-8.209
GOVT	53.751	54.445	55.064	55.625	56.139
WAG	2.037	1.945	1.86	1.783	1.711
	Welfare Impacts to capital input tax in the electricity sector				
	CP1	CP2	CP3	CP4	CP5
WELFARE	-7.948	-8.083	-8.189	-8.275	-8.347
UTIL	-7.927	-8.061	-8.168	-8.254	-8.326
GOVT	54.351	55.289	56.032	56.635	57.135
WAG	1.993	2.028	2.056	2.079	2.097
	Welfare Impacts to value added tax in the electricity sector				
	VT1	VT2	VT3	VT4	VT5
WELFARE	-7.891	-8.086	-8.257	-8.409	-8.545
UTIL	-7.899	-7.874	-7.824	-7.757	-7.674
GOVT	53.977	55.087	55.968	56.684	57.278
WAG	1.984	1.993	2	2.007	2.013



# Sensitivity of Model to the Elasticities of Substitution in Consumption, Production and Trade

## Configuration of Elasticities

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
Elasticity in consumption (ELU)	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
Elasticity in productions (ELP)	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
Elasticity in trade (ELA)	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50

## Sensitivity to elasticity of substitution in consumption (Percentage change relative to the benchmark)

	AGR	COAL	OIL	MAN	ELEC	GAS	CON	WHOL	TRAN	FIN	SERV
EMPL .EL1	-4.23	-1.66	-1.00	1.05	-3.12	-4.92	3.70	-2.93	-1.14	-2.05	5.24
EMPL .EL2	-3.85	-1.55	-0.94	1.02	-2.79	-4.68	3.65	-2.79	-1.10	-1.90	4.82
EMPL .EL3	-3.54	-1.47	-0.88	0.98	-2.53	-4.47	3.59	-2.66	-1.06	-1.77	4.45
EMPL .EL4	-3.28	-1.41	-0.84	0.95	-2.32	-4.27	3.54	-2.55	-1.02	-1.66	4.14
EMPL .EL5	-3.05	-1.35	-0.80	0.92	-2.14	-4.09	3.48	-2.44	-0.99	-1.56	3.87
EMPL .EL6	-2.86	-1.31	-0.76	0.89	-1.99	-3.93	3.43	-2.34	-0.96	-1.48	3.63
EMPL .EL7	-2.69	-1.27	-0.73	0.86	-1.86	-3.78	3.38	-2.25	-0.93	-1.40	3.41
EMPL .EL8	-2.54	-1.23	-0.70	0.84	-1.75	-3.64	3.33	-2.17	-0.91	-1.33	3.22
OUTPUT.EL1	-1.37	-1.46	-0.70	0.90	-1.15	-3.26	1.75	-2.10	-0.79	-0.97	3.70
OUTPUT.EL2	-1.24	-1.37	-0.66	0.87	-1.03	-3.10	1.73	-2.00	-0.77	-0.90	3.40
OUTPUT.EL3	-1.14	-1.30	-0.63	0.84	-0.93	-2.96	1.70	-1.91	-0.74	-0.84	3.14
OUTPUT.EL4	-1.05	-1.24	-0.59	0.81	-0.85	-2.83	1.68	-1.82	-0.72	-0.78	2.92
OUTPUT.EL5	-0.98	-1.19	-0.57	0.78	-0.79	-2.71	1.65	-1.75	-0.69	-0.74	2.73
OUTPUT.EL6	-0.92	-1.15	-0.54	0.76	-0.73	-2.60	1.63	-1.68	-0.67	-0.70	2.56
OUTPUT.EL7	-0.86	-1.12	-0.52	0.74	-0.69	-2.50	1.60	-1.61	-0.65	-0.66	2.41
OUTPUT.EL8	-0.82	-1.09	-0.50	0.71	-0.64	-2.41	1.58	-1.55	-0.64	-0.63	2.28
PRICE .EL1		1.66	0.97	1.81	0.55	0.88	2.87	1.13	1.52	1.00	3.02
PRICE .EL2		1.50	0.85	1.65	0.51	0.77	2.70	1.00	1.37	0.89	2.75
PRICE .EL3		1.38	0.76	1.52	0.48	0.68	2.55	0.90	1.24	0.81	2.53
PRICE .EL4		1.27	0.69	1.41	0.45	0.60	2.42	0.81	1.14	0.74	2.34
PRICE .EL5		1.18	0.63	1.31	0.43	0.54	2.32	0.74	1.05	0.68	2.18
PRICE .EL6		1.10	0.57	1.23	0.40	0.49	2.22	0.68	0.97	0.63	2.04
PRICE .EL7		1.03	0.53	1.16	0.38	0.45	2.14	0.63	0.91	0.59	1.92
PRICE .EL8		0.97	0.49	1.10	0.36	0.41	2.06	0.58	0.85	0.55	1.81

