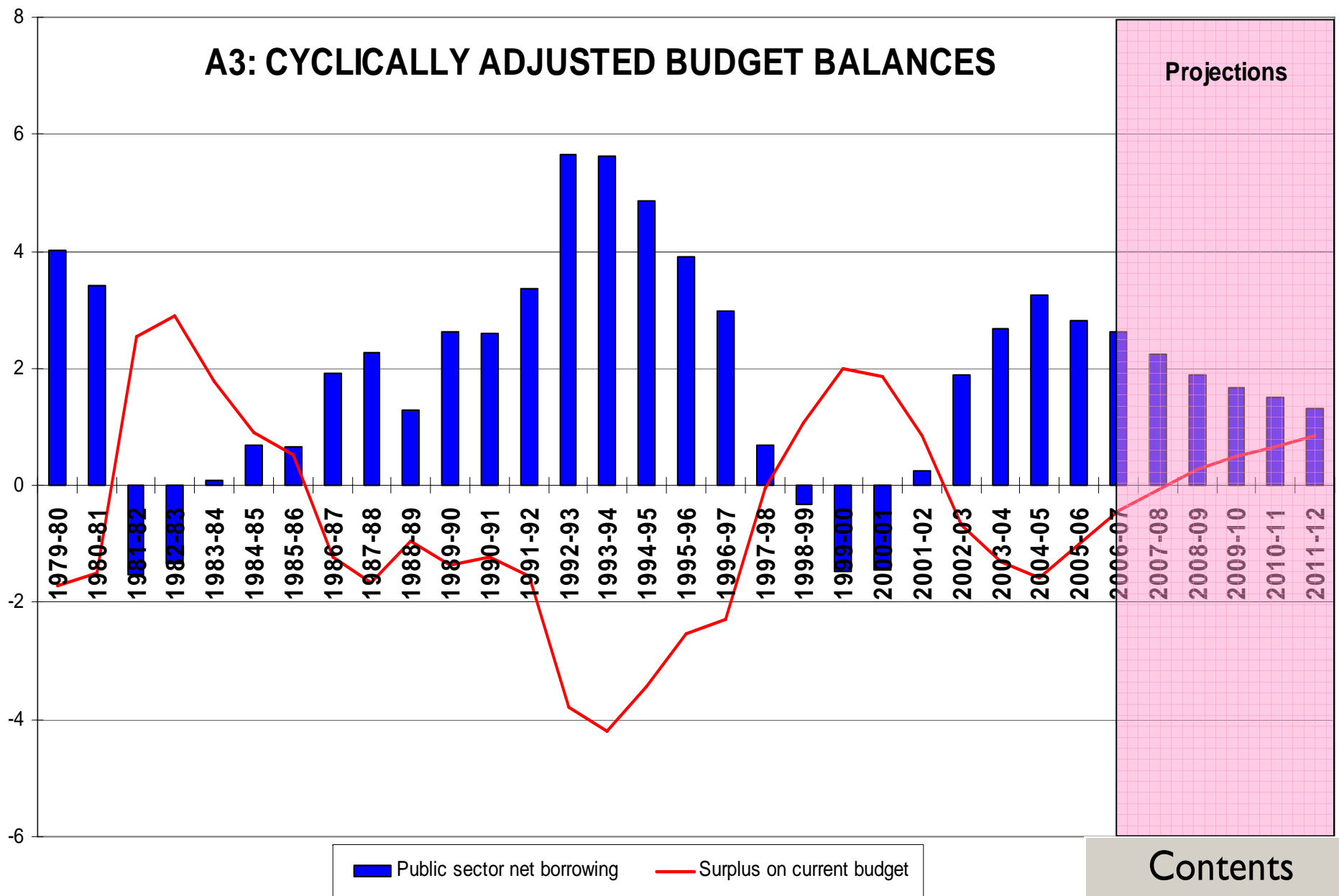


# Fiscal Policy and Golden Rules to Fine-Tune the Economy

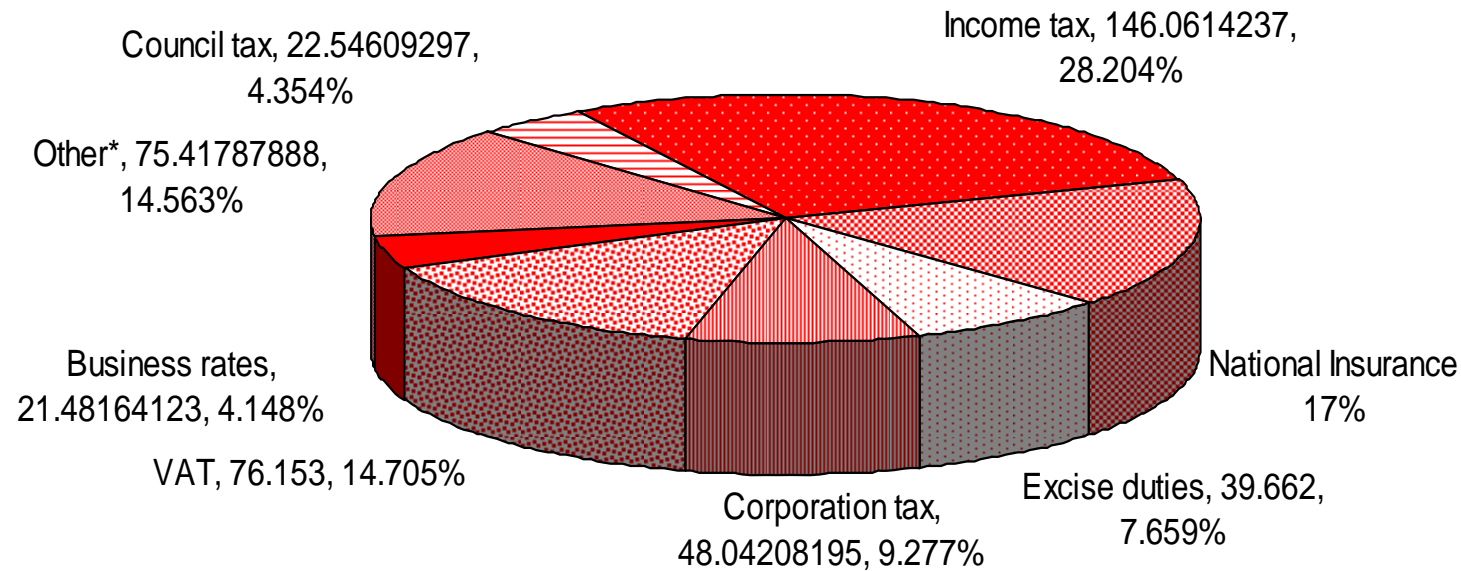
<http://www.hmrc.gov.uk/stats/index.htm>

[http://www.hm-treasury.gov.uk/economic\\_data\\_and\\_tools/  
forecast\\_for\\_the\\_uk\\_economy/data\\_forecasts\\_index.cfm](http://www.hm-treasury.gov.uk/economic_data_and_tools/forecast_for_the_uk_economy/data_forecasts_index.cfm)

# Government Budget Deficit Percent of GDP



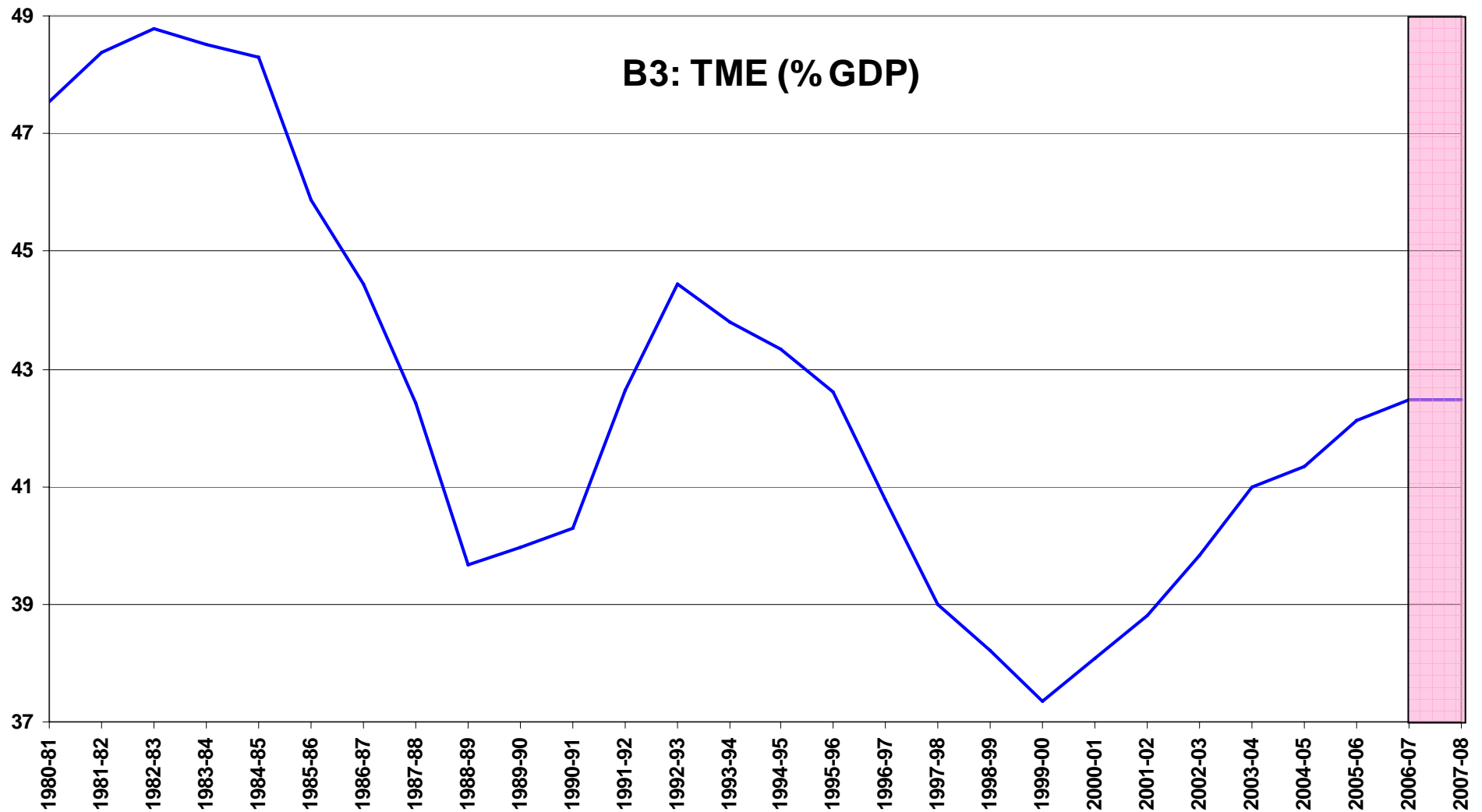
### C3: GOVERNMENT RECEIPTS BY FUNCTION 2006-2007 (PROJECTIONS)



