Welfare Impacts of Equal Yield Tax Reforms in the UK Economy

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Input-Output and General Equilibrium: Data, Modelling and Policy Analysis
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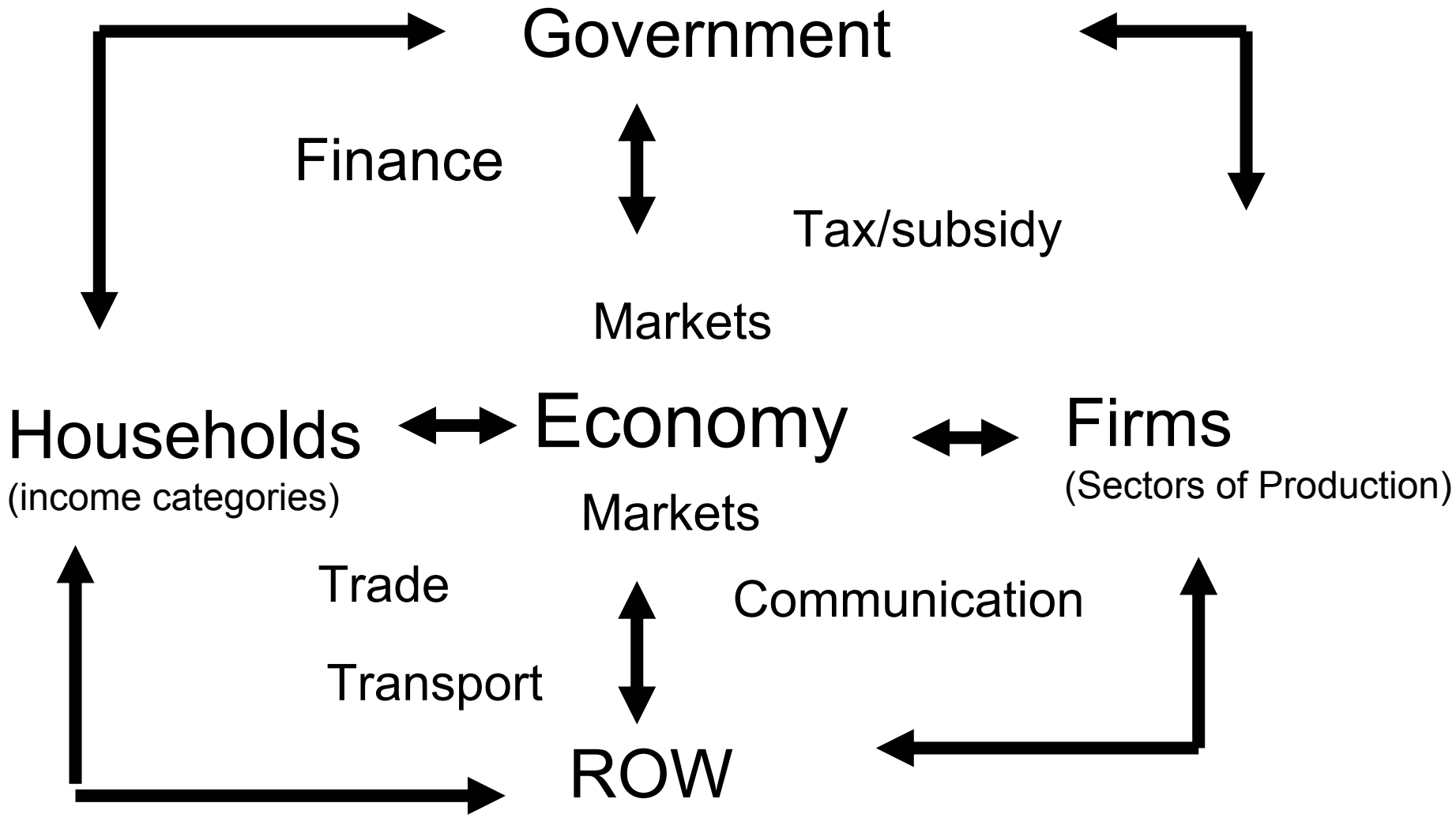
Macro Economic models in UK are shaped by ideas classical economists, Keynes and macroeconomic modelling.

Originator of systematic national accounting and economic models.

Focus on Long run models of economic growth and fluctuation in recent years.
Economy run by fiscal and monetary policy rules.

Economy with best record of sustained economic growth in recent years.
Fourth largest and highly industrialised economy in the world.
Country of origin of Industrial Revolution and scientific inventions.
The leading Economy in the World from 1820-1890.



General Equilibrium Models Assume Clearing of all Markets

But has no trade-off between unemployment and inflation.

GDP for 11 regions
123 input-output table
New Earnings survey
Family Expenditure survey
Trade with EU and ROW
ONS' quarterly GDP series
BOE's financial statistics

Source of the map: http://www.GraphicMaps.Com

Features of the Dynamic General Equilibrium Tax Model of the UK Economy

Price based market economy

Infinitely lived households deciding over consumption-saving, leisure and labour supply.

They equalise marginal utility of consumption across sectors over time.

Profit maximising producers make decisions on investment and investment equalising marginal product of capital.

Capital accumulation key to economic growth process.

Coexistence of the private and public sector.

Government tax and transfer system to influence production, consumption, and distribution of income.

Traders optimise: Armington type differentiated products.

Competitive Equilibrium: Prices and Quantities such that

Households maximise life time utility subject to their wealth constraint.

Investors maximise profits subject to arbitrage conditions in capital markets.

Producers minimise costs subject to technology constraints.

Unit profits are zero in all production sectors.

Markets for goods and services clear.

Revenue and expenditure of government balance (in each time or over period).

Trade is balanced in each period or over time.

Economy grows at steady state rate beyond the model horizon T.

Dimension and Parameters in the Dynamic General Equilibrium Tax Model of the UK Economy

16 production sectors and supply sectors (**Agriculture, Extraction Other Mining, Chemicals, Metals, Engineering ,Food and drink, Other Manuf., Utilities, Construction Distribution, Transport, Financial, Public Admin, Educ. Health, Housing)**

Sector Specific Capital, Labour input growing at exogenous rate,
Time Horizon 65 years

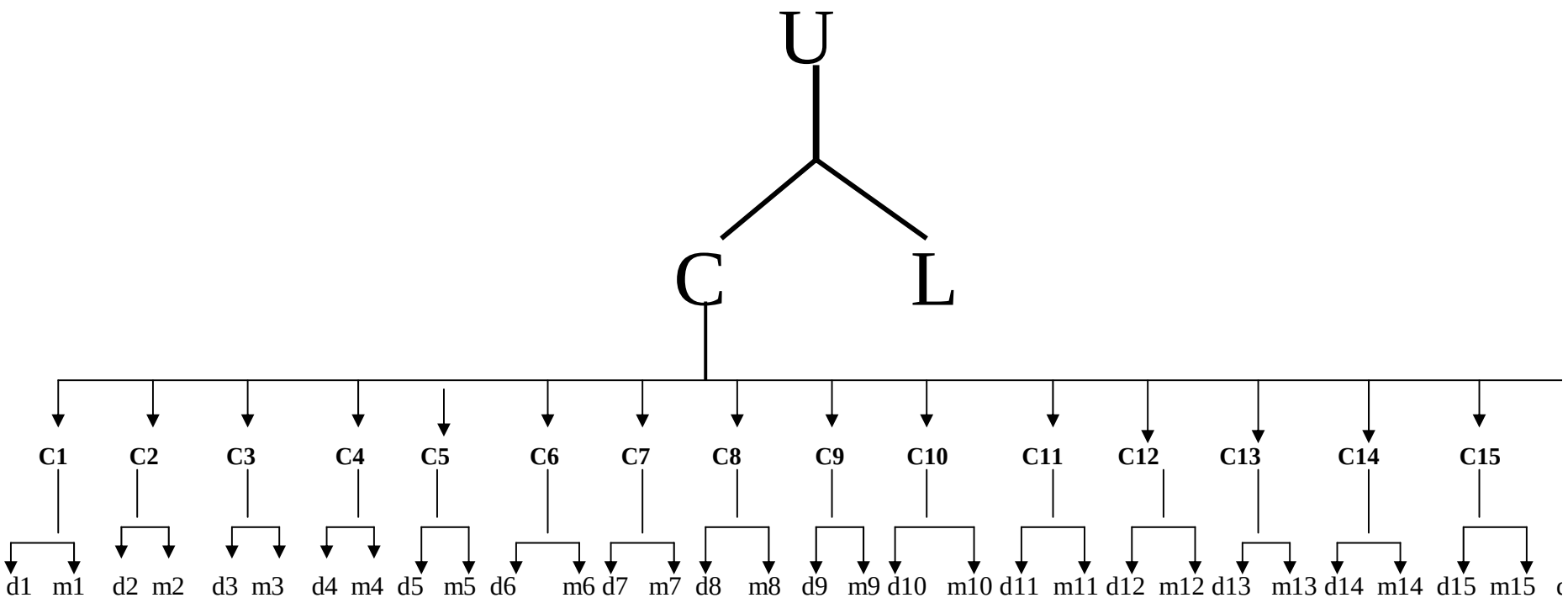
Equilibrium between demand and supply is determined by a set of
of behavioral and policy parameters and endowments:

Behavioral Parameters (shares, elasticities of substitution)
- preferences (inter and intra temporal)
- technology (nested production function)
- trade (differentiated product assumption)
- accumulation: rate of depreciation and discount