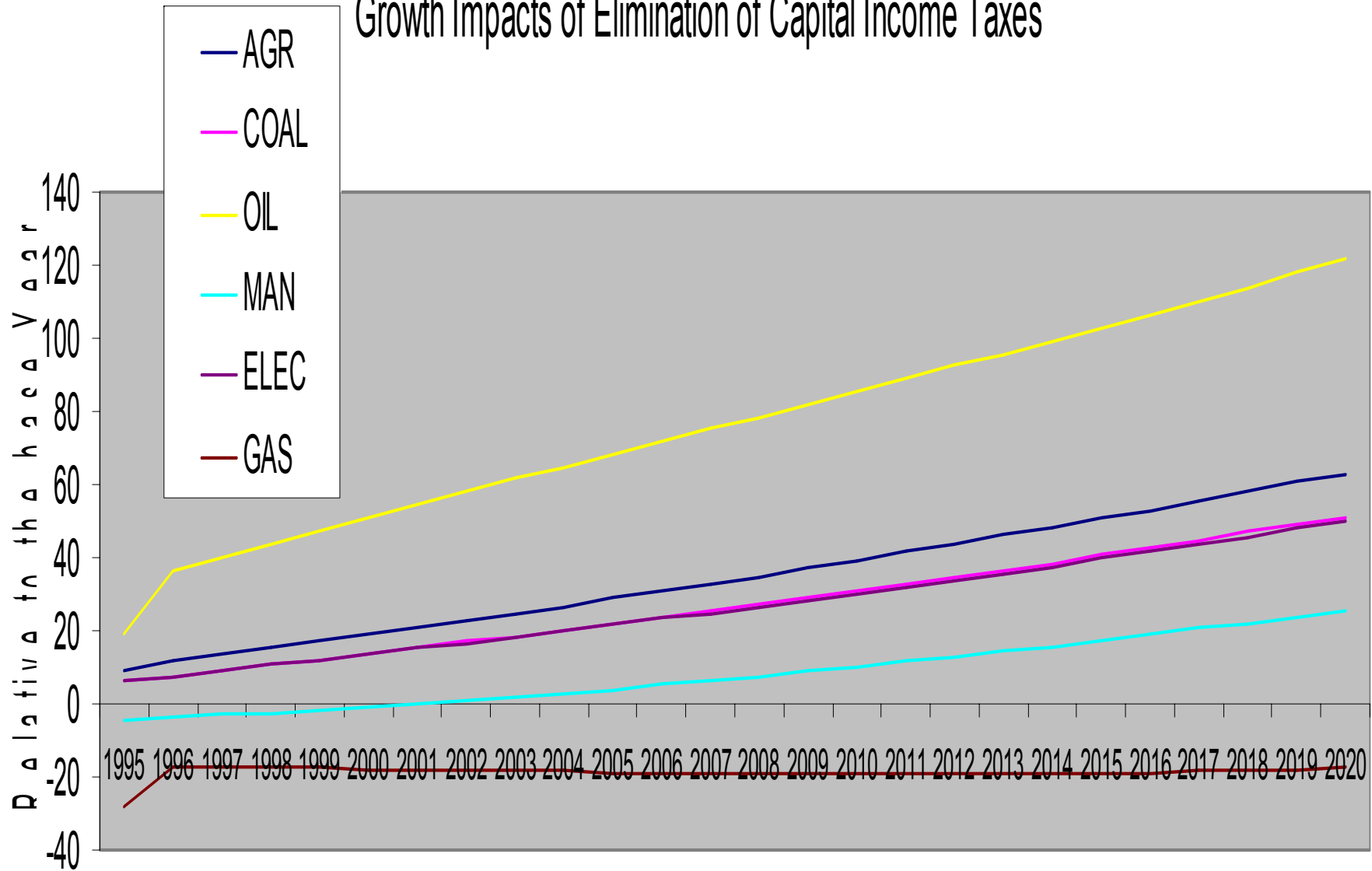
Sensitivity to elasticity of substitution in production  
(Percentage change relative to the benchmark)