\*Other receipts include capital taxes, stamp duties, vehicle excise duties, and some other tax and non-tax receipts- for example interest and dividends

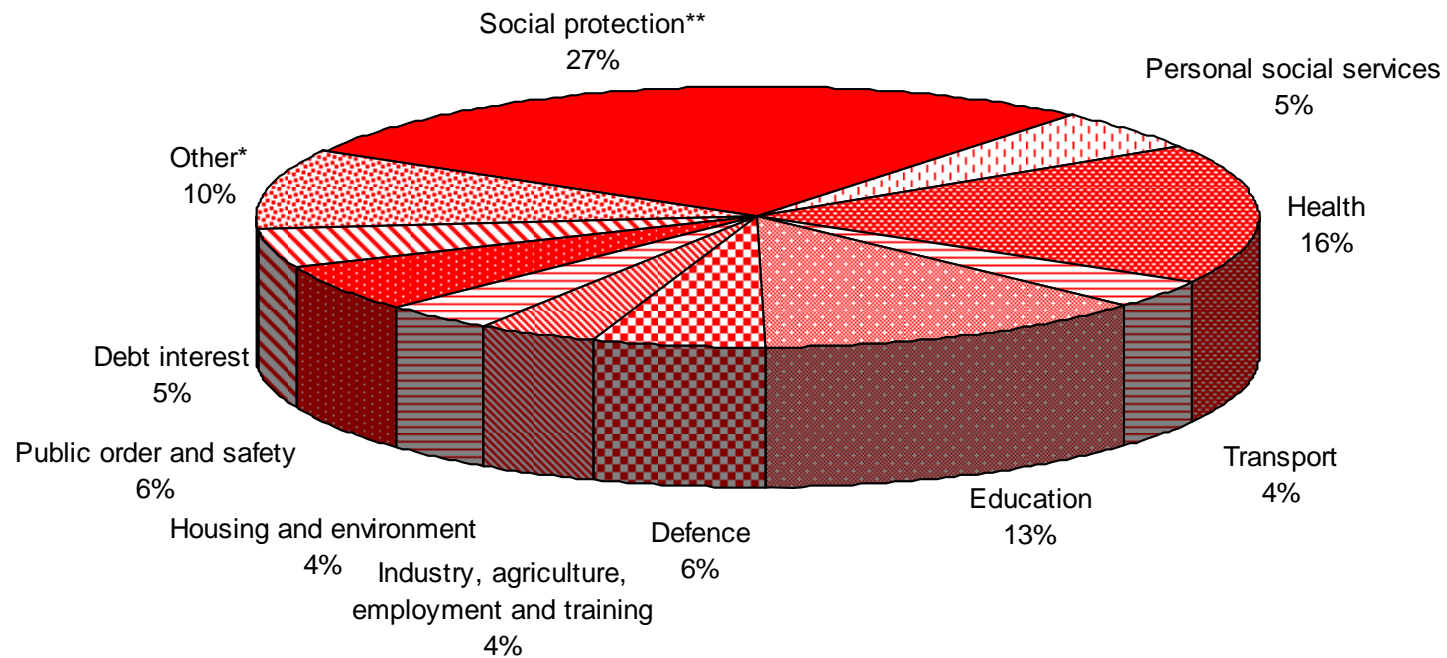
[Contents](#)

# Ratio of Government Spending to GDP in UK



Contents

## B4: GOVERNMENT SPENDING BY FUNCTION 2006-07 (Projections)



\*Includes spending on general public services; recreation, culture and religion; international cooperation and development; public service pensions; plus spending yet to be allocated and some accounting adjustments.

\*\*Includes tax credit payments in excess of an individual's tax liability, which are now counted in AME, in line with OECD guidelines

Center

What is a golden rule of fiscal policy?

Why is this necessary?

**Golden rule of Fiscal Policy:**

**Borrow only to invest**

**Balance budget over the business cycle**

Theory on economic policy:

Rules are better than discretion

Scope for discretion provides opportunity to cheat public

Tools: Inflation Unemployment GAME

Nash Bargaining: non-cooperative solution

Cooperative Solution is Pareto Optimal

Cooperation generates credibility

Backward Induction: Cooperative Solution of a dynamic Game

## Objectives of Fiscal Policy

- **Macroeconomic stabilisation**
- **Higher growth rate of output**
- **Full employment**
- **Stable prices:**
  - **low rate of inflation**
  - **stable interest and exchange rates**
- **Equity: horizontal and vertical (tax/transfer)**
- **Efficiency in resource allocation**
- **Provision of public goods**
- **Externality: max positive externality, min neg. ext.**
- **Market failure**
- **Public private partnership (education, health, R&D)**

# Instruments of Fiscal Policy

- Taxes
  - Direct: income, profit, wealth
  - Indirect: VAT, tariff, excise, business
  - Subsidies: goods/services and for use of inputs
- Spending
  - Public goods: defence, law / order, national parks
  - Semi-public goods: education, health, R&D
- Debt
  - Borrowing from the private sector : Crowding out
  - From the central banks : inflation
  - Theory of Ricardian equivalence

# Who bears the burden of taxes and who benefit from the public spending?

- Producers

  - Labour supply (work hours, leaves, retirement)