Endowments
- initial and terminal capital and Labour

Policy parameters
- tax rates on capital income, labour income and final demand

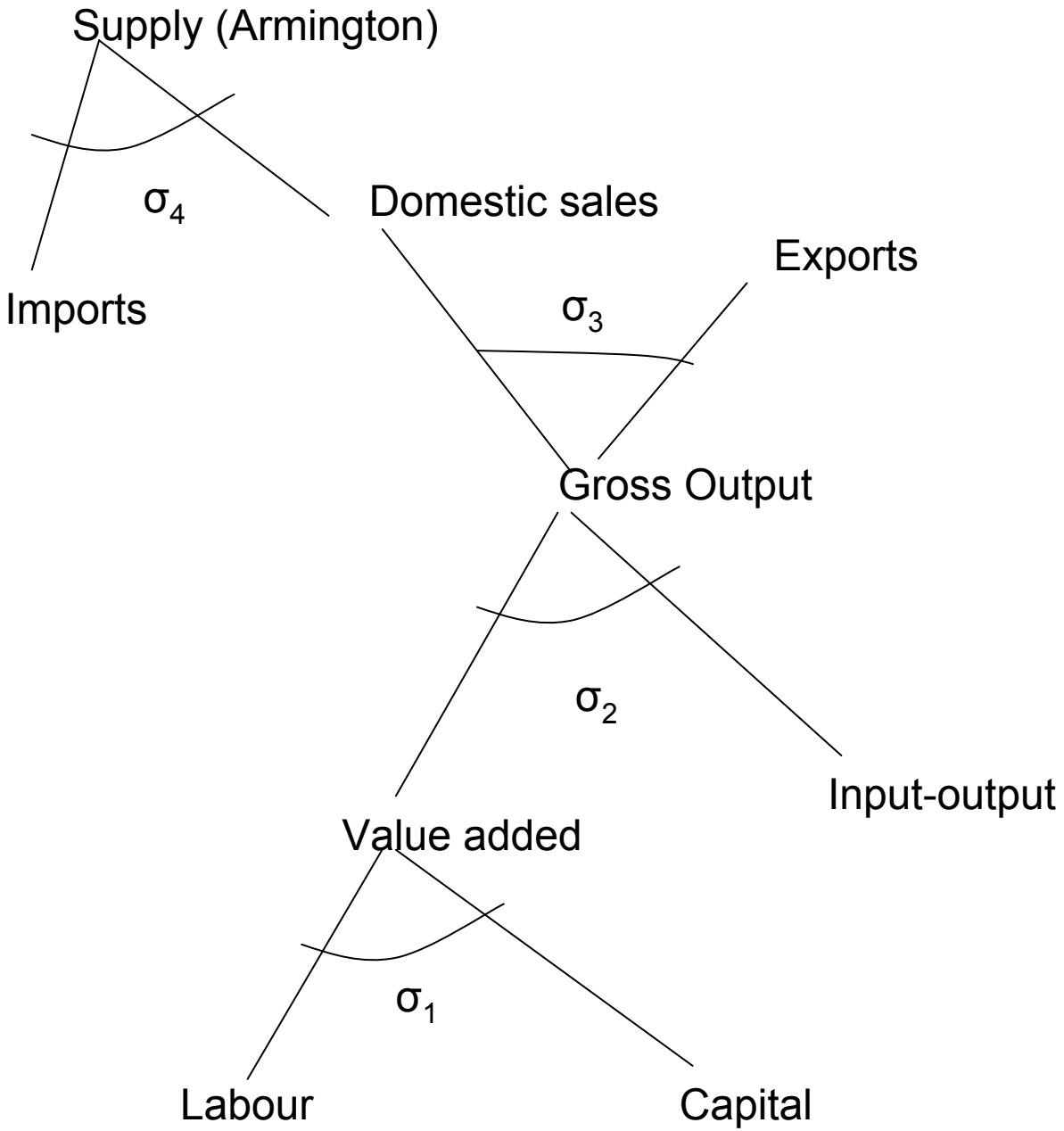
Nesting Structure in utility functions used in the UK model



Notation:

U = Utility
C = Composite consumption good
L = Leisure
C1..C16 = Sectoral composite
d1..d16 = domestic supply for consumption
m1..m16 = imports for consumption

Nesting of production and trade in the GE Model of UK



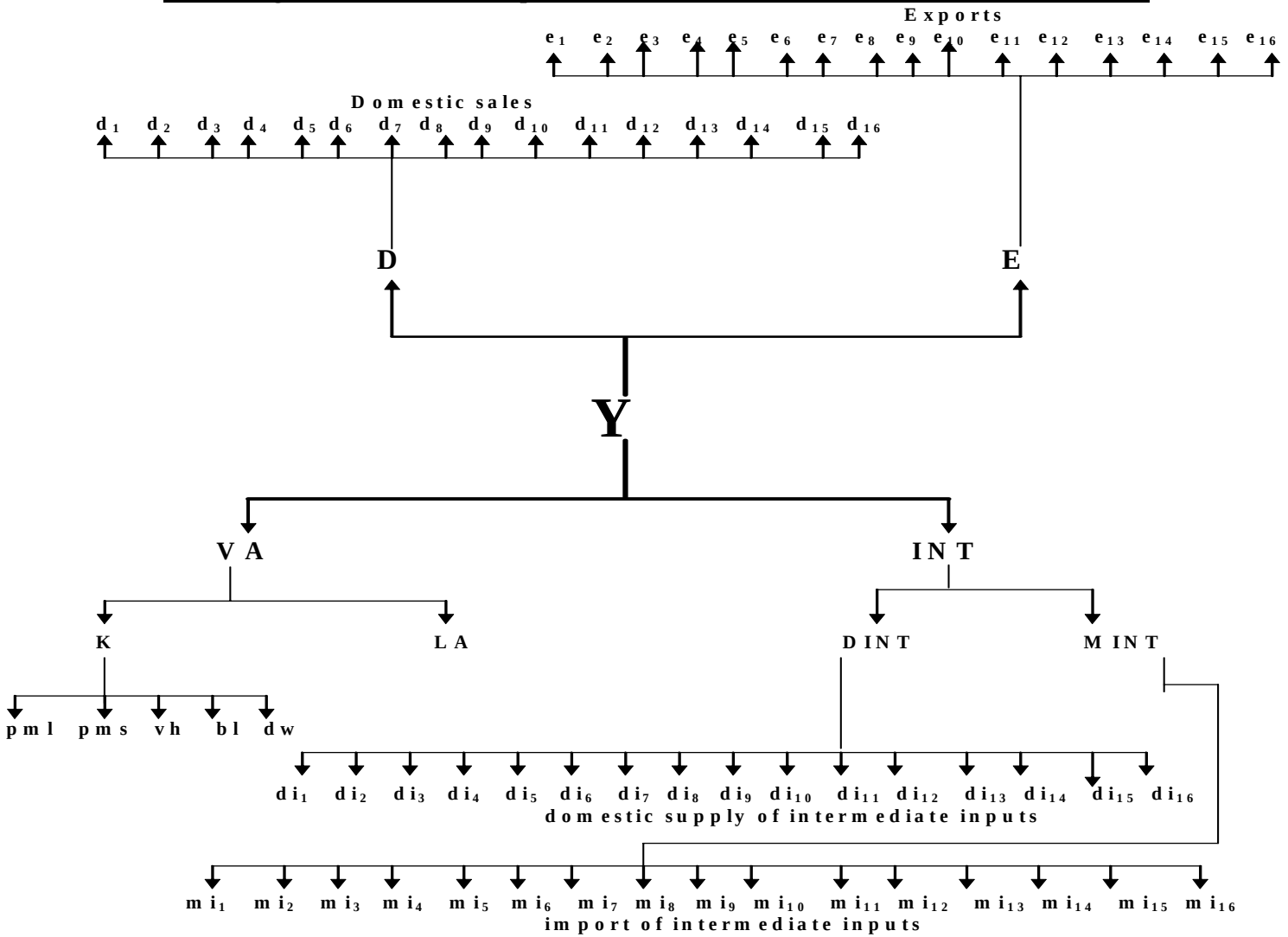
Analysis

Comparative Static

and

Dynamic

Nesting Structure in production used in the UK tax model



Notations:

Y = output
D = domestic sales
E = Exports
K = Composite capital
LA = labour
di$_1$..di$_{16}$ = domestic intermediate inputs
mi$_1$ .. mi$_{16}$ = imported intermediate inputs

VA = value added
INT = intermediate inputs
DINT = domestic intermediate inputs
MINT = Import of intermediate inputs

pml = plant and machinery long life
pls = plant and machinery short life
vh = vehicles
bl = buildings
dw = dwellings
e$_1$..e$_{16}$ = exports
d$_1$..d$_{16}$ = domestic sale

Use of the Dynamic General Equilibrium Tax Model

Analysis of sector specific growth paths of
- output
- employment
- investment
- and capital stock

Dynamic efficiency analysis
- welfare measures
- total of backward and forward linkages

Capital accumulation
- levels, Initial and terminal
- Saving-investment over time

Public policy
- Analysing the impact of golden rule of fiscal policy
- Existence or non existence of Ricardian equivalence
- Intertemporally balanced budget

Intertemporal redistribution
- Optimal rate of saving

Examination of the impacts of different rules of balance in trade and payment

Studies on Impacts of taxes in Macro Economic Models

Core growth models:

Walras (1954), Ramsey (1928), Leontief (1948), Arrow-Debreau (1954), Solow (1956), Cass (1965) , Koopman (1965), Uzawa (1962), Lucas (1988), Romer (1989) Parente (1994)

HM Treasury, Bank of England, Inland Revenue, London Business School, Liverpool, National Institute of Economic and Social Research, Macro Modelling Bureau, Cambridge University.

Keynes-Klien-Wallis and NIESR tradition.

Applied General Equilibrium Modelling (too many !!):

Harberger A.C. (1962), Shoven and Whalley (1973), Adelman and Robinson (1978) King and Fullerton (1984), Shoven and Whalley (1984), Ballard, Fullerton, Shoven and Whalley(1985), Auerback and Kotlikoff (1987), Robinson (1991), Mercenier and Srinivasan (1994), Rutherford (1989,1995), Harrison, Rutherford and Tarr (1997) Ginsburgh and Keyzer – (MIT volume), ORANI, Harrison-Pearson (1996)