	AGR	COAL	OIL	MAN	ELEC	GAS	CON	WHOL	TRAN	FIN	SERV
EMPL .ELP1	-4.23	-1.66	-1.00	1.05	-3.12	-4.92	3.70	-2.93	-1.14	-2.05	5.24
EMPL .ELP2	-4.11	-1.64	-0.96	1.03	-3.06	-4.85	3.64	-2.91	-1.12	-2.02	5.19
EMPL .ELP3	-4.00	-1.62	-0.92	1.02	-3.01	-4.79	3.58	-2.88	-1.10	-1.99	5.14
EMPL .ELP4	-3.90	-1.60	-0.89	1.00	-2.96	-4.73	3.53	-2.86	-1.08	-1.97	5.09
EMPL .ELP5	-3.80	-1.58	-0.86	0.99	-2.91	-4.67	3.48	-2.84	-1.07	-1.94	5.04
EMPL .ELP6	-3.71	-1.56	-0.83	0.97	-2.86	-4.61	3.42	-2.81	-1.05	-1.91	4.99
EMPL .ELP7	-3.62	-1.54	-0.80	0.96	-2.81	-4.55	3.37	-2.79	-1.03	-1.89	4.95
EMPL .ELP8	-3.54	-1.52	-0.78	0.94	-2.77	-4.50	3.33	-2.77	-1.02	-1.86	4.90
OUTPUT.ELP1	-1.37	-1.46	-0.70	0.90	-1.15	-3.26	1.75	-2.10	-0.79	-0.97	3.70
OUTPUT.ELP2	-1.33	-1.44	-0.68	0.88	-1.13	-3.22	1.72	-2.08	-0.78	-0.96	3.66
OUTPUT.ELP3	-1.29	-1.43	-0.65	0.86	-1.11	-3.18	1.70	-2.07	-0.77	-0.95	3.62
OUTPUT.ELP4	-1.26	-1.41	-0.63	0.84	-1.09	-3.13	1.67	-2.05	-0.76	-0.93	3.59
OUTPUT.ELP5	-1.23	-1.39	-0.61	0.82	-1.07	-3.09	1.65	-2.04	-0.75	-0.92	3.55
OUTPUT.ELP6	-1.20	-1.38	-0.59	0.80	-1.05	-3.05	1.62	-2.02	-0.74	-0.91	3.52
OUTPUT.ELP7	-1.17	-1.36	-0.57	0.79	-1.04	-3.02	1.60	-2.01	-0.72	-0.90	3.49
OUTPUT.ELP8	-1.14	-1.34	-0.55	0.78	-1.02	-2.98	1.58	-1.99	-0.71	-0.89	3.45
PRICE .ELP1		1.66	0.97	1.81	0.55	0.88	2.87	1.13	1.52	1.00	3.02
PRICE .ELP2		1.61	0.95	1.76	0.52	0.85	2.81	1.09	1.48	0.96	2.95
PRICE .ELP3		1.56	0.93	1.71	0.50	0.83	2.75	1.05	1.43	0.92	2.89
PRICE .ELP4		1.52	0.92	1.66	0.47	0.80	2.69	1.01	1.39	0.89	2.84
PRICE .ELP5		1.48	0.90	1.62	0.45	0.78	2.63	0.97	1.35	0.86	2.78
PRICE .ELP6		1.44	0.89	1.58	0.43	0.76	2.58	0.94	1.32	0.83	2.73
PRICE .ELP7		1.41	0.87	1.54	0.41	0.74	2.53	0.91	1.28	0.80	2.68
PRICE .ELP8		1.37	0.86	1.51	0.40	0.72	2.48	0.87	1.25	0.78	2.63