  - Taxed sectors vs. subsidised sector

  - Domestic vs. foreign goods

  - Excise duties

- Consumers

  - VAT and market prices

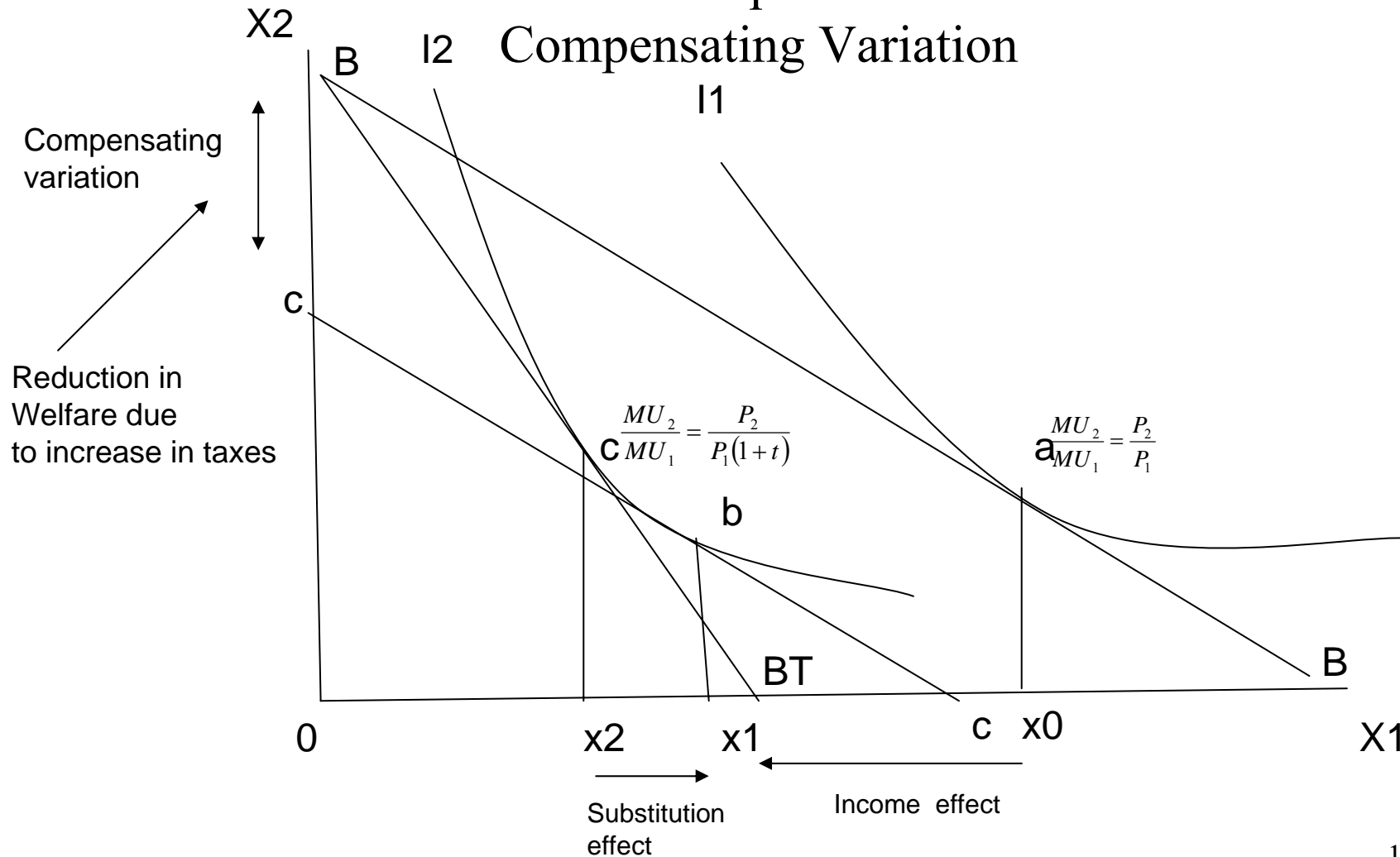
  - Sin goods (tobacco, alcohol,

- Traders: imports and exports, custom unions

# Microeconomic Tools To Evaluate the Impact of Taxes

# Impact of Increase in Taxes in Demand for a commodity

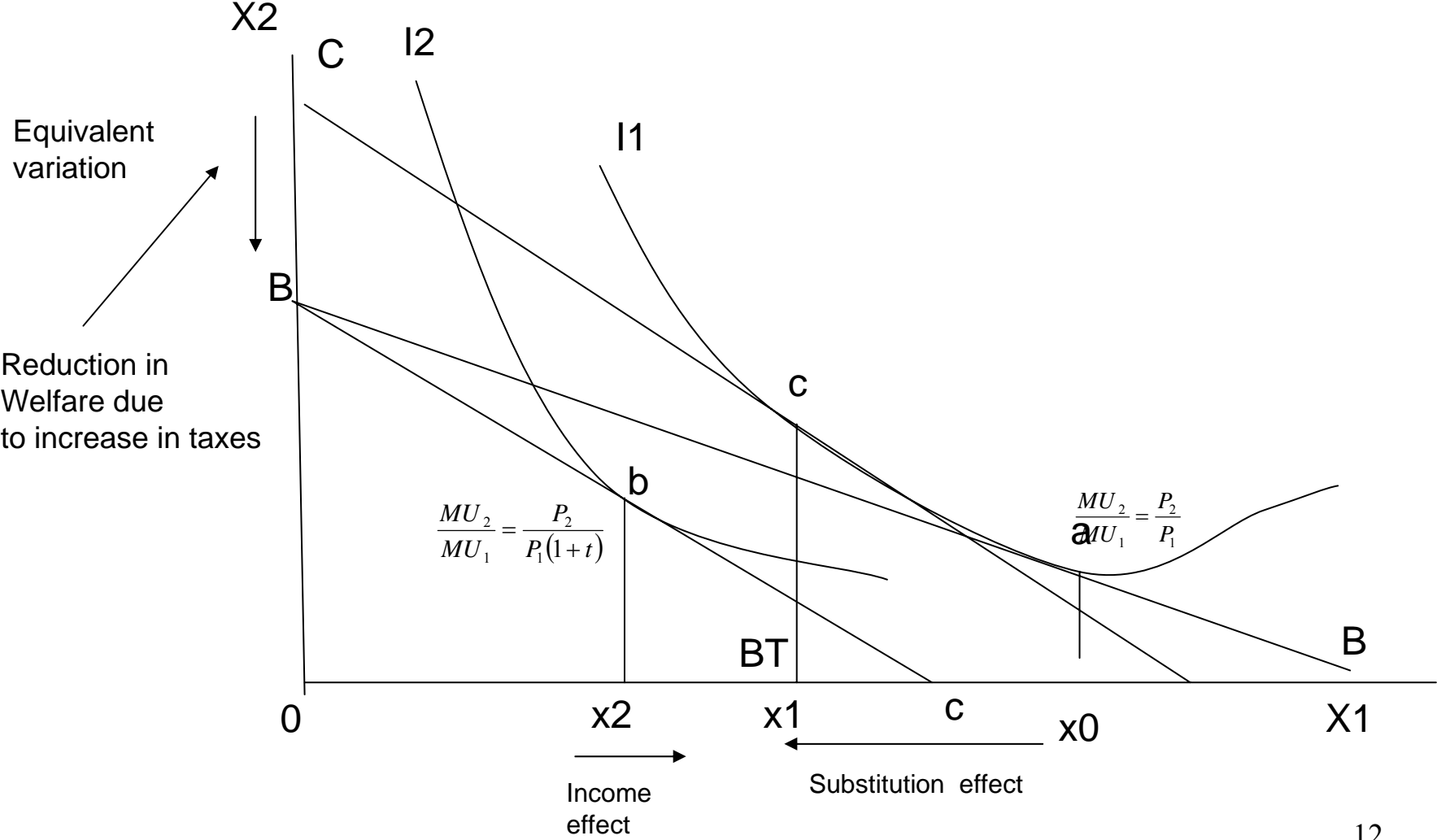
## Income and Price Effects: Hicksian and Slutsky Decomposition



# Impact of Increase in Taxes in Demand for a commodity

## Income and Price Effects: Hicksian and Slutsky Decomposition

### Equivalent Variation



## Compensating Variation

Base utility  $u_0 = x_1^{\frac{1}{2}} x_2^{\frac{1}{2}}$ , with budget  $m = p_1 x_1 + p_2 x_2$  if  $(p_1, p_2) = (1, 1)$

demand functions  $x_1 = \frac{m}{2p_1}$ ,  $x_2 = \frac{m}{2p_2}$ , given  $m = 100$   
 $(x_1, x_2) = (50, 50)$ .

Tax on good one rises to 2,  $(p_1, p_2) = (2, 1)$ , income remains the same  $m = 100$ ,  $x_1 = \frac{m}{2p_1} = \frac{100}{2 \times 2} = 25$ ,

$$x_2 = \frac{m}{2p_2} = \frac{100}{2 \times 1} = 50.$$

How much income need to be compensated to this consumer to maintain at the old level of utility,

$$u_0 = 50^{\frac{1}{2}} 50^{\frac{1}{2}} = \left(\frac{m'}{4}\right)^{\frac{1}{2}} \left(\frac{m'}{2}\right)^{\frac{1}{2}} = 50 \rightarrow m' = 141,$$

Therefore compensating variation is  $141 - 100 = 41$ .  
Compensating variation is positive for a price rise.

## Equivalent Variation

How much money should be taken away from the consumer in the original prices to make him/her achieve the utility level after the price change.

$$u_n = 25^{\frac{1}{2}} 50^{\frac{1}{2}} = \left(\frac{m'}{2}\right)^{\frac{1}{2}} \left(\frac{m'}{2}\right)^{\frac{1}{2}} = 5 \times 5 \times \sqrt{2}$$

$$m' = 2 \times 5 \times 5 \times \sqrt{2} = 70.7$$

$$EV = 70.7 - 100 = -29.3.$$

Equivalent variation is negative for a rise in price level

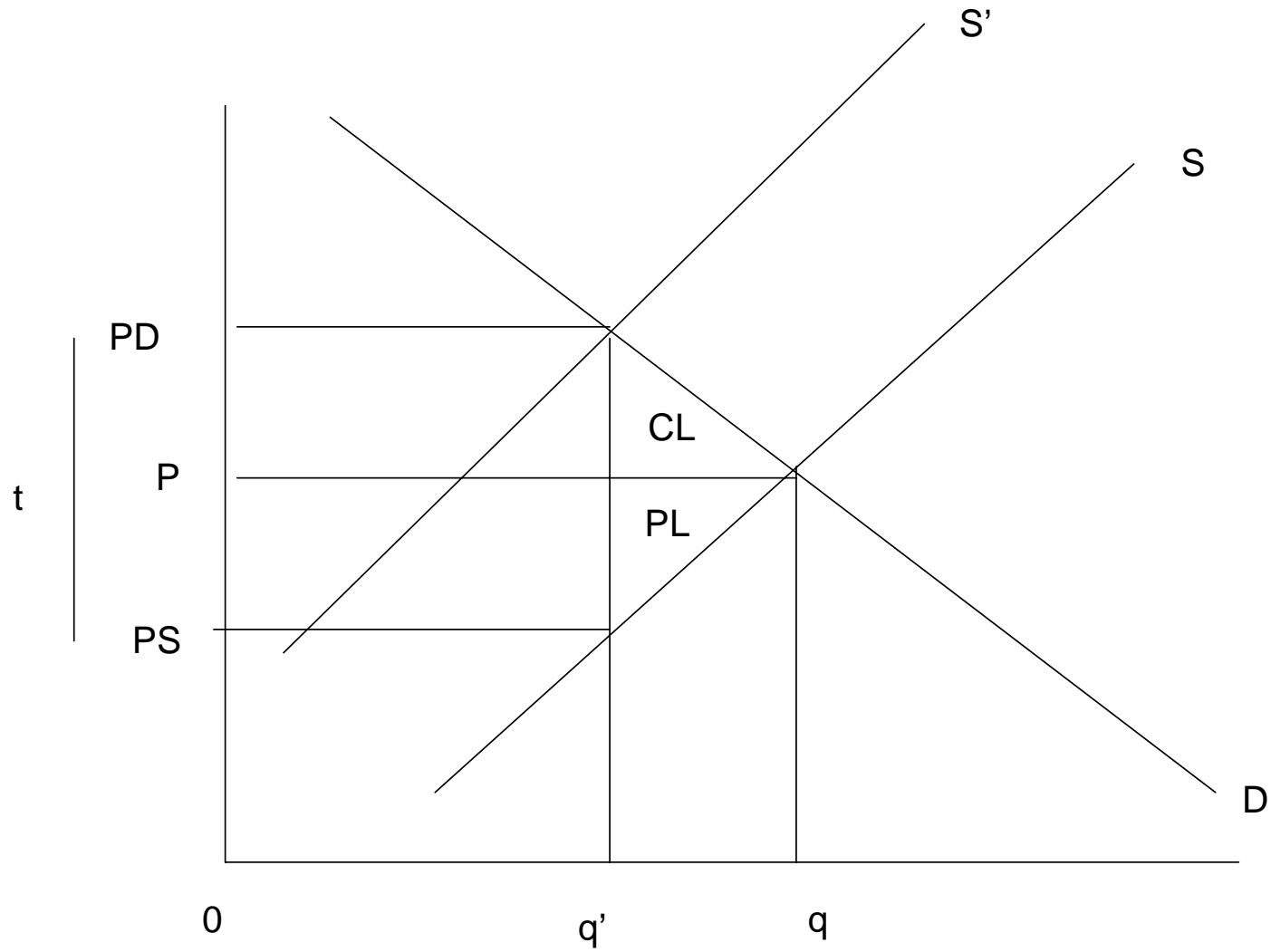
## Money Metric Measure of Changes in Welfare Due to Tax Reforms

	Rise in tax	Fall in tax
Equivalent Variation	Negative	Positive
Compensating Variation	Positive	Negative

Why General equilibrium models to evaluate tax reforms:

Need to consider income and substitution effects in individual markets and take account of multiple rounds of knock on effects to measure the Impacts of tax changes more accurately.