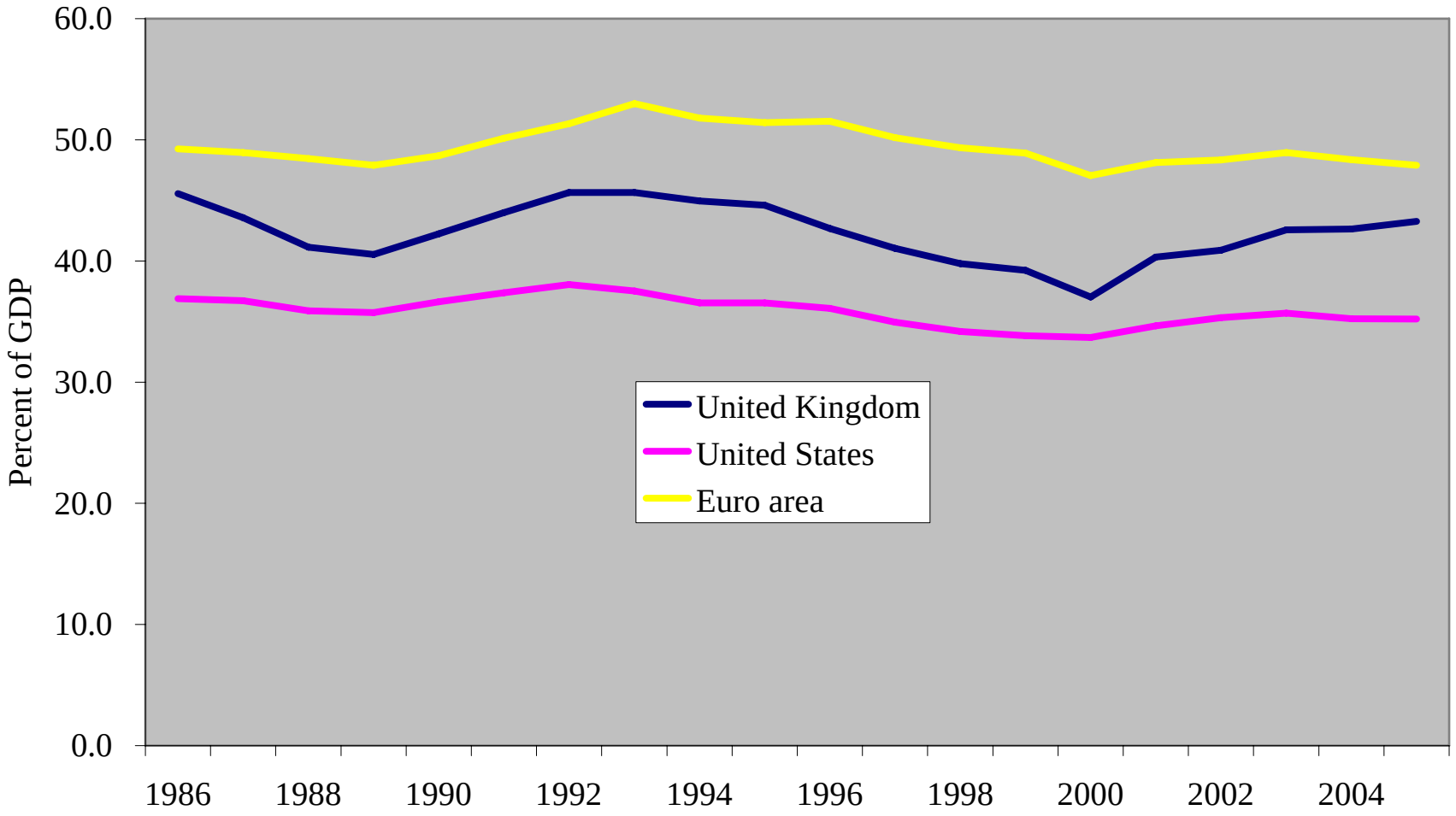
Stochastic Dynamic GE models in recent years.

Applied General Equilibrium Models of UK:

Piggott and Whalley (1985), Bhattarai and Whalley (1999), Hutton and Kenc (1994), Bank of England (2000, 2004), NIGEM (NIESR),

My Work: Bhattarai (1999, 2000), Bhattarai (2004)

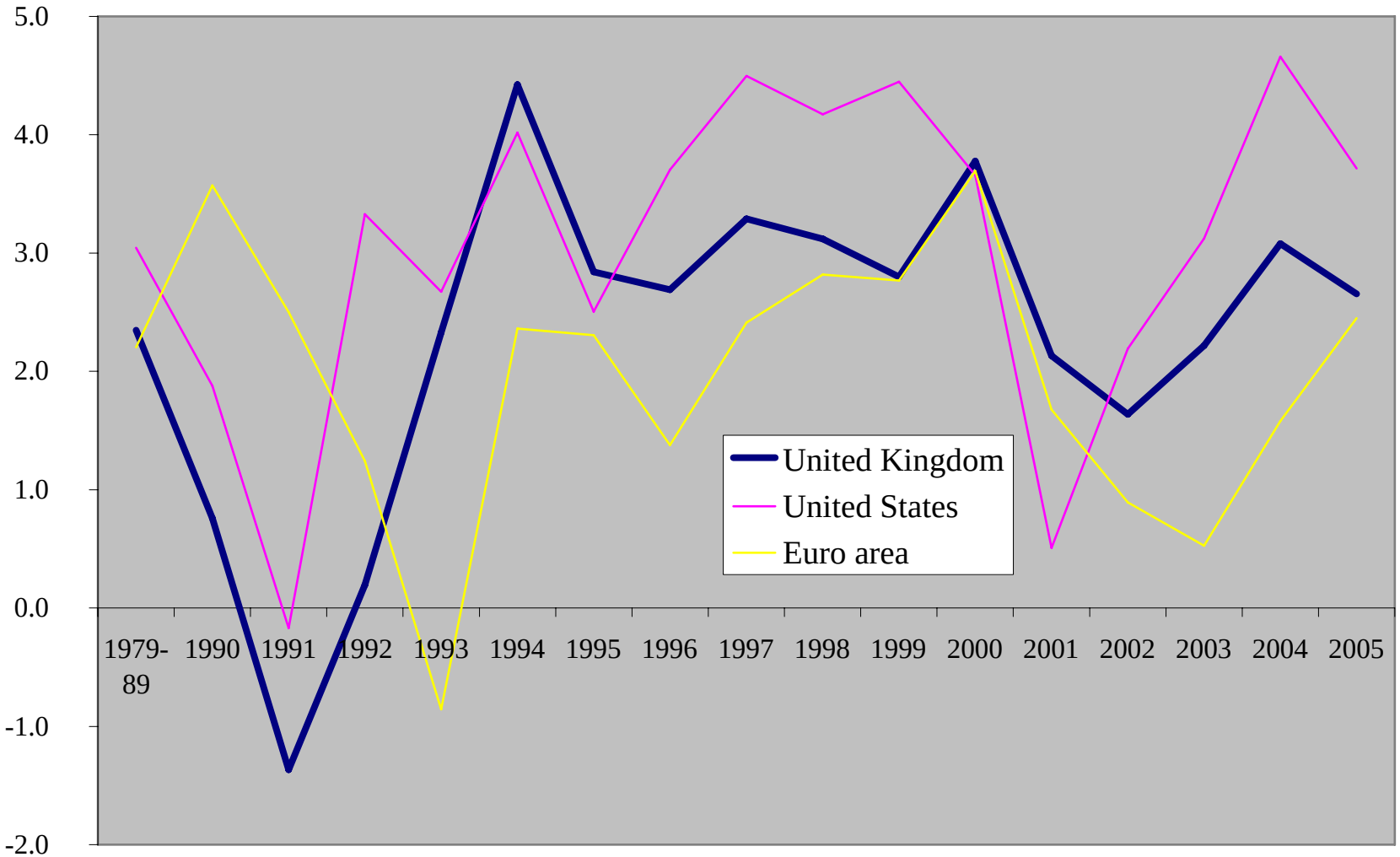
Ratio of General Government Expenditure to GDP



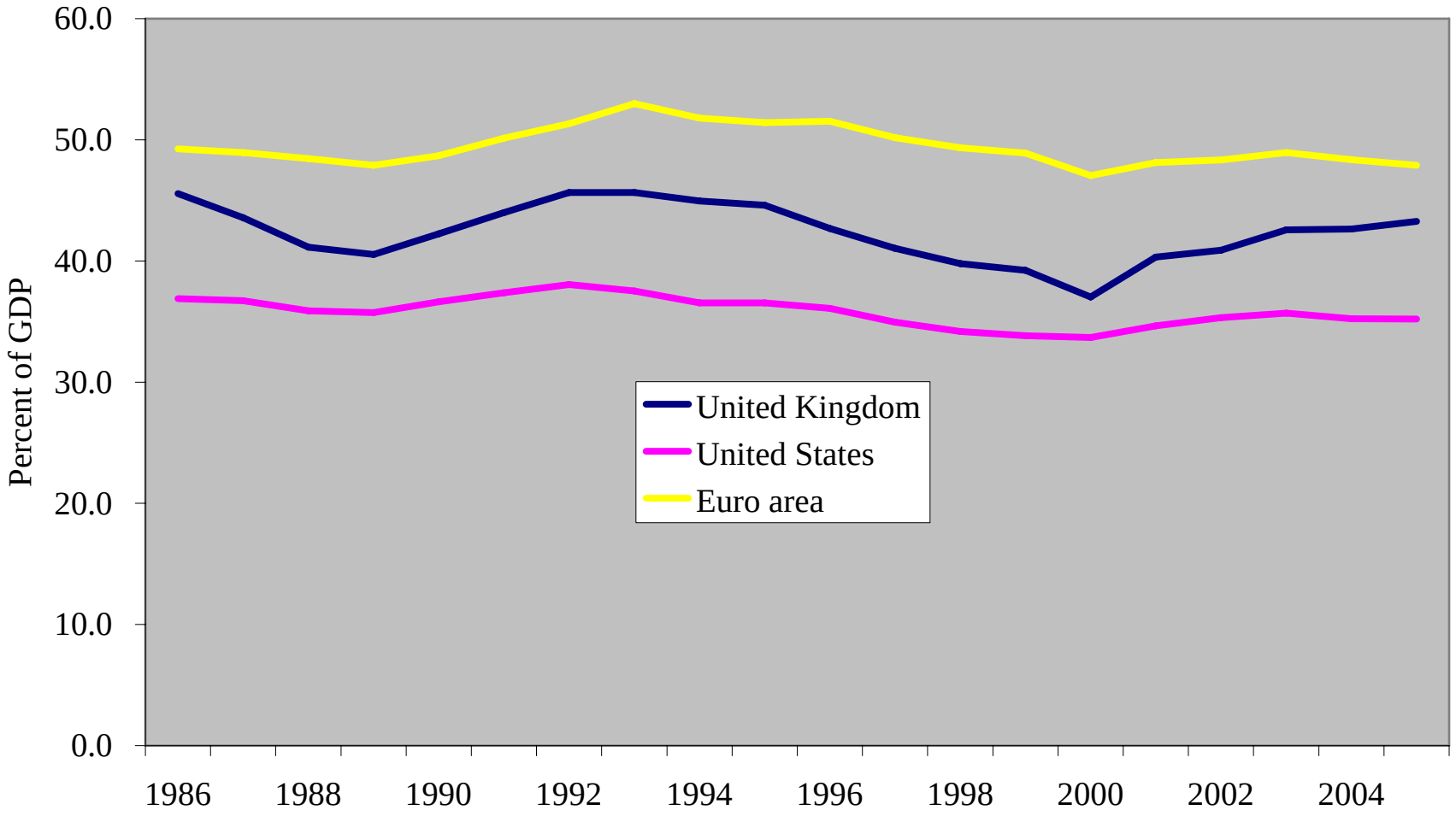
Literature on Tax Policy Analysis

- Adam Smith's Cannon of taxes: Equity, efficiency, sanctions and economy
- Classical free market economy: minimum government and transparent taxes
- Dalton's Principles of taxes: Pareto efficiency the basis of tax
- Partial equilibrium analysis: Marshall-Hicks-Atkinson
  prices, supply and demand in goods and factor markets
- Impact of taxes in macroeconomic models: macro-modelling bureau (Treasury, BOE, NIESR, IFS, Cambridge, LBS, Warwick, Liverpool, Exeter, Hull): Keynes, Stones, Klein, Wallis, Weale, Minford, Scott
- Taxes on economic growth models
- Golden rule of fiscal policy
- Growth and redistribution impacts of taxes: a general equilibrium analysis
- Applied GE Models of the UK economy:

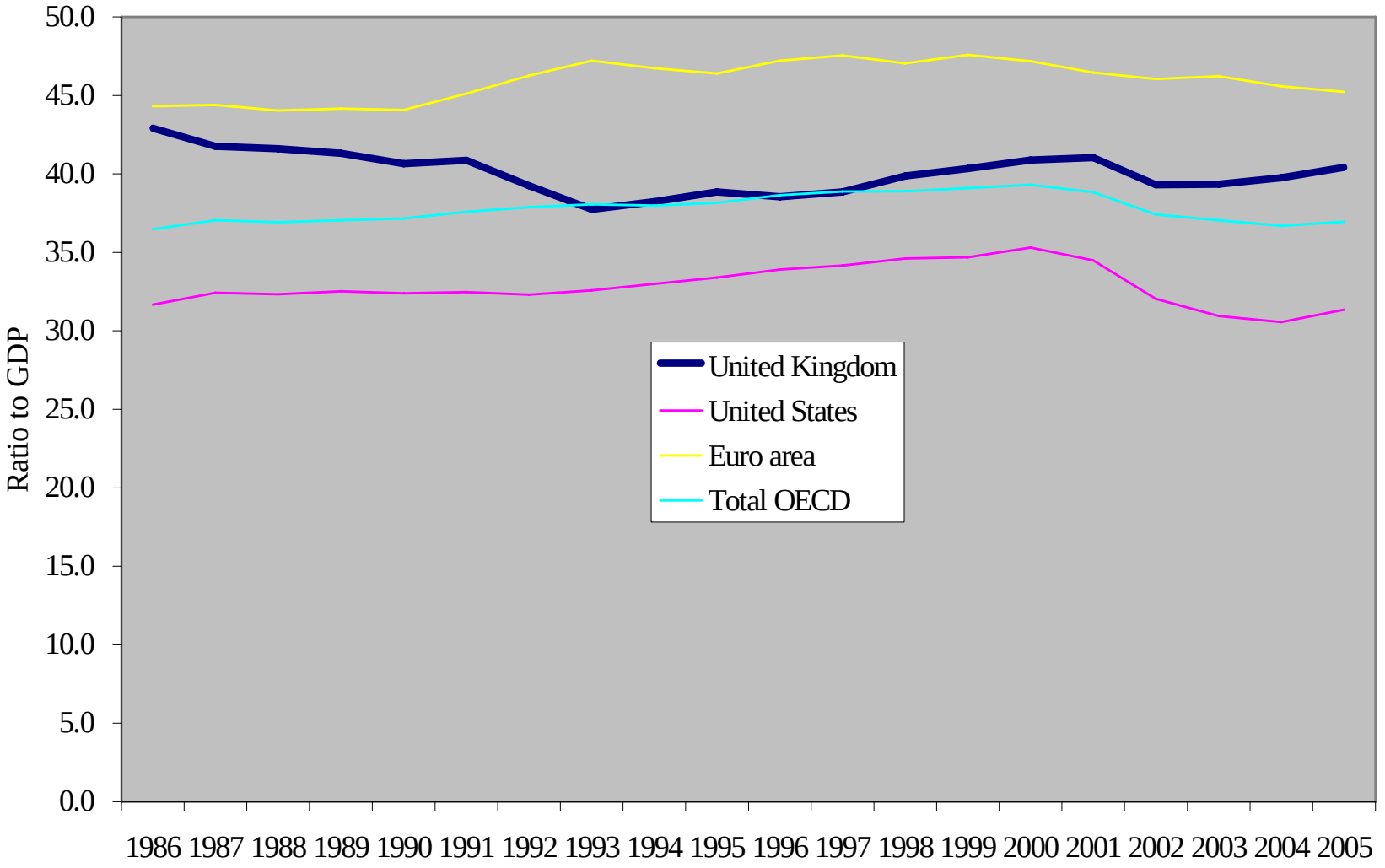
Growth Rates in the UK, USA and Euro Area



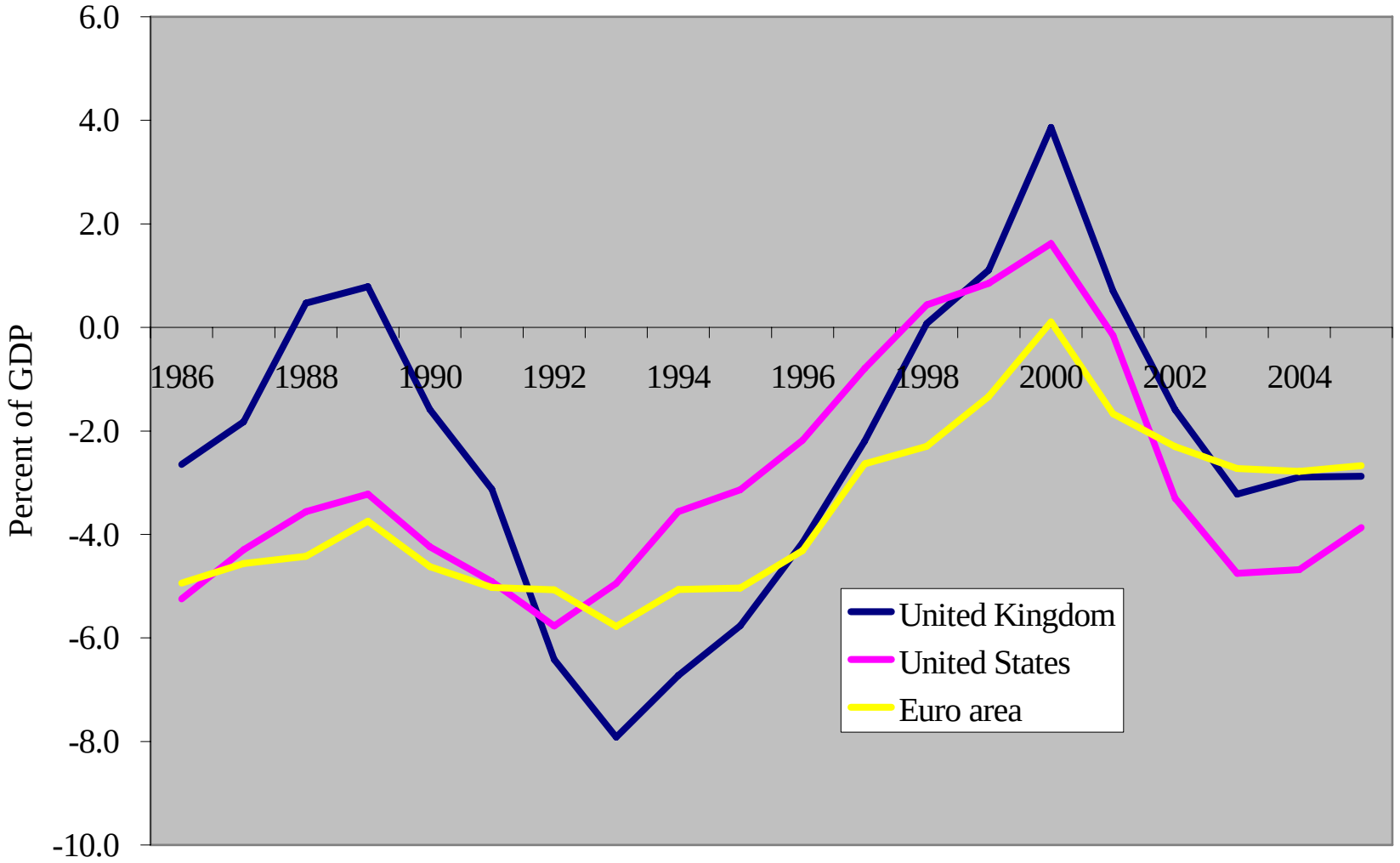
Ratio of General Government Expenditure to GDP



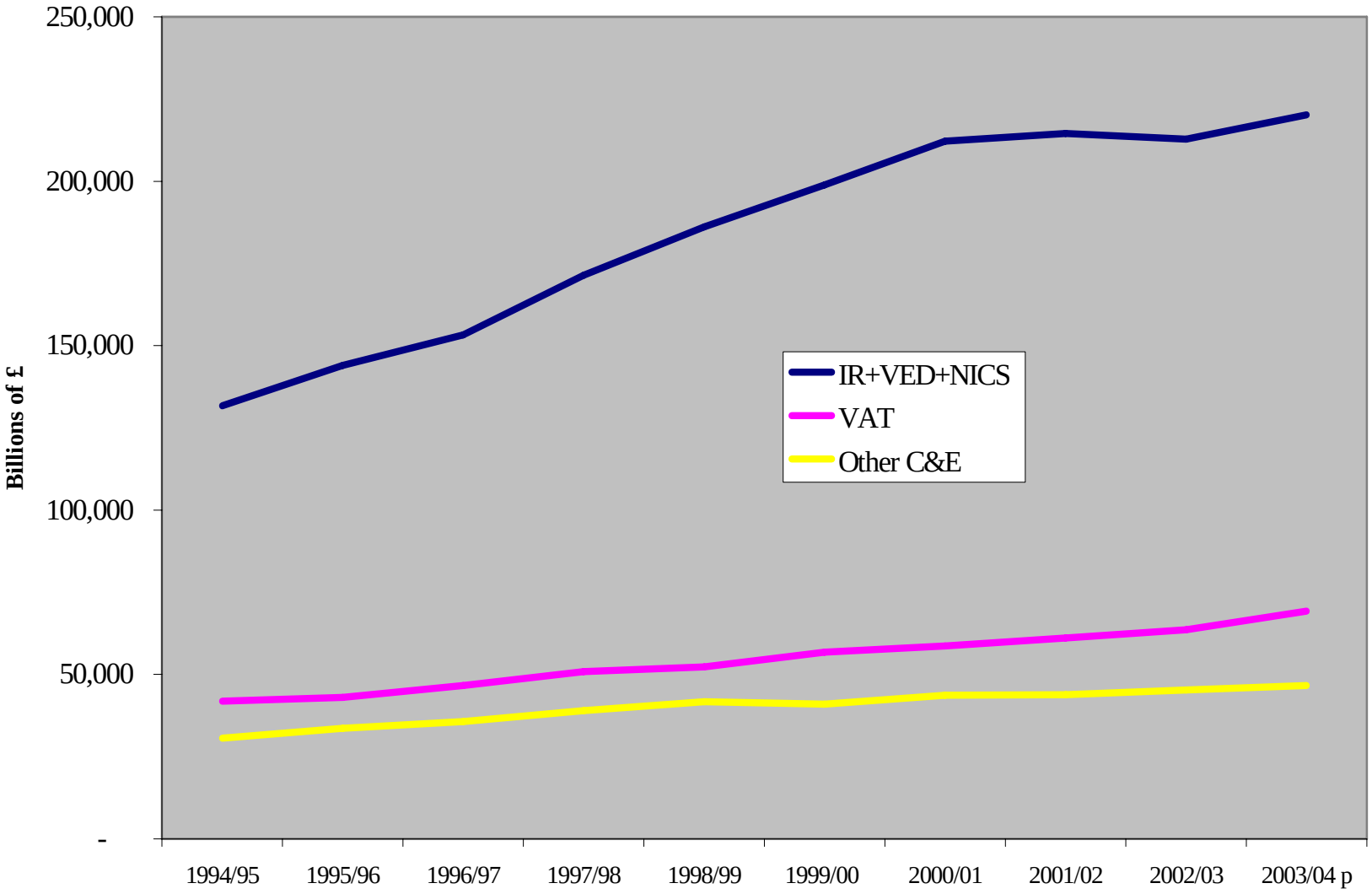
General Governmental Tax and Non-tax Receipt