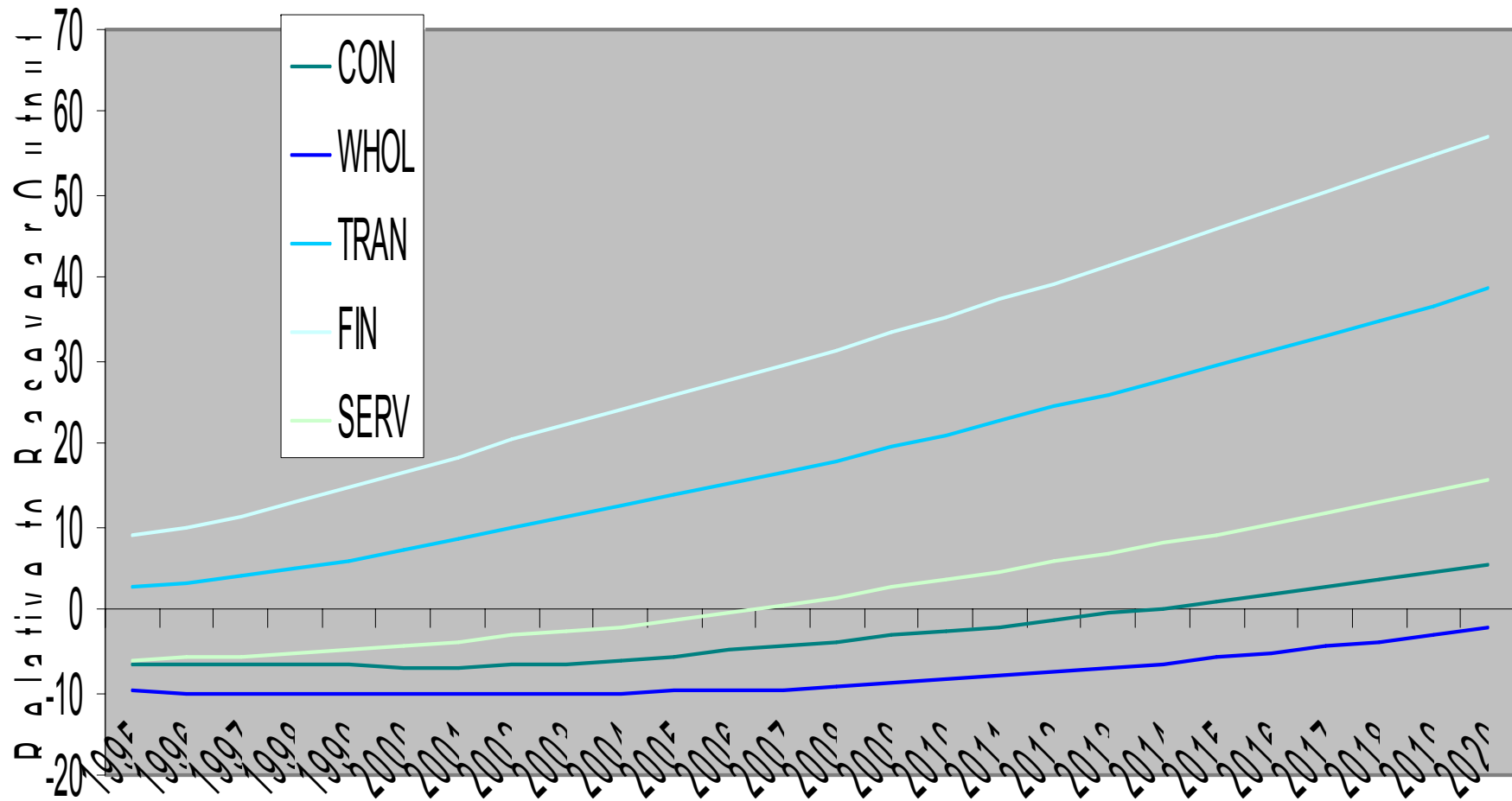
## Sensitivity to elasticity of substitution in trade (Percentage change relative to the benchmark)