# Measuring the Impact of Taxes in the Economy



Take regular demand and supply functions

$$D = a - bP$$

$$S = -c + dP$$

equilibrium price and quantity

$$P = \frac{a + c}{b + d} ; q = \frac{ad + bc}{b + d} .$$

A tax on the commodity creates a wedge between the price received by suppliers and price paid by consumers.

This distorts the market equilibrium and allocation.

$$D = a - bP^D$$

$$S = -c + dP^S$$

Price that consumers pay is higher with taxes

$$P^D = P^S + t$$

Demand equals supply in equilibrium:

$$a - bP^D = -c + dP^S$$

$$a - b(P^S + t) = -c + dP^S$$

$$a - bP^S - bt = -c + dP^S$$

$$a + c - bt = bP^S + dP^S$$

Price received by suppliers:  $P^S = \frac{a + c - bt}{b + d}$

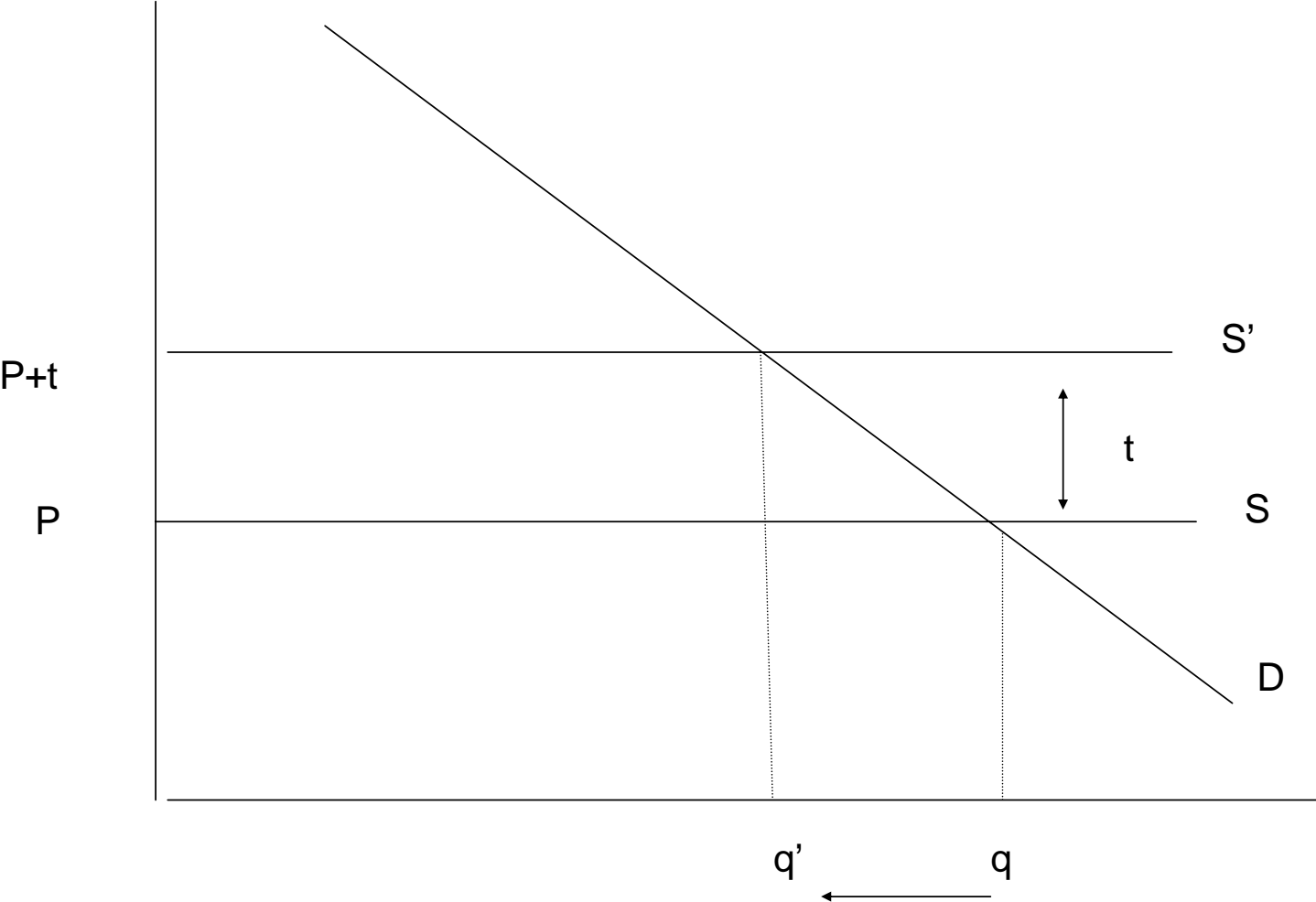
Price paid by consumers:

$$P^D = P^S + t = \frac{a + c - bt}{b + d} + t = \frac{a + c + dt}{b + d}$$

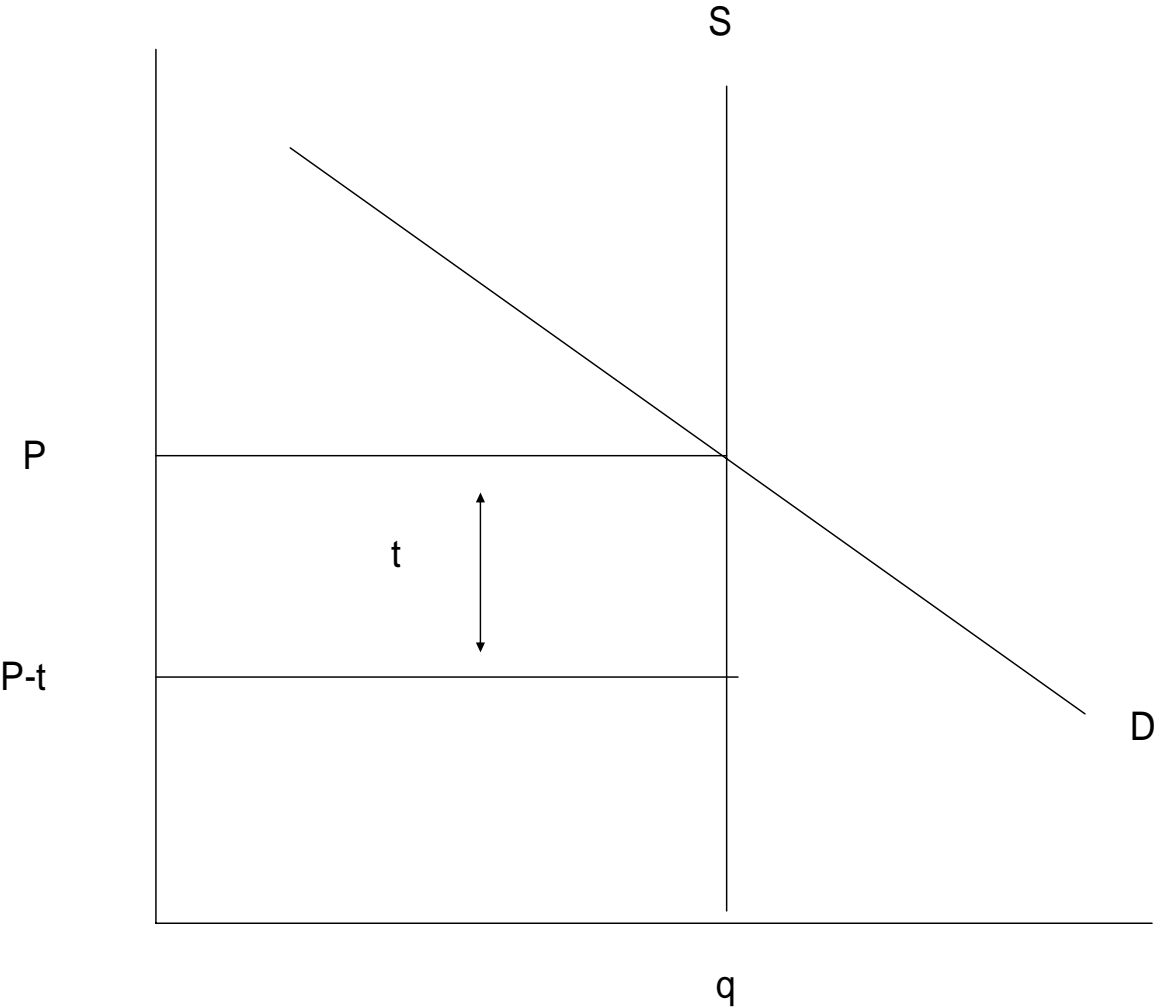
The equilibrium quantity in the distorted market :

$$D = a - bP^D = a - b\left(\frac{a + c + dt}{b + d}\right) = \frac{ad - bc + bdt}{b + d}$$