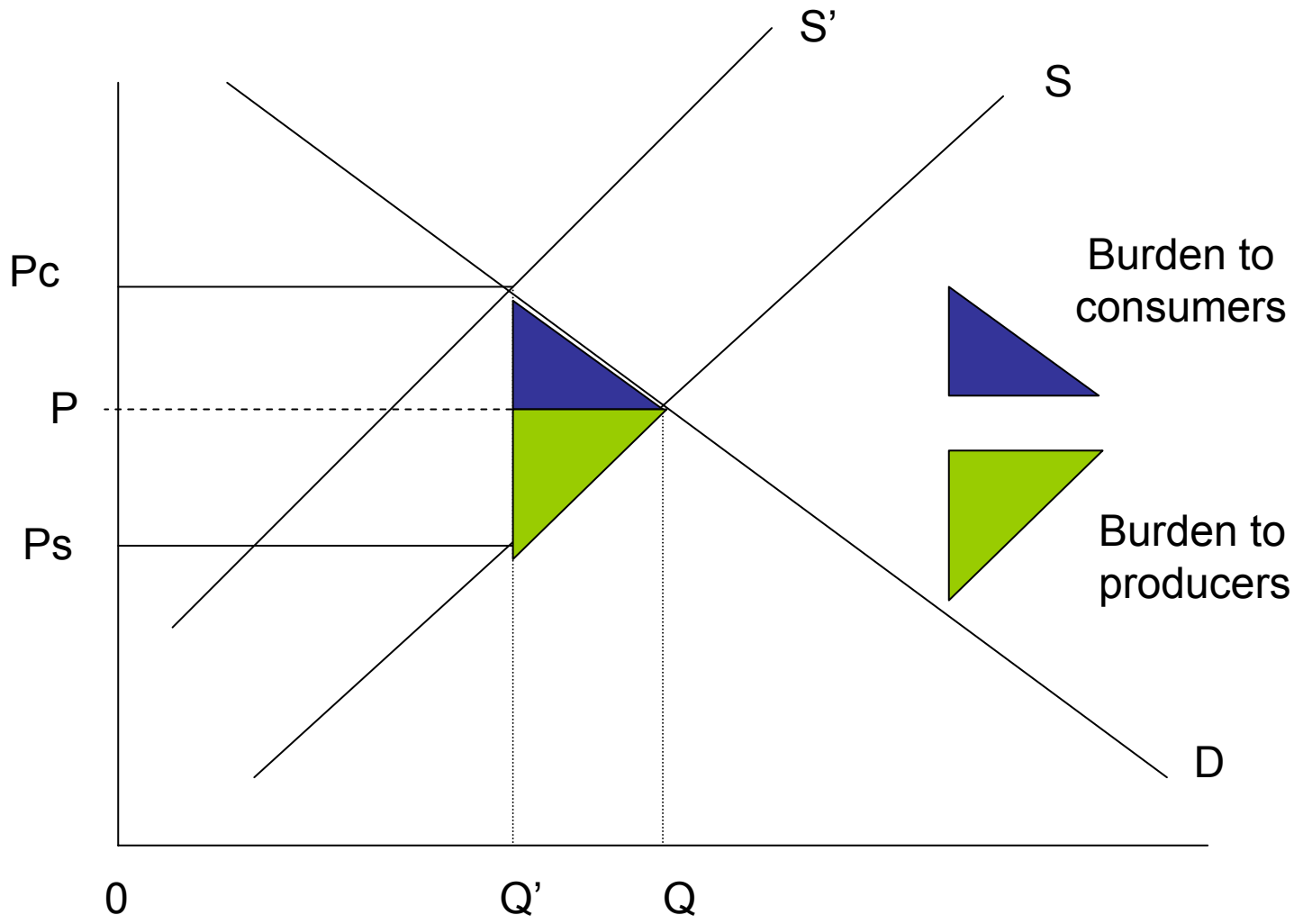
Government Budget Deficit or Surplus



Composition of the Public Revenue in the UK



First Round Impact of Taxes: Partial Equilibrium Analysis



Equilibrium in a Single Market

General Equilibrium Impact of Taxes

- First round effects: incidence of tax
  - Reduction (increase) in
    - household income
    - Profit of firs
    - Demand for products by households and foreigners
    - Supply of goods and services by firms
    - Government spending
    - Investment spending
- Second round effects: Gradual shifting of the burden of taxes
  - Increase or decrease in prices of commodities
  - Collection of revenue
- Final impacts
  - When all shifting burdens works through-out the economy

Preferences and Demand for Goods and Services

$$\sum_{t=0}^{\infty} \beta t \frac{U_t^{1-\sigma}-1}{1-\sigma}$$

$$U(C_t, L_t) = \left(\alpha_c C_t^{\frac{\gamma-1}{\gamma}} + (1-\alpha_c) L_t^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}}$$

$$U = \sum_{t=0}^{\infty} \left(\frac{1}{1+\rho}\right)^t \frac{\left(\left(\alpha_c C_t^{\frac{\gamma-1}{\gamma}} + (1-\alpha_c) L_t^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}} \right)^{1-\sigma} - 1}{1-\sigma}$$

Life Time Budget Constraint

$$R_t^{-1} = \prod_{s=0}^{t-1} 1/(1+r_s) \qquad P_t = \vartheta \prod_{i=1}^{n} p_{i,t}^{\alpha_i}$$

$$W = \frac{J_0}{1+r_0^c} + \frac{J_1}{(1+r_0^c)(1+r_1^c)} + \ldots + \frac{J_2}{\Pi_s^t (1+r_s^c)} + \ldots = \sum_{t=0}^{\infty} R_t^{-1} J_t$$

$$J_t = (1-t_l) w_t L S_t + (1-t_k) r_t K_t + TR_t$$

$$S_t = J_t - P_t C_t$$

$$\sum_{t=0}^{\infty} R_t^{-1} (P_t C_t + w_t L_t) = W$$

Production and Supply

$$\Pi^{y}_{j,t} = [((1-\delta^{e}_{i})PD_{i,t}^{\frac{\sigma_y - 1}{\sigma_y}} + \delta^{e}_{i} PE_{i,t}^{\frac{\sigma_y - 1}{\sigma_y}})]^{\frac{1}{\sigma_y - 1}}$$

$$-\theta^{v}_{j} PY^{v}_{j,t} - \theta^{d}_{j} \sum_{i} a^{d}_{i,j} P_{i,t} - \theta^{m}_{j} \sum_{i} a^{m}_{i,j} PM_{j,t}$$

$$Y_{i,t} = \Omega_{i}\left((1-\delta_{i})(K_{i,t})^{\gamma_i} + \delta_{i}(LS_{i,t})^{\gamma_i}\right)^{\frac{1}{\gamma_i}}$$

$$PY_{i,t} Y_{i,t} = w_t LS_{i,t} + r_t K_{i,t}$$

$$GY_{i,t} = \min\left(Y_{i,t}, \left(\frac{DI_{i,j,t}}{a^{d}_{i,j}}\right)_{i=j}, \left(\frac{MI_{i,j,t}}{a^{m}_{i,j}}\right)_{i=j}\right)$$

Capital Accumulation

$$K_{i,t+1} = K_{i,t}(1-\delta_i) + I_{i,t}$$

$$I_{i,T} = K_{i,T}(g+\delta_i)$$

$$LS_t = \overline{L}_t - L_t$$

Arbitrage Condition for Investment

$$R_{i,t} - \delta_i \leq r_t$$

$$I_{i,t} \geq 0$$

$$I_{i,t}(R_{i,t} - \delta_i - r_t) = 0$$

Trade and Absorption

$$A_{i,t} = \Phi\left(\delta_i^d D_{i,t}^{\frac{\sigma_m - 1}{\sigma_m}} + \delta_i^m M_{i,t}^{\frac{\sigma_m - 1}{\sigma_m}}\right)^{\frac{\sigma_m}{\sigma_m - 1}}$$

$$PA_{i,t} A_{i,t} = PD_{i,t} D_{i,t} + PM_{i,t} M_{i,t}$$

$$A_{i,t} = CC_{i,t} + G_{i,t} + I_{i,t} + \sum_j DI_{i,j,t} + \sum_j MI_{i,j,t}$$

$$GY_{i,t} = \Theta\left((1-\delta_i^e) D_{i,t}^{\frac{\sigma_y - 1}{\sigma_y}} + \delta_i^e E_{i,t}^{\frac{\sigma_y - 1}{\sigma_y}}\right)^{\frac{\sigma_y}{\sigma_y - 1}}$$

Trade and BOP Constraint

$$PA_{i,t}A_{i,t} = PD_{i,t}D_{i,t} + PM_{i,t}M_{i,t}$$

$$A_{i,t} = CC_{i,t} + G_{i,t} + I_{i,t} + \sum_j DI_{i,j,t} + \sum_j MI_{i,j,t}$$

$$GY_{i,t} = \Theta\left((1-\delta_i^e)D_{i,t}^{\frac{\sigma_y-1}{\sigma_y}} + \delta_i^e E_{i,t}^{\frac{\sigma_y-1}{\sigma_y}}\right)^{\frac{\sigma_y}{\sigma_y-1}}$$

$$P_{i,t}GY_{i,t} = PD_{i,t}D_{i,t} + PE_{i,t}E_{i,t} \qquad \Pi_{j,t}^{y} \le 0$$

$$\sum_i PE_{i,t}E_{i,t} = \sum_i PM_{i,t}M_{i,t}$$

$$\sum_t (1+r^W)^{-t} \sum_i PE_{i,t}E_{i,t} = \sum_t (1+r^W)^{-t} \sum_i PM_{i,t}M_{i,t}$$

Tax Revenue and Public Spending

$$REV_t = \sum_i t_i^k r_t K_{i,t} + \sum_i t_i^{vc} P_{i,t} CC_{i,t}$$
$$+ \sum_i t_i^{vg} P_{i,t} G_{i,t} + \sum_i t_i^{vk} P_{i,t} I_{i,t} + \sum_i t_l wLS_t$$
$$+ \sum_i t_i^m PM_{i,t} M_{i,t} + \sum_i t_i^p P_{i,t} GY_{i,t}$$

$$REV_t = G_t + TR_t$$

$$G = \sum_i PA_i GD_i + \sum_i PA_i GM_i$$

Features of a Inter-temporal Competitive General Equilibrium

Demand equals supply in equilibrium in all periods in

labour market

capital market

Goods market

trade and government budget is balanced over time.