	AGR	COAL	OIL	MAN	ELEC	GAS	CON	WHOL	TRAN	FIN	SERV
EMPL .EL1	-4.23	-1.66	-1.00	1.05	-3.12	-4.92	3.70	-2.93	-1.14	-2.05	5.24
EMPL .EL2	-4.85	-1.74	-1.34	1.17	-3.43	-5.11	4.01	-3.14	-1.22	-2.29	5.68
EMPL .EL3	-5.25	-1.79	-1.64	1.24	-3.61	-5.21	4.18	-3.26	-1.26	-2.44	5.94
EMPL .EL4	-5.51	-1.82	-1.91	1.29	-3.72	-5.27	4.29	-3.33	-1.28	-2.53	6.10
EMPL .EL5	-5.71	-1.84	-2.15	1.32	-3.80	-5.32	4.37	-3.38	-1.30	-2.60	6.21
EMPL .EL6	-5.86	-1.85	-2.37	1.35	-3.86	-5.36	4.43	-3.42	-1.31	-2.65	6.29
EMPL .EL7	-5.98	-1.86	-2.57	1.37	-3.91	-5.38	4.47	-3.44	-1.32	-2.69	6.36
EMPL .EL8	-6.07	-1.87	-2.75	1.38	-3.95	-5.41	4.51	-3.46	-1.33	-2.72	6.41
OUTPUT.EL1	-1.37	-1.46	-0.70	0.90	-1.15	-3.26	1.75	-2.10	-0.79	-0.97	3.70
OUTPUT.EL2	-1.47	-1.54	-0.72	0.95	-1.26	-3.37	1.90	-2.20	-0.84	-1.05	3.97
OUTPUT.EL3	-1.54	-1.58	-0.73	0.98	-1.32	-3.44	1.99	-2.25	-0.86	-1.09	4.13
OUTPUT.EL4	-1.59	-1.60	-0.74	1.00	-1.36	-3.48	2.04	-2.29	-0.88	-1.12	4.23
OUTPUT.EL5	-1.62	-1.62	-0.75	1.01	-1.39	-3.50	2.08	-2.31	-0.88	-1.14	4.30
OUTPUT.EL6	-1.65	-1.63	-0.75	1.02	-1.41	-3.53	2.11	-2.33	-0.89	-1.16	4.35
OUTPUT.EL7	-1.67	-1.64	-0.76	1.03	-1.43	-3.54	2.13	-2.34	-0.90	-1.17	4.39
OUTPUT.EL8	-1.68	-1.65	-0.77	1.04	-1.44	-3.56	2.15	-2.35	-0.90	-1.18	4.43
PRICE .EL1		1.66	0.97	1.81	0.55	0.88	2.87	1.13	1.52	1.00	3.02
PRICE .EL2		1.28	0.61	1.38	0.46	0.67	2.19	0.91	1.18	0.79	2.25
PRICE .EL3		1.04	0.40	1.12	0.40	0.52	1.78	0.75	0.97	0.65	1.80
PRICE .EL4		0.88	0.26	0.94	0.34	0.42	1.51	0.64	0.82	0.55	1.50
PRICE .EL5		0.76	0.17	0.81	0.30	0.35	1.32	0.56	0.71	0.48	1.29
PRICE .EL6		0.67	0.10	0.71	0.27	0.29	1.17	0.50	0.63	0.43	1.13
PRICE .EL7		0.60	0.05	0.64	0.24	0.24	1.06	0.45	0.56	0.38	1.00
PRICE .EL8		0.54	0.01	0.58	0.22	0.21	0.97	0.41	0.51	0.35	0.90

# Growth Impacts of Elimination of Capital Income Taxes



## Growth Impacts of Removing Capital Income Taxes



# Future Activities: Energy in Macro-Modelling

- Integration of ICF in the GE Model
- Substitutability between various sources of energy
- More elaboration in the dynamic model
- Impact of energy efficiency in Labour-leisure choice and capital accumulation and growth
- Energy poverty and income distribution
- Equal yield tax reform for more efficient energy sector
- Impact of Investment tax credit in technical progress in the energy sector
- Adjustment costs Heterogeneity of capital
- Environmental regulations



# References

- Aurbach, A. J. and L. J. Kotlikoff (1987), *Dynamic Fiscal Policy*. Cambridge University Press.
- Bhattarai, K. and J. Whalley (2000) "General Equilibrium Modelling of UK Tax Policy" in Sean Holly and Martin Weale ed. *Econometric Modelling: Technique and Applications*, Cambridge University Press.
- Bhattarai, K. (1999) A Forward-Looking Dynamic Multisectoral General Equilibrium Tax Model of the UK Economy, Hull Economics Research Papers no. 269, University of Hull, HU6 7RX, UK.
- Bhattarai, K. (2000) Efficiency and Factor Reallocation Effects and Marginal Excess Burden of Taxes in the UK Economy, Hull Economics Research Papers no. 278, University of Hull, HU6 7RX, UK.
- Green R J and D. Newbery ( 1992) "Competition in the British Spot Market."\_The Journal of Political Economy **100**(5): 929-953.
- King, M.A. and D. Fullerton (1984) *The taxation of income from capital :a comparative study of the United States, the United Kingdom, Sweden and West Germany* Chicago University Press.
- Perroni, C. (1995), "Assessing the Dynamic Efficiency Gains of Tax Reform When Human Capital is Endogenous," *International Economic Review* 36, 907-925.
- Rutherford, T. F. (1995) "Extension of GAMS for Complementary Problems Arising in applied Economic Analysis" *Journal of Economic Dynamics and Control* 19 1299-1324.