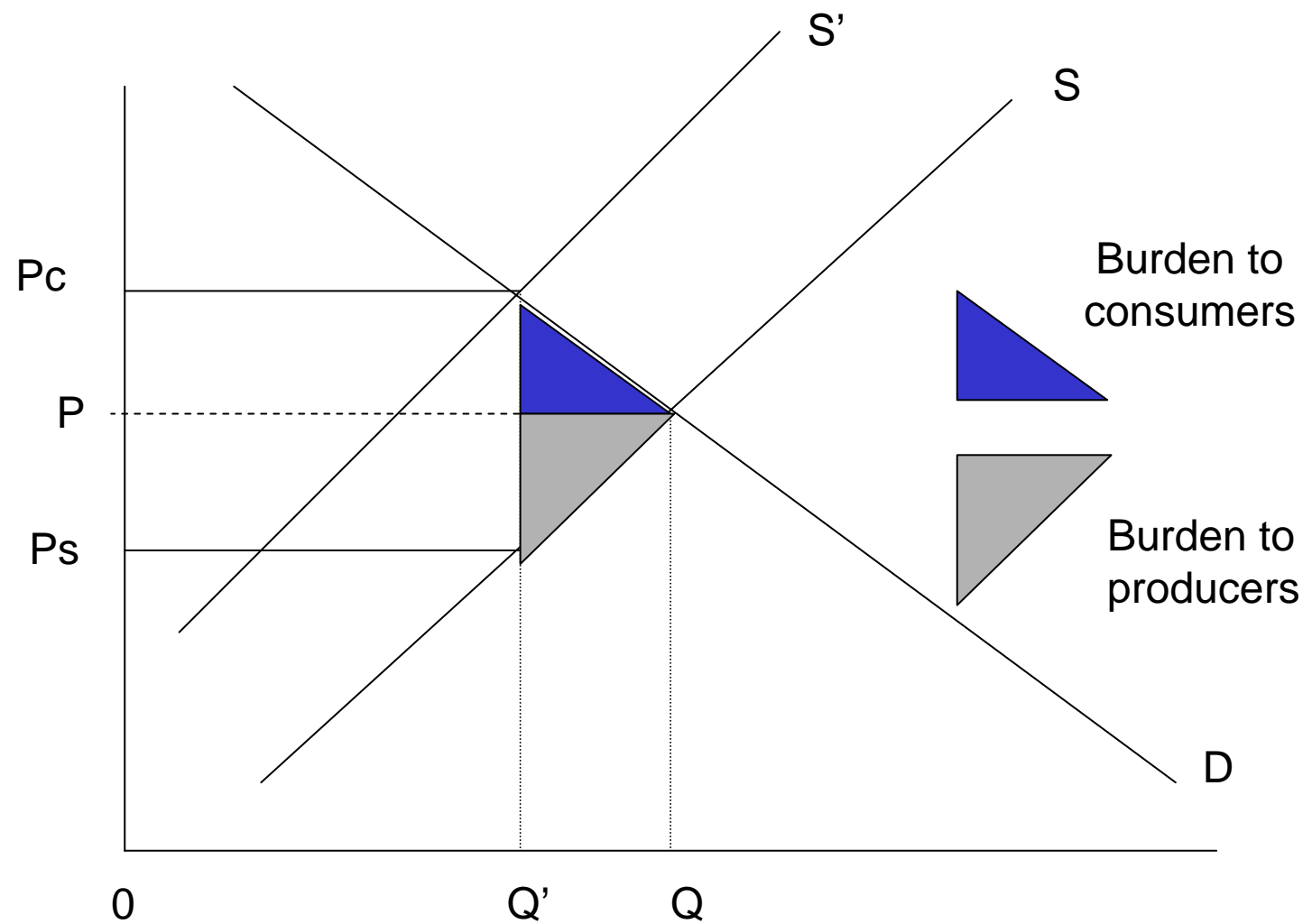
When supply is perfectly elastic all burden of tax falls on to the consumers.



# When Demand is Perfectly Inelastic All Burden taken by Suppliers



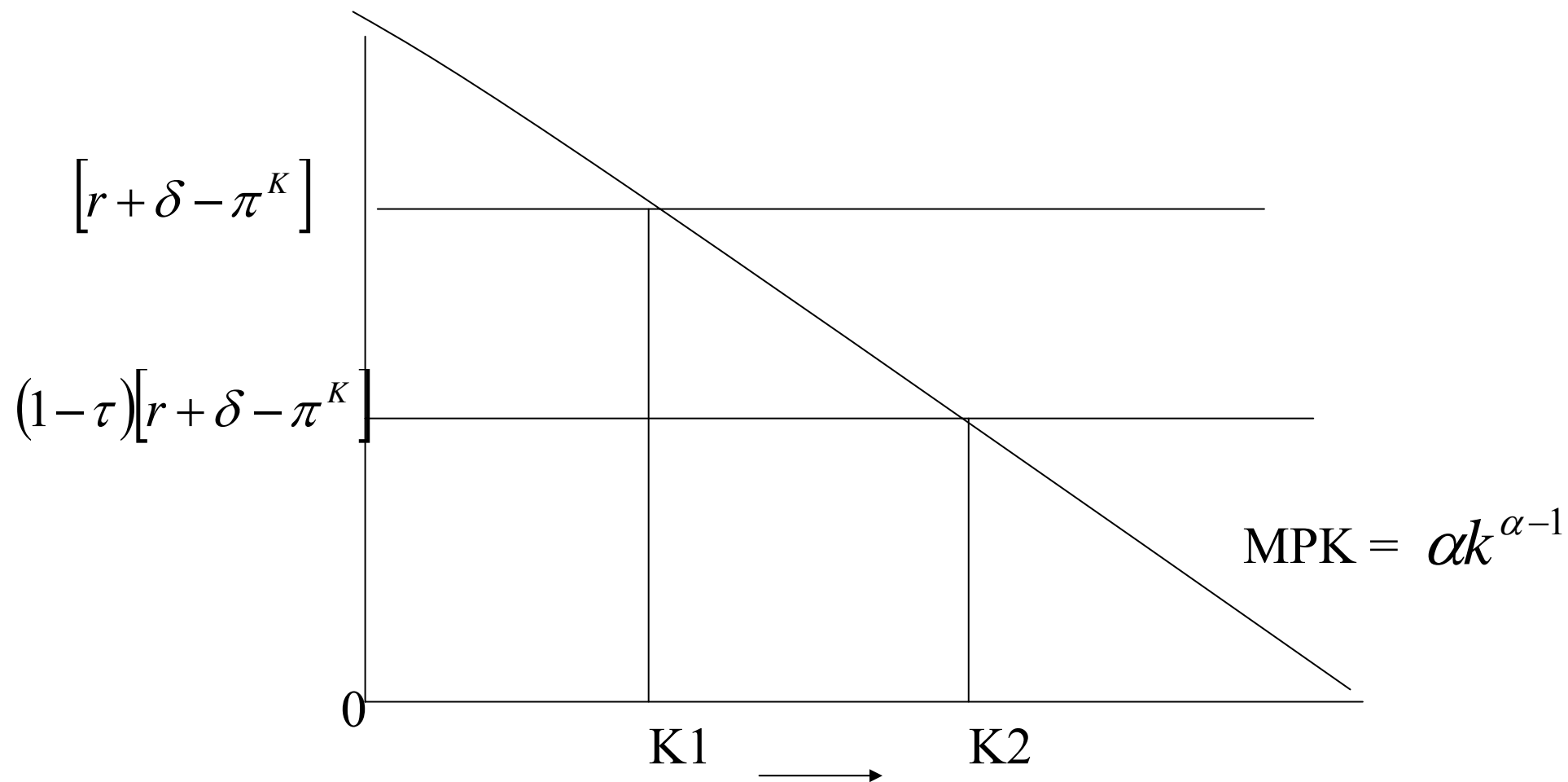
# First Round Impact of Taxes: Partial Equilibrium Analysis