Equilibrium is guaranteed by the relative prices which are equate demand and supply and determined in terms of

Behavioural parameters:

shares of spending, costs and the elasticities of substitution in

preferences (inter and intra temporal)

technology (nested production function)

trade (differentiated product assumption)

accumulation: rate of depreciation and discount

Policy parameters

tax rates on capital income, labour income and final demand

Endowments:

initial and terminal capital and Labour

Calibration of the Dynamic Economy to the Benchmark Micro-Consistent Data set

$$U = \sum_{t=1}^{T} \beta^t U(C_t) + \sum_{t=T+1}^{\infty} \beta^t U(C_t)$$

$$I_T = K_T(g+\delta) \qquad P_t = P_{t+1}^k$$

$$P_t^k = (1+r)P_t \qquad P_t^k = r_1^k + (1-\delta)P_{t+1}^k$$

$$r_t^k = (r+\delta)P_t^k$$

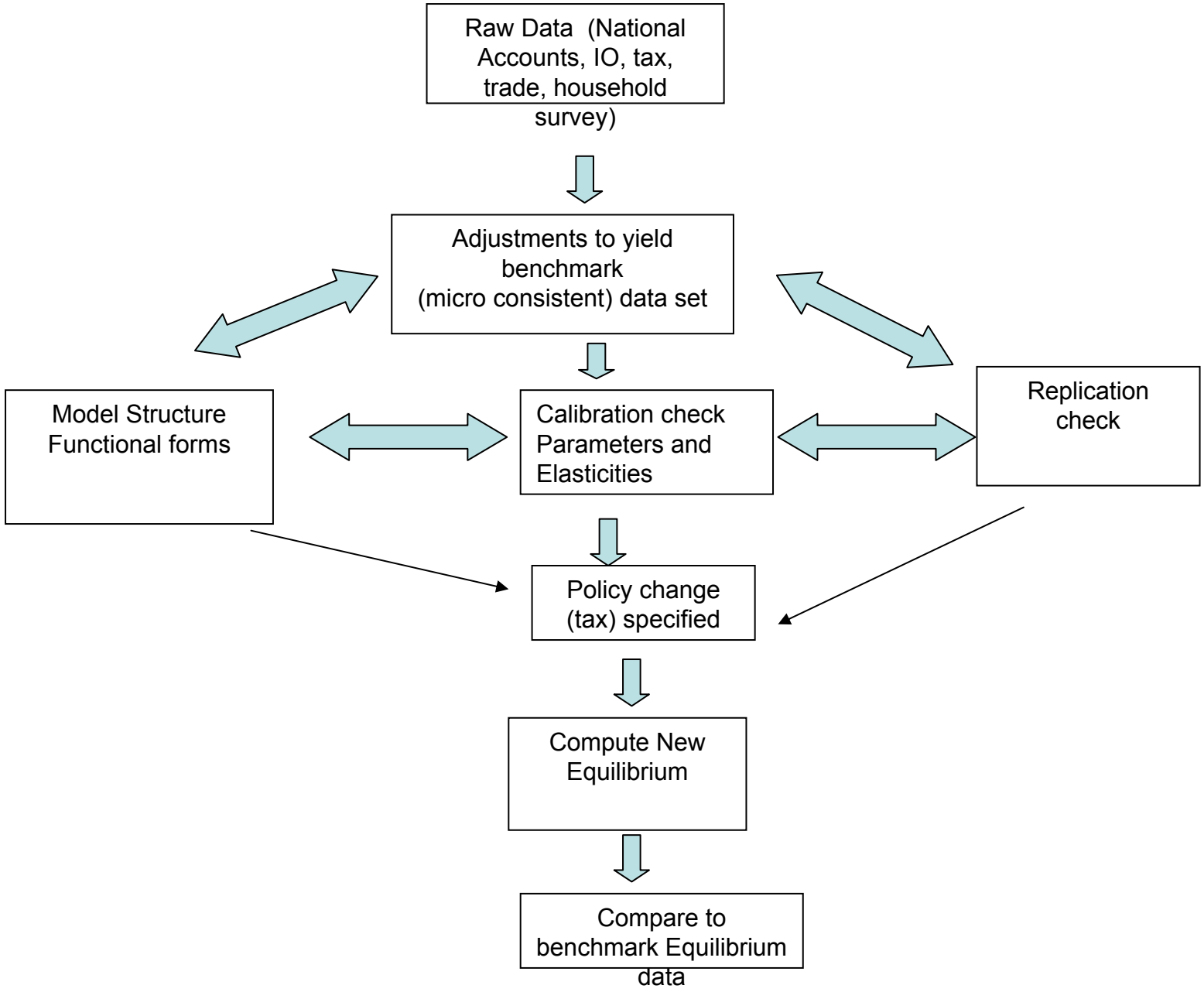
$$\frac{P_{t+1}^k}{P_t^k} = \frac{1}{1+r}$$

$$\overline{V}_i = r_t^k K_i$$

$$\overline{V}_i = (r+\delta_i)K_i$$

$$I_i = \frac{(g+\delta_i)}{(r+\delta_i)}\overline{V}_i \qquad K_i = \frac{\overline{V}_i}{(r+\delta_i)}$$

Model is solved using the GAMS/MPSGE software.



Steps for Implementation of a General Equilibrium Model

Table 1
Basic Parameters of the UK Model

Steady state growth rate for sectors (g)	0.02
Net interest rate in non-distorted economy (r)	0.05
Refercene quantity for each sector , Q_{rf}	$(1+g)^{t-1}$
Reference price for each sector, P_{rf}	$1/(1+r)^{t-1}$
Elasticity of transformation between UK's Domestic supplies and exports to the Rest of the World (ROW) , σ_y	1.5
Elasticity of substitution between domestic products and imports from rest of the World (ROW), σ_m	1.5
Intertemporal elasticity of substitution, σ	0.5
Intra temporal elasticity of substitution between leisure And composite goods, γ	0.5
Elasticity of substitution in consumption goods Across sectors, σ_c	0.5

Share Parameters of the General Equilibrium Tax model of the UK Economy

	Shares of spending on Final demand			Value Added	
Industry	Share of household spending on goods	Share of government spending on goods	Share of investor's spending on goods	Share of capital total	Share of lab total
Agric	0.0174	0.0003		0.265	0.735
Minin	0.0009	0.0004		0.845	0.155
Chemi	0.0367	0.0303	0.0040	0.219	0.781
Metal	0.0009	0.0046	0.0733	0.387	0.613
Engin	0.0168	0.0366	0.2399	0.185	0.815
Foodd	0.1183	0.0051	0.0015	0.272	0.728
Othma	0.1121	0.0497	0.1510	0.317	0.683
Power	0.0411	0.0102		0.183	0.817
Const	0.0093	0.0341	0.4274	0.541	0.459
Distr	0.2981	0.0087	0.0225	0.034	0.966
Trans	0.0582	0.0210	0.0066	0.229	0.771
Finan	0.0591	0.0685	0.0739	0.235	0.765
Pubad	0.0426			0.269	0.731
Educa	0.1095	0.3071		0.031	0.969
House	0.1216			0.032	0.968
Dwelling				1.000	0.000

Source: UK tax model 1998.

Table 2
Depreciation, Capital Income and Indirect Tax Rates (%)

Industry	Elasticity of substitution between labour and capital (γ_i)	Depreciation rate (annual %)	Capital income tax rate	Indirect tax on private consumption	Indirect tax on public consumption	Indirect tax on investment	Production tax rates	Tariff rates
Agric	**1.2**	**8.3**	**41.4**	**1.6**	**7.7**		**-10.9**	**2.5**
Extra	**1.7**	**16.6**	**26.2**					**2.5**
Minin	**1.5**	**10.4**	**31.0**	**12.5**	**32.7**		**-0.6**	**2.5**
Chemi	**1.7**	**5.6**	**24.0**	**15.4**	**8.3**		**14.3**	**2.5**
Metal	**1.6**	**5.4**	**25.3**	**100.8**	**47.5**	**3.8**	**0.0**	**2.5**
Engin	**1.5**	**6.0**	**27.6**		**31.1**	**4.9**	**0.0**	**2.5**
Food	**1.0**	**5.4**	**28.0**	**17.0**	**3.5**		**12.2**	**2.5**
Othma	**0.9**	**6.4**	**26.2**	**26.3**	**19.**	**6.1**	**0.0**	**2.5**
Power	**1.5**	**4.1**	**28.9**	**5.7**	**22.1**		**3.4**	**2.5**
Constr	**1.0**	**9.4**	**30.3**	**13.3**	**27.8**	**2.5**	**-0.1**	
Distr	**1.6**	**5.9**	**33.9**	**4.4**			**5.4**	
Trans	**1.6**	**7.5**	**29.7**	**8.3**	**15.3**	**0.1**	**-2.2**	**2.5**
Finan	**1.6**	**6.9**	**41.9**	**1.0**	**11.0**	**0.3**	**2.0**	**2.5**
PubAD	**1.6**	**4.**	**45.8**					**2.5**
EducA	**1.6**	**3.8**	**48.1**	**7.5**	**0.6**		**1.9**	**2.5**
House	**1.0**	**2.0**					**-0.3**	**2.5**

Table 3
Counterfactual tax rates in the dynamic UK model

Tax experiment	Counterfactual tax rates
Capital income tax rate	25.0
Indirect tax on private consumption	10.0
Indirect tax on public consumption	5.0
Indirect tax on investment	5.0
Production tax rates	5.0
Tariff rates	1.0
Household income tax rate	15.0

Model Scenarios

- Closed or Open capital market
- Pre-announcement and no pre-announcement effects
- Uniform equal yield tax reform
- Tax reduction

Table 4

Efficiency effects of tax reform in the dynamic UK model

Efficiency change as a percentage of Benchmark GDP (%)

	Closed capital market with no announcement	Closed capital market with announcement	Open capital market with no announcement
Capital income tax	0.699	0.633	0.768
Labour income tax	-2.054	-2.054	-2.195
Production tax	1.421	1.284	1.442
Investment tax	-0.085	-0.048	-0.106
Household consumption tax	0.112	0.557	0.693
Government consumption tax	0.297	0.256	0.317
Tariffs	0.070	0.053	0.081

Interpretation of Equal-Yield Tax Reform Results

- equal yield tax experiments welfare gains up to 1.4 percent of base year GDP can occur by removing distortions in taxes.