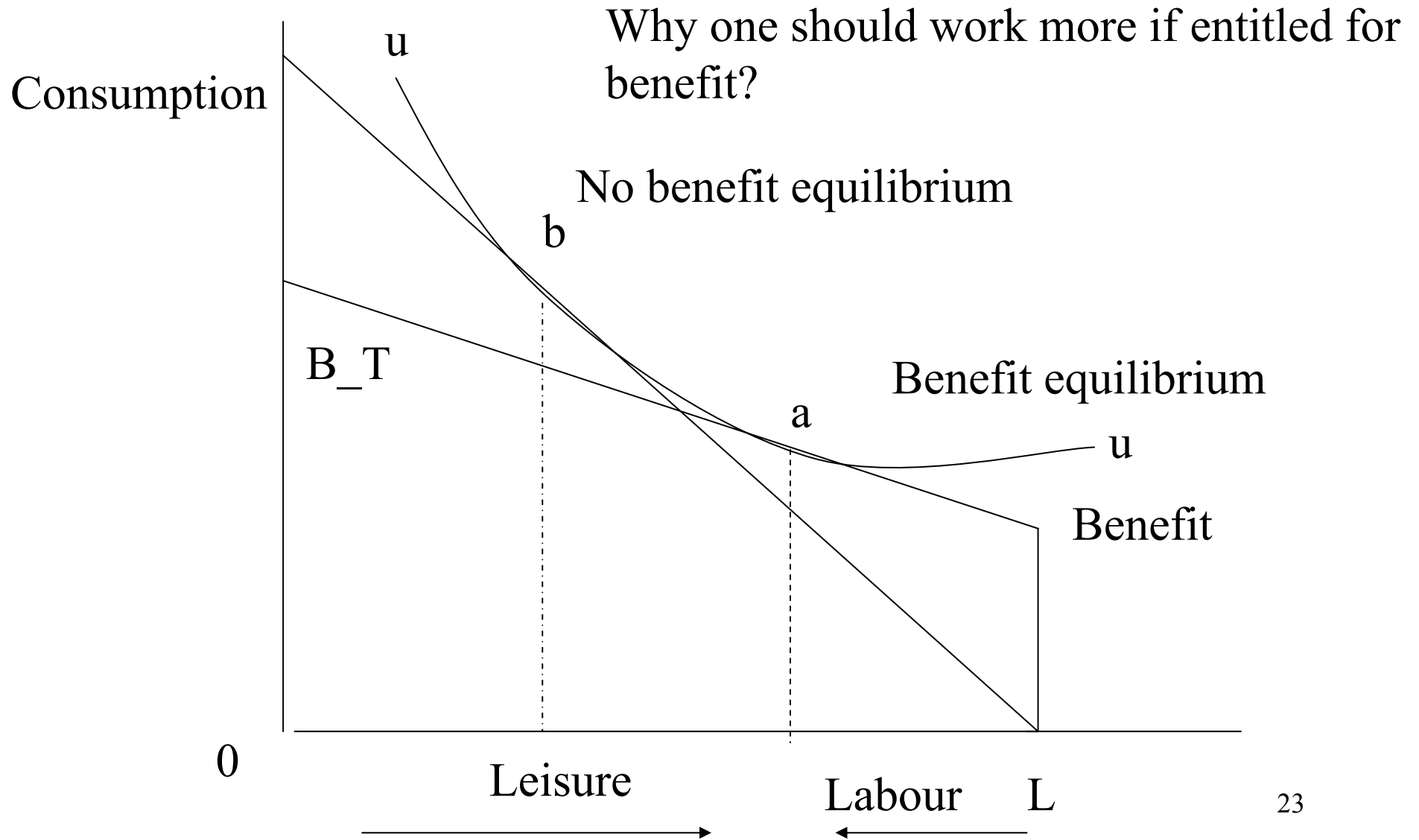
Equilibrium in a Single Market

# Tax Credit Promotes Investment

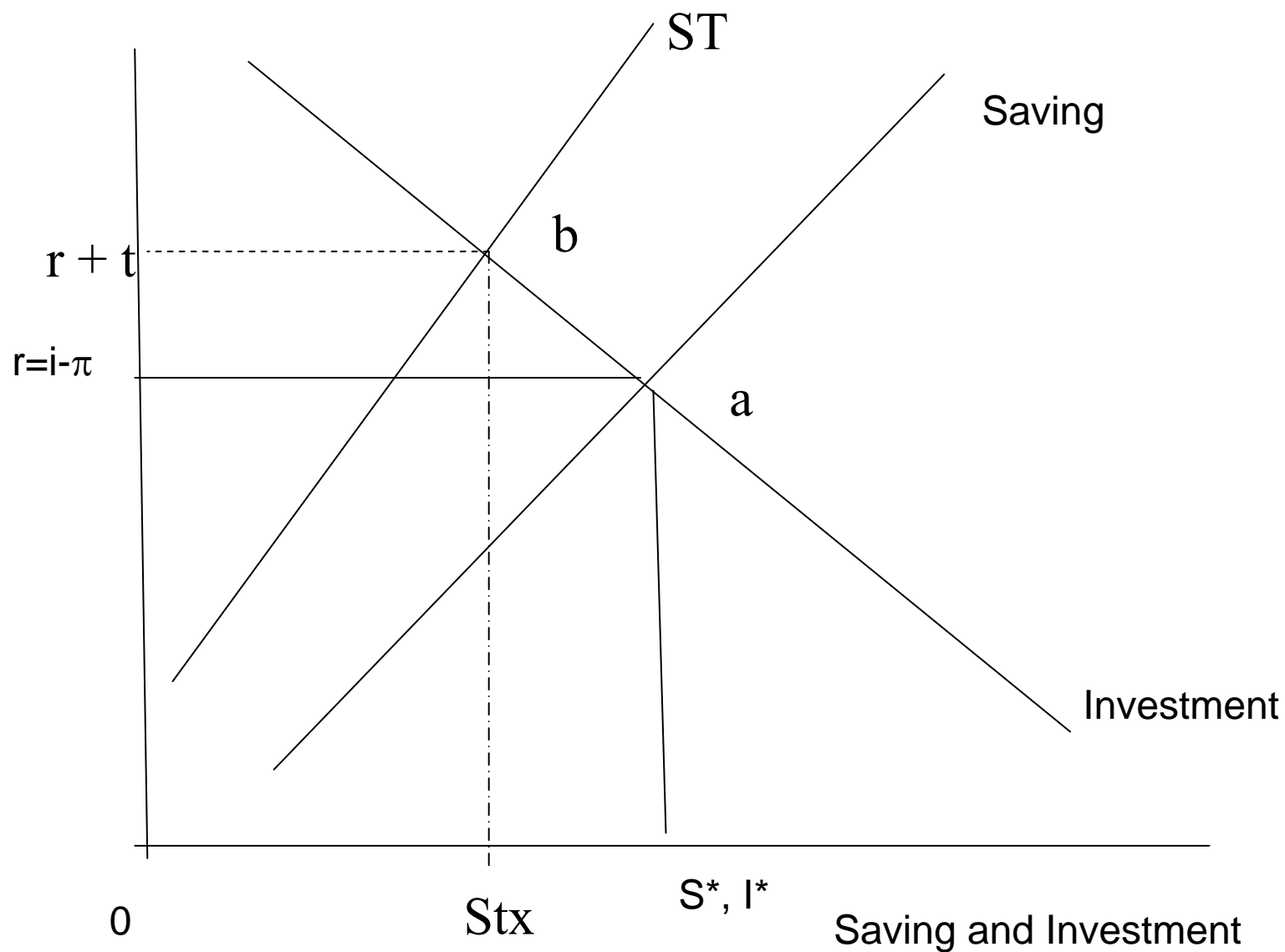
## Why Manufacturers Lobby for a Tax Credit?



# Impact of Taxes and Transfer on Labour Supply of Individuals

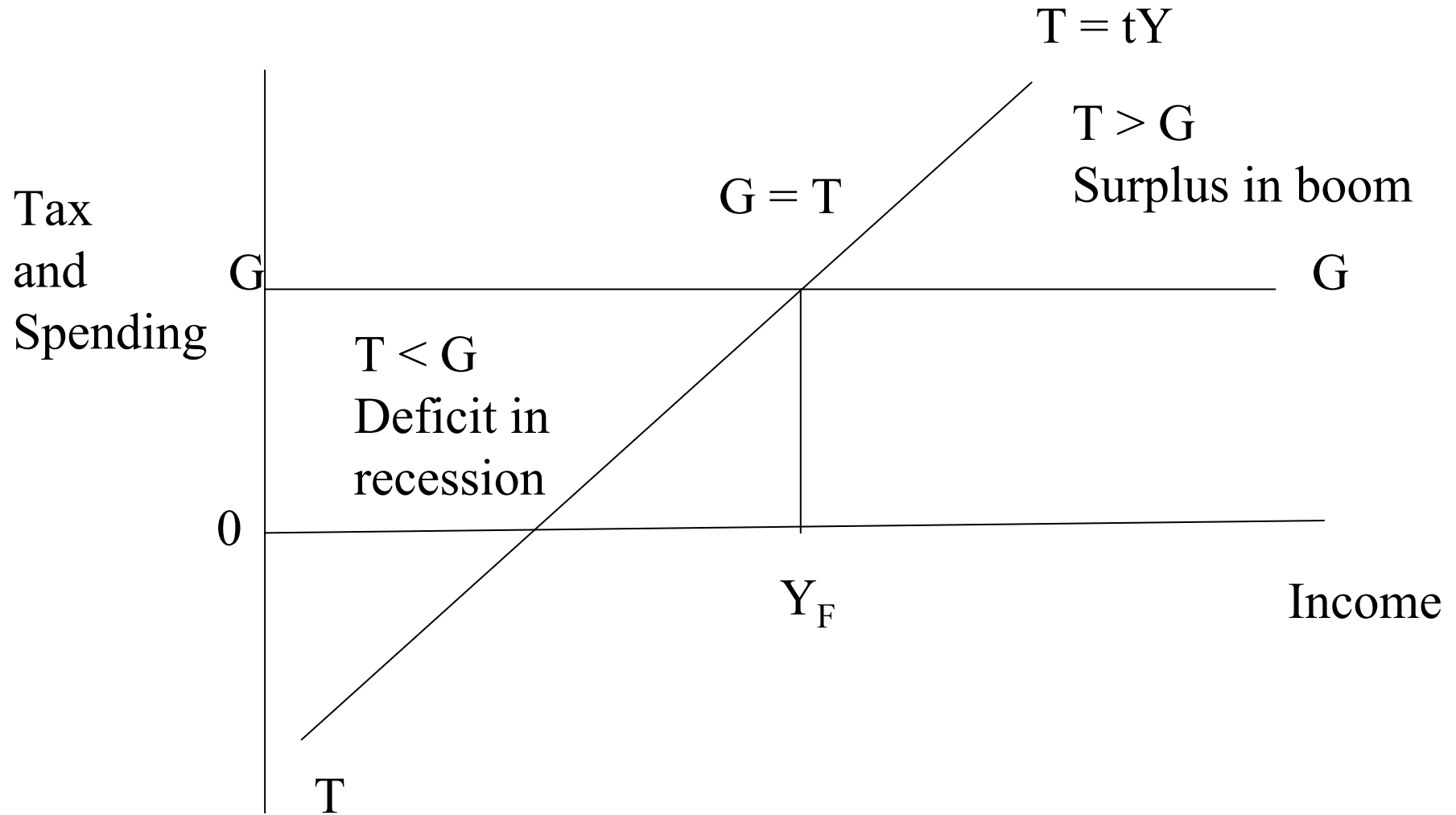


# Higher taxes reduce saving and investment and growth

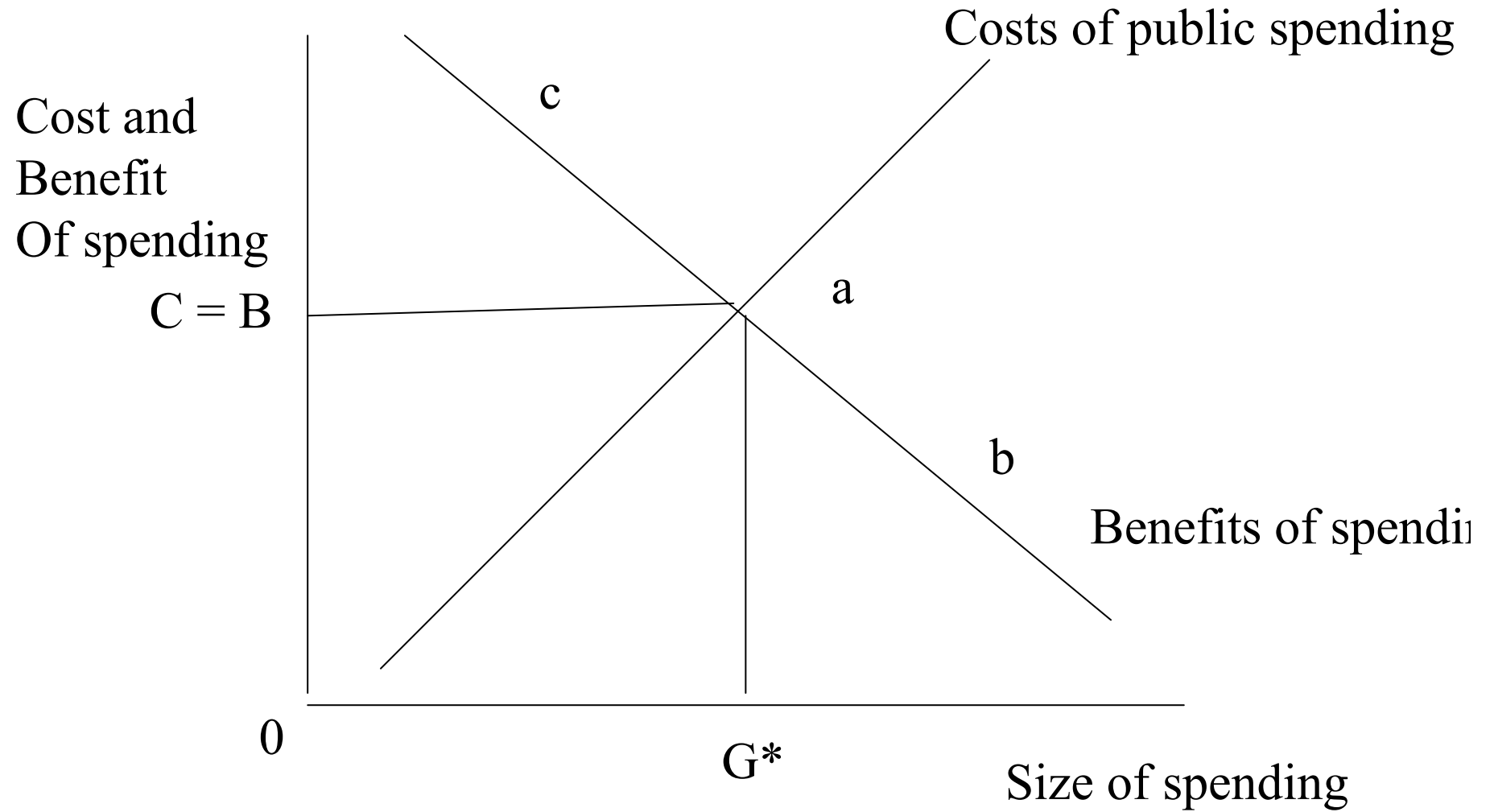


# Macroeconomic Tools to Evaluate the Impacts of Taxes

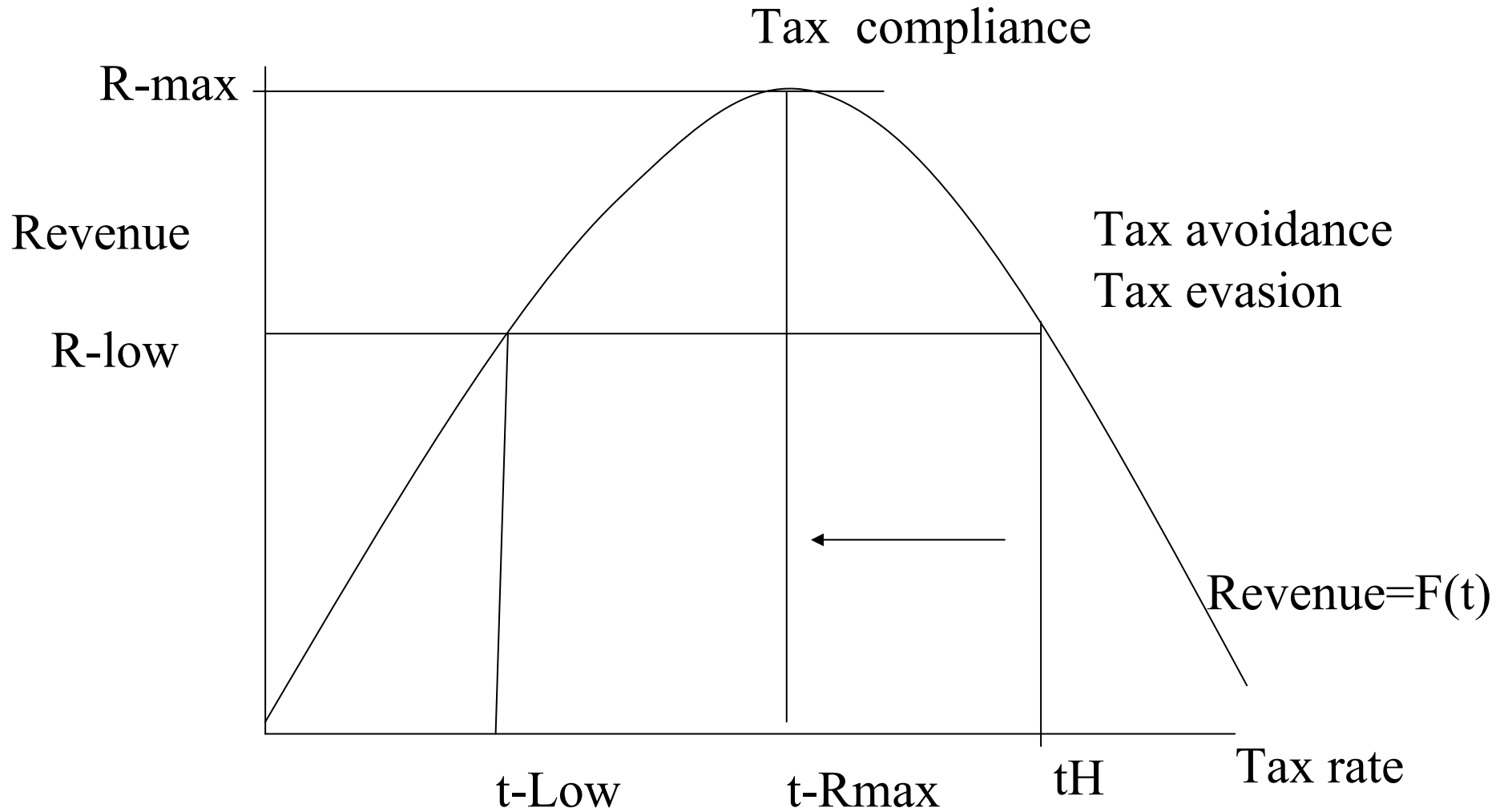
# Macroeconomic Stabilisation Role of Tax and Spending



# How High Should be Public Spending?



How much should be the tax rate to maximise the government revenue ?



## Balanced Budget Multiplier with Lump-Sum Taxes

The real national income is given by the IS Curve:

$$Y = \frac{1}{1 - c_1} [c_0 + \bar{I} + G - c_1 T]$$

Positive Government expenditure multiplier:  $\frac{\partial Y}{\partial G} = \frac{1}{1 - c_1}$

Negative tax multiplier:  $\frac{\partial Y}{\partial T} = -\frac{c_1}{1 - c_1}$

The balanced budget multiplier:  $\frac{\partial Y}{\partial G} + \frac{\partial Y}{\partial T} = 1/(1 - c_1) - c_1/(1 - c_1) = 1$

A change of 100 in both G and T also raised income by 100.

Balanced change in G and T is not macro economically neutral<sub>29</sub>

## Automatic Stabiliser with Proportional Taxes

Consumption:  $C = c_0 + c_1 Y_D$   $0 < c_1 < 1$

Disposable income:  $Y_D = Y - T$

Tax Revenue  $T = t_0 + t_1 Y$   $0 < t_1 < 1$

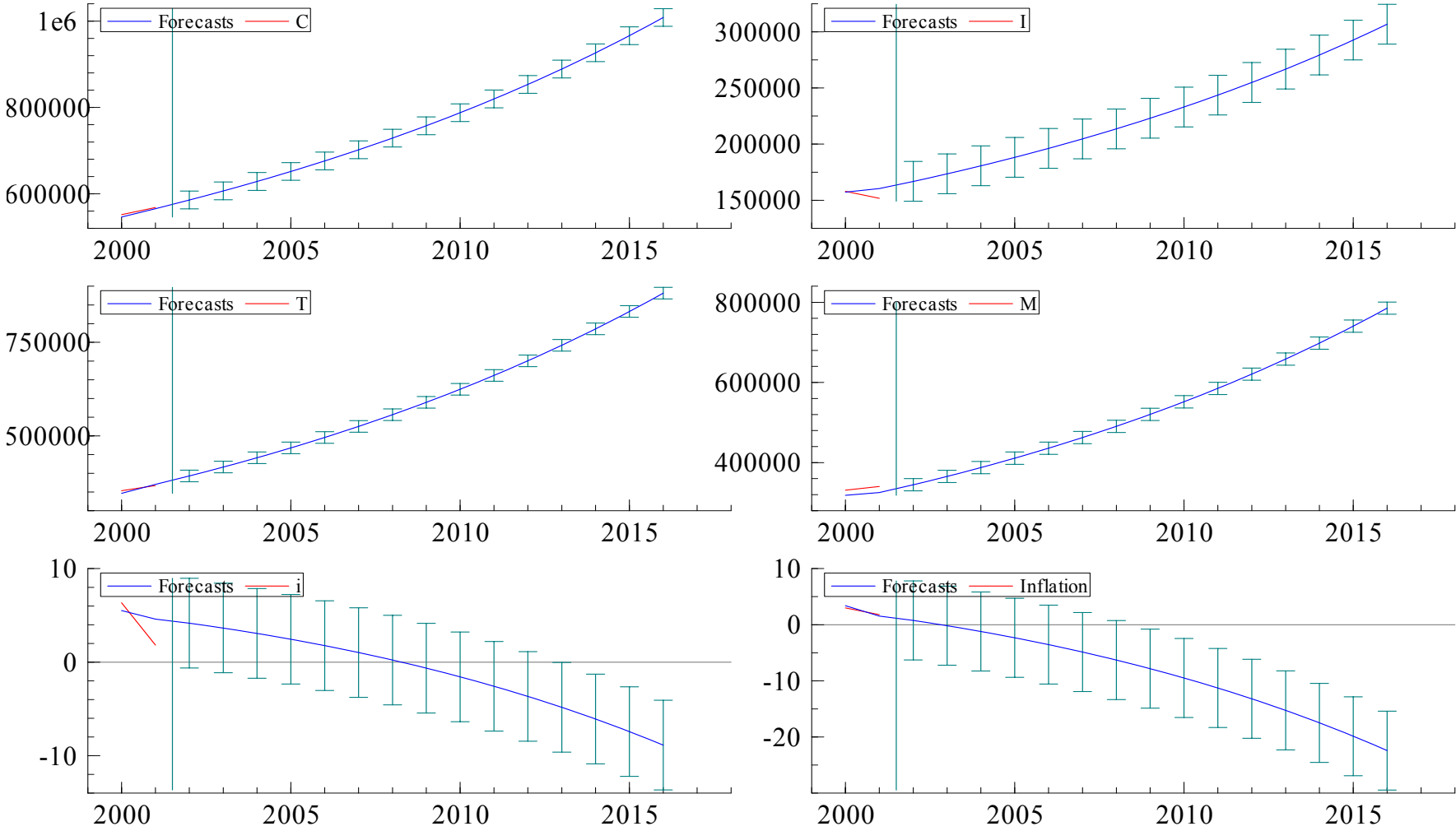
Income (IS curve):  $Y = c_0 + c_1 Y_D + I + G$