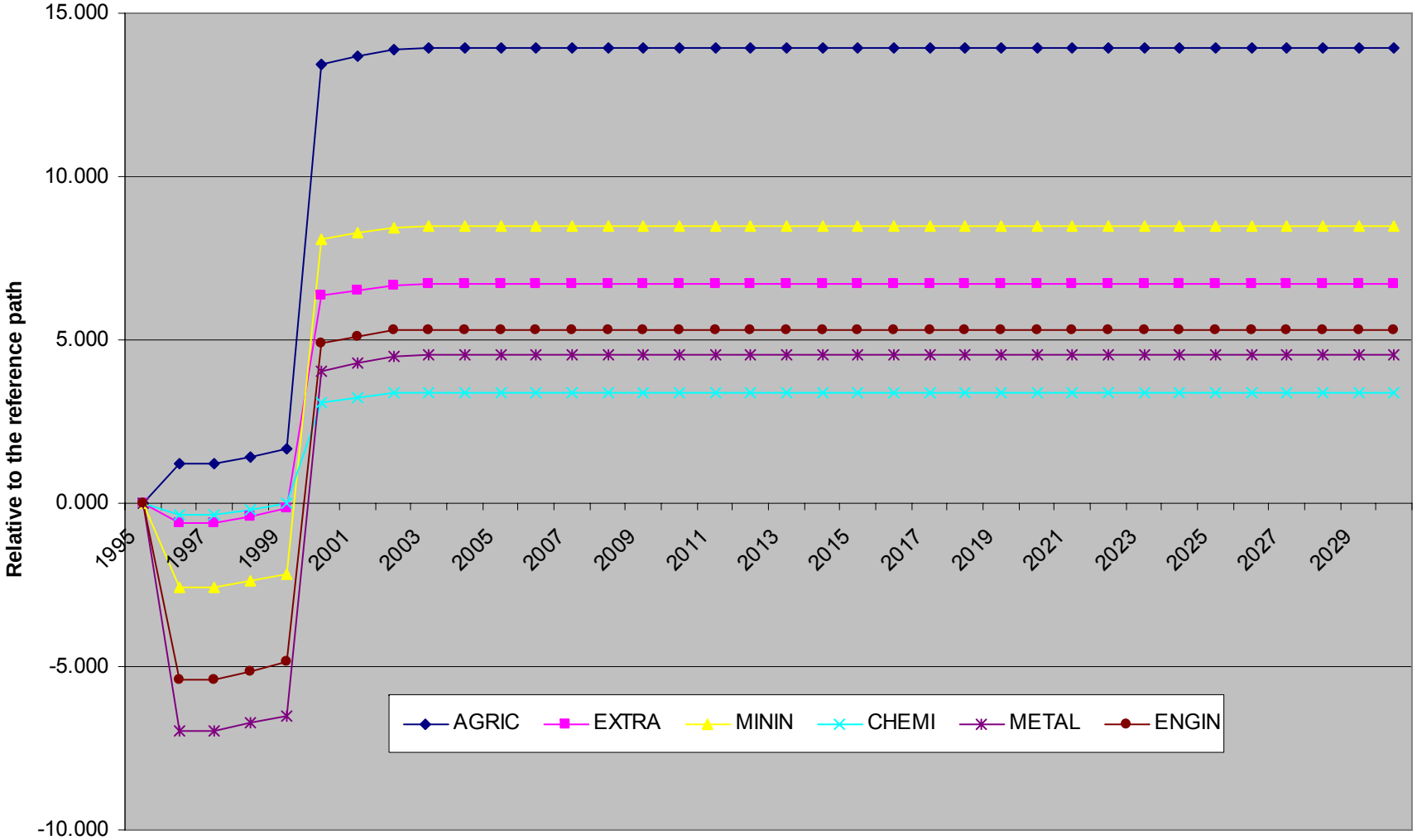
- Welfare loss of up to 2.05 percent of it can happen if a less distortionary tax, such as the labour income tax is replaced by more distortionary taxes to meet equal yield constraint.

- Setting a uniform rate of capital income tax is welfare improving.

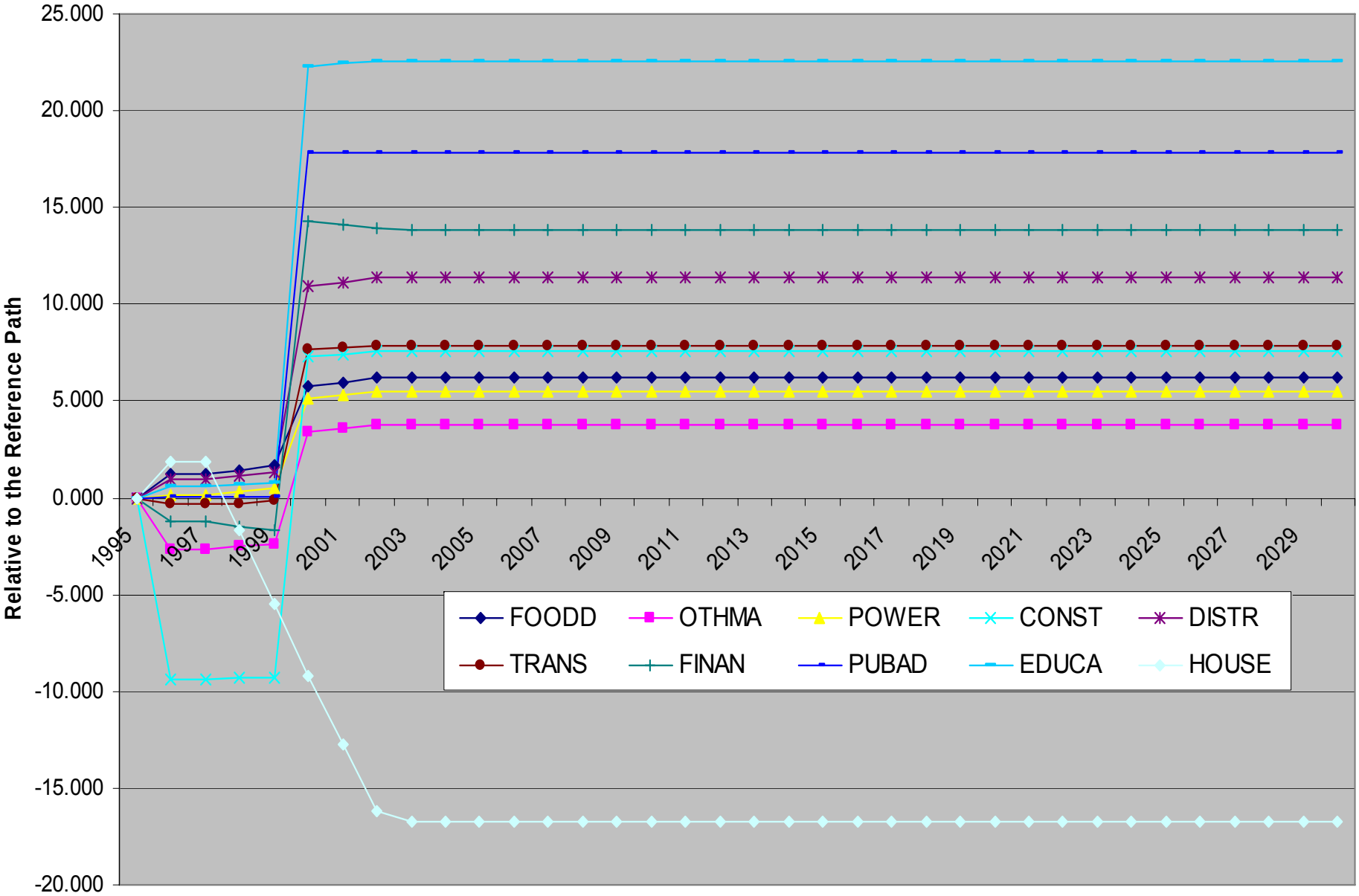
- Making tax rates in private and public consumption uniform across sectors raises the life time utility.

- simulation results are robust to whether the capital market is closed or open.

Impact of Tax Reform in Accumulation of Capital Stock Across Sectors



Impact of Tax Reform in the Capital Accumulation Accross Sectors



Impact of Pre-announcement of tax reform on growth, investment, capital stock and employment across sectors

- impacts of an unanticipated tax reform on investment, capital accumulation, output and employment are less than those of anticipated tax reforms.
-
- producers, traders, investors and the government are more capable of adjusting their economic behaviour than the households when tax announcements are made in advance.

- Impacts on growth, investment, capital accumulation and employment across sectors are proportional to the initial distortions of the taxes.

Table A2

A 16 Sector Industry by Industry Input-Output Table of the United Kingdom 1995

I x I Domestic Use Matrix	Agriculture	Extraction	Other Mining	Chemicals	Metals	Engineering	Food, drink	Other Manuf.	Utilities	Construction	Distribution	Transport	Financial	Public Admin	Educ. Health,	Housing	Total intermediate	Consumers' expenditure	GGFC	GDFCF	Stocks	Exports	Total final demand	
Agriculture	2,096	0	14	27	7	5	12,132	435	0	4	564	48	15	0	148	0	**15,495**	6,730	42	0	0	1,942	8,713	
Extraction	0	2,439	0	4,697	3	0	0	0	3,622	0	0	0	0	0	0	0	**10,762**	0	0	0	0	6,942	6,942	
Other Mining	20	0	353	218	846	26	45	130	1,897	401	105	17	8	0	57	0	**4,124**	339	47	0	0	983	1,369	
Chemicals	1,433	10	37	3,899	433	546	571	1,484	466	737	1,299	1,254	913	0	3,204	19	**16,304**	3,764	3,116	0	261	28,663	35,804	
Metals	110	162	192	1,225	7,249	6,320	1,831	5,197	50	7,074	503	389	5	0	84	0	**30,392**	346	588	7,158	779	10,230	19,101	
Engineering	0	576	317	682	1,254	5,705	528	2,432	634	788	848	1,808	1,018	0	1,567	36	**18,192**	0	1,589	2,613	332	50,923	55,457	
Food, drink	2,797	52	25	356	82	120	6,382	350	64	51	6,589	650	1,058	0	1,796	4	**20,377**	25,904	411	0	153	10,270	36,737	
Other Manuf.	583	80	134	1,781	1,839	3,005	2,816	16,404	474	4,242	6,702	4,139	8,242	0	3,340	283	**54,064**	18,082	3,872	8,933	1,185	39,858	71,928	
Utilities	279	0	160	1,330	1,596	1,189	931	1,980	12,273	272	1,201	857	1,184	0	705	23	**23,981**	16,353	1,323	0	0	62	17,738	
Construction	172	0	122	109	32	56	0	31	0	21,085	603	151	1,985	0	146	3,929	**28,420**	3,521	4,414	47,764	285	0	55,983	
Distribution	1,005	200	206	1,479	2,489	4,115	1,647	3,724	355	1,371	4,164	2,470	2,276	0	790	0	**26,289**	111,181	1,229	2,586	0	13,701	128,698	
Transport	245	704	335	1,232	2,047	1,415	1,583	3,614	183	887	14,871	15,642	17,082	0	3,175	198	**63,216**	19,715	2,637	779	0	12,194	35,324	
Financial	1,949	671	471	4,070	2,781	6,194	4,205	9,177	1,884	10,483	22,425	12,387	50,836	0	13,435	15,221	**156,189**	25,373	8,458	8,483	0	12,545	54,859	
Public Admin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	63,843	0	0	0	63,843	
Educ. Health,	378	1	41	520	253	581	496	2,618	179	242	1,001	1,369	4,031	0	7,756	67	**19,535**	43,653	46,265	0	0	4,504	94,422	
Housing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	53,269	0	0	0	0	53,269	
Total intermediate	**11,067**	**4,895**	**2,410**	**21,626**	**20,912**	**29,276**	**33,168**	**47,576**	**22,081**	**47,638**	**60,876**	**41,182**	**88,652**	**0**	**36,201**	**19,781**	**487,339**	**328,229**	**137,832**	**78,316**	**2,995**	**192,816**	**740,188**	1
Imports	1,630	989	425	10,639	7,613	15,965	8,827	30,336	3,612	5,151	3,532	4,895	3,949	0	2,960	19	**100,541**	52,021	9,995	28,174	1,563	2,494	**94,248**	
Duty on imports	34	6	5	136	101	214	171	405	48	66	51	26	2	0	9	0	**1,273**	547	91	382	20	32	**1,073**	
VAT	0	0	0	0	0	0	0	0	0	0	0	218	3,259	0	1,181	0	**4,658**	33,257	3,915	3,731	0	0	**40,902**	
Duties and levies	211	2	103	1,175	344	176	460	331	1,378	130	1,275	2,026	896	0	344	36	**8,887**	22,713	434	0	0	0	**23,147**	
Other taxes and subsidies	-265	-25	-10	-50	-53	-46	-1,454	-212	-10	-34	-443	-404	-409	0	-186	-6	**-3,607**	4,559	-577	-45	4	-556	**3,384**	
Value added – Labour	7,143	1,409	1,822	10,151	15,790	18,529	9,691	36,483	5,492	29,947	61,877	35,191	70,149	60,316	69,067	0	**433,059**	0	0	0	0	0	**0**	
Value added – Gross profits etc	4,388	10,428	738	8,432	4,786	9,536	6,250	11,074	9,118	1,505	27,820	15,406	44,549	3,527	4,381	33,440	**195,376**	0	0	0	0	0	**0**	
Total inputs	**24,208**	**17,704**	**5,493**	**52,108**	**49,493**	**73,649**	**57,114**	**125,992**	**41,719**	**84,404**	**154,987**	**98,540**	**211,047**	**63,843**	**113,957**	**53,269**	**1,227,526**	**441,325**	**151,691**	**110,558**	**4,582**	**194,786**	**902,942**	2

Source: ONS, Input-Output Tables of the United Kingdom, 1995; Siddorn (1999).

Table A3

Industry by Industry Import Use Matrix for the UK economy 1995

x I Imports Use Matrix	Agricul ture	Extracti on	Other Mining	Chemic als	Metals	Engine ering	Food, drink	Other Manuf.	Utili-Ties	Constr uction	Distrib ution	Transp ort	Financi al	Public Admin	Educ. Health,	Hou sing	Total interme-diate	Cons mers' expend iture	GGFC	GDFCF	Stocks	Exports	Total final deman d	Total
Agriculture	462	0	0	2	0	0	2,342	394	0	0	546	9	0	0	0	0	**3,755**	1,471	0	0	0	46	1,517	**5,272**
Extraction	0	133	0	1,532	0	0	0	0	1,613	0	0	0	0	0	0	0	**3,278**	0	0	0	0	0	0	**3,278**
Other Mining	0	0	68	359	540	31	4	50	312	540	0	0	0	0	0	0	**1,905**	29	3	0	0	2,003	2,035	**3,941**
Chemicals	802	11	142	7,931	1,028	1,274	844	7,476	382	196	165	609	22	0	299	0	**21,182**	2,259	873	0	199	165	3,495	**24,677**
Metals	26	180	57	222	5,249	2,251	378	1,745	0	1,690	64	0	0	0	0	0	**11,863**	0	0	3	220	0	222	**12,085**
Engineering	45	161	61	13	286	11,980	22	2,177	855	770	46	791	78	0	119	0	**17,403**	6,220	3,123	22,859	148	164	32,513	**49,916**
Food, drink	291	0	0	275	0	0	4,641	36	0	0	936	53	0	0	0	0	**6,232**	8,812	348	0	18	19	9,198	**15,430**
Other Manuf.	0	0	79	300	478	369	565	18,399	12	1,900	1,206	641	60	0	357	0	**24,365**	24,075	2,893	5,312	979	98	33,357	**57,722**
Utilities	0	0	0	3	4	1	2	3	432	0	0	0	0	0	0	0	**446**	0	0	0	0	0	0	**446**
Construction	0	0	0	0	0	0	0	0	0	44	0	0	0	0	0	0	**44**	0	0	0	0	0	0	**44**
Distribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	3,518	0	0	0	0	3,518	**3,518**
Transport	0	504	11	0	5	0	4	0	0	2	530	2,720	375	0	60	0	**4,211**	4,036	342	0	0	0	4,378	**8,590**
Financial	4	1	8	0	20	50	22	0	4	10	35	33	3,369	0	886	19	**4,463**	0	1,328	0	0	0	1,328	**5,791**
Public Admin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	416	0	0	0	416	**416**
Educ. Health,	0	0	0	1	3	8	2	55	2	0	3	38	45	0	1,238	0	**1,395**	1,035	669	0	0	0	1,704	**3,099**
Housing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	566	0	0	0	0	566	**566**
Total Imports	**1,630**	**989**	**425**	**10,639**	**7,613**	**15,965**	**8,827**	**30,336**	**3,612**	**5,151**	**3,532**	**4,895**	**3,949**	**0**	**2,960**	**19**	**100,541**	**52,021**	**9,995**	**28,174**	**1,563**	**2,494**	**94,248**	**194,789**

Source: ONS, Input-Output Tables of the United Kingdom, 1995; Siddorn (1999).

Aggregation of 123 sectors into 16 sectors from 1990 Input-Output Sectoral Classification

INDUSTRY/ASSET	1990 I-O Sectors	1990 sectoral code	1995 sectoral code
Agriculture	Agriculture, Forestry, Fishing	1,2,3	1-3
Extraction	Extraction – oil and gas	5	5
Other mining & quarrying	Coal extraction, stone, clay, sand, gravel, metal ores and minerals	4 ,14, 10	4,6,7
Chemicals	Coke ovens, oil proc, nuclear fuel, inorganic chemicals, organic chemicals, fertilisers, synthetic resins, paints, dyes, printing ink, special chemical for industry, pharmaceutical products, soap and toilet preparations, chemical products, man-made fibres	6, 20-29	35-46
Metals and mineral products	Iron and Steel, Aluminium, other non-ferrous metals, structural clay products, Cement, lime and plaster, concrete, asbestos, abrasive prods, glass, refractory and ceramic goods, metal casting, metal doors, windows, packaging products of metals, industrial plant and steel work, engineers small tools	11-13, 15-19, 30-34, 37	49-61
Engineering	Agricultural machinery and tractors, metal working machine tools, textile etc machinery, process machinery and contractors, mining equipment, mech power transmission equipment, other machinery, ordnance samll arms and ammunition, insulated wires and cables, basic electrical equipment, industrial electrical equipment, telecommunications etc. equipment, electronic components, electronic consumer goods, demestic electric appliances, electric lighting equipment, instrument engineering	35,36,38-52,57	62-76
Food, drinks and tobacco	Oils and fats, slaughtering and meat processing, milk and products, fruit vegetable and fish processing, grain milling and starch, bread, biscuits, sugar, confectionary, animal feeding stuffs, miscellaneous foods, alcoholic drink soft drinks, tobacco	58-70	8-20
Other manufacturing	Motor vehicles and parts, shipbuilding and repairing, aerospace etc, other vehicles, woollen and worsted, cotton spinning and weaving, hosiery and other knitted goods, textile finishing, carpets, jute, leather and leather goods, footwear, clothing furs, household and other textiles, timber and wood products, wooden furniture, pulp, paper and board, paper and board products, printing and publishing, rubber products, processing of plastics, jewellery and coins, sports goods and toys, other goods	53-56, 71-90	21-34, 47-48,77-84
Electricity, gas and water	Electricity production, gas, water supply	7,8,9	85-87
Construction	Construction	91	88
Distribution, hotels, etc.	Wholesale distribution, retail distribution, distribution and vehicles repairs, hotels catering, pubs etc.	92,93,94 ,95	89-92
Transport, storage, and communication	Railways, road and other inland transport, sea transport, air transport, transport services, postal services, telecoomunication	96-102	93-99
Financial sector	Banking and finance, insurance, auxiliary financial services, estate agents, legal services, accountancy services, other professional services, advertising, computing services, other business services, renting of movables, owning and dealing in real estate, research and development	103-114, 118	100-103, 105-114
Public administration	Public administration	115	115
Education, health and social work	Sanitary services, education, health services, recreation and welfare services, personal services, domestic services	116, 117 ,119-122	116-123