$$Y = \frac{1}{(1 - c_1 + c_1 t_1)} * [c_0 - c_1 t_0 + I + G]$$

The multiplier =  $1/(1 - c_1 + c_1 t_1) < 1/(1 - c_1)$ ,  
so the economy responds less to changes in  
autonomous spending when  $t_1$  is positive.

High  $T$  when  $Y$  is high.  
Low  $T$  when  $Y$  is low.

# Macroeconomic Forecasting and Revenue Projection



Results from GiveWin PcGive.

## Laffer Curve Model: A Numerical Example

$$R_t = 50t - 2t^2$$

Where R is revenue in billion of pounds, t is the tax rate.

The tax rate that maximises the revenue is given by

$$\frac{\partial R_t}{\partial t} = 50 - 4t = 0 \rightarrow t = 12.5$$

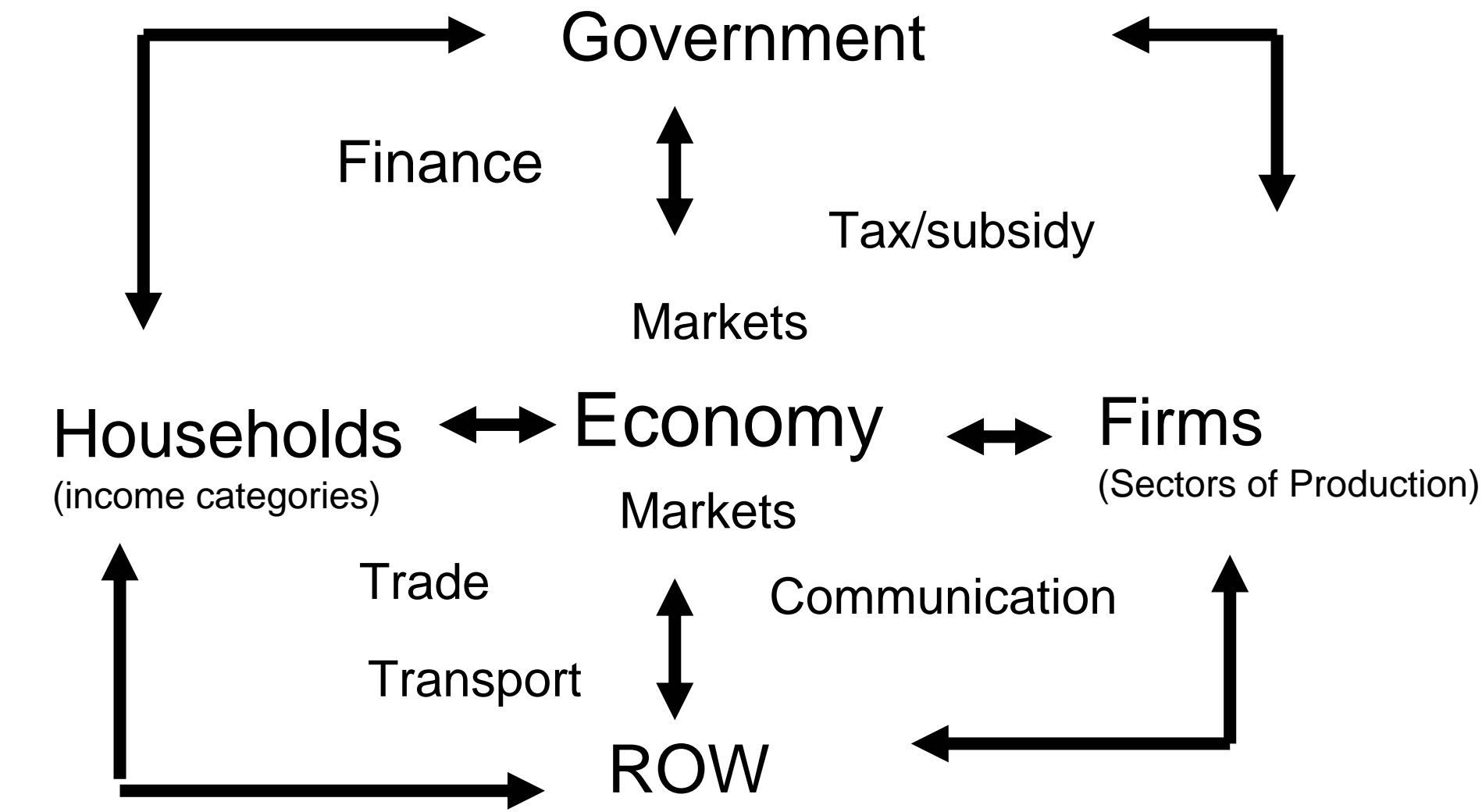
There are two tax rates that can raise the same revenue.

$$200 = 50t - 2t^2 \rightarrow$$

$$t^2 - 25t + 100 = 0; t_1 = \frac{-(-25) \pm \sqrt{(-25)^2 - 4(100)}}{2} =$$

$$t_1 = \frac{25 \pm 15}{2} = 5, 20$$

# **General Equilibrium Analysis on Impact of Taxes**



General Equilibrium Models Assume Clearing of all Markets

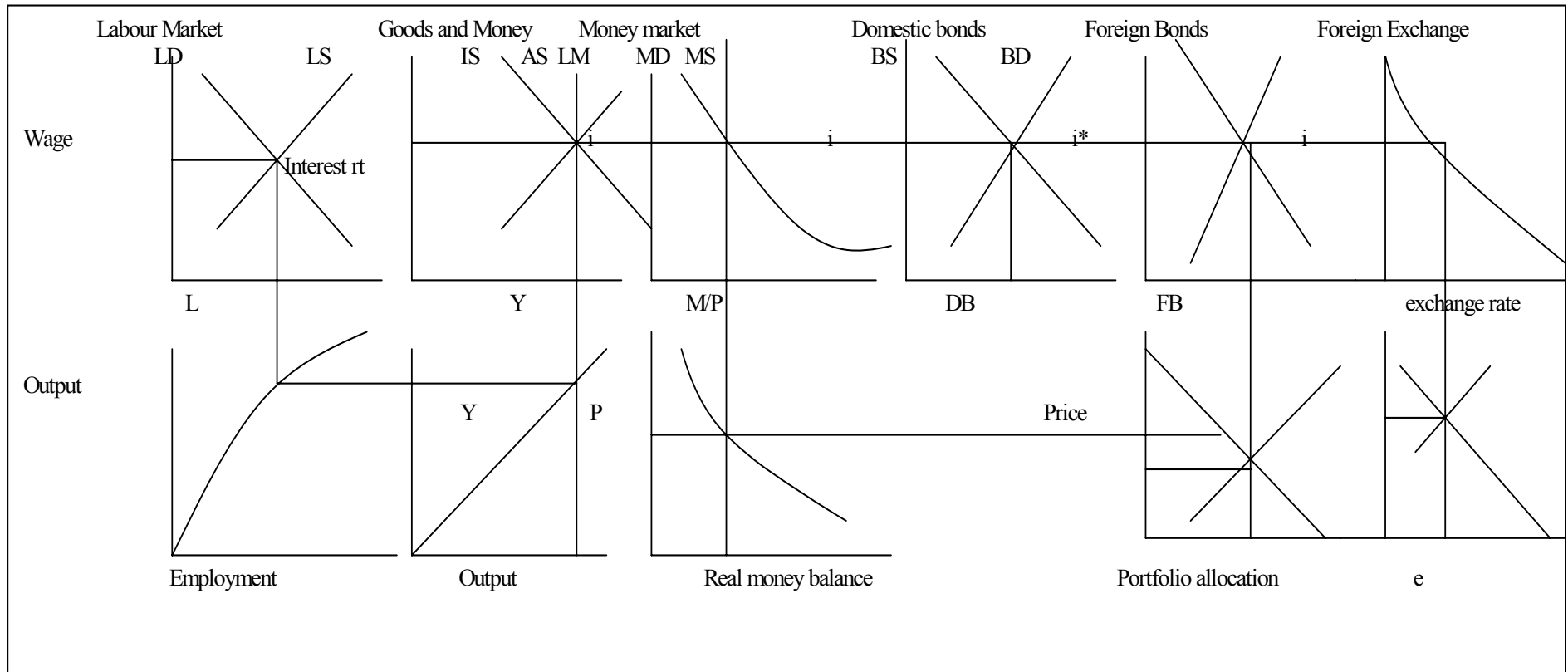
But has no trade-off between unemployment and inflation.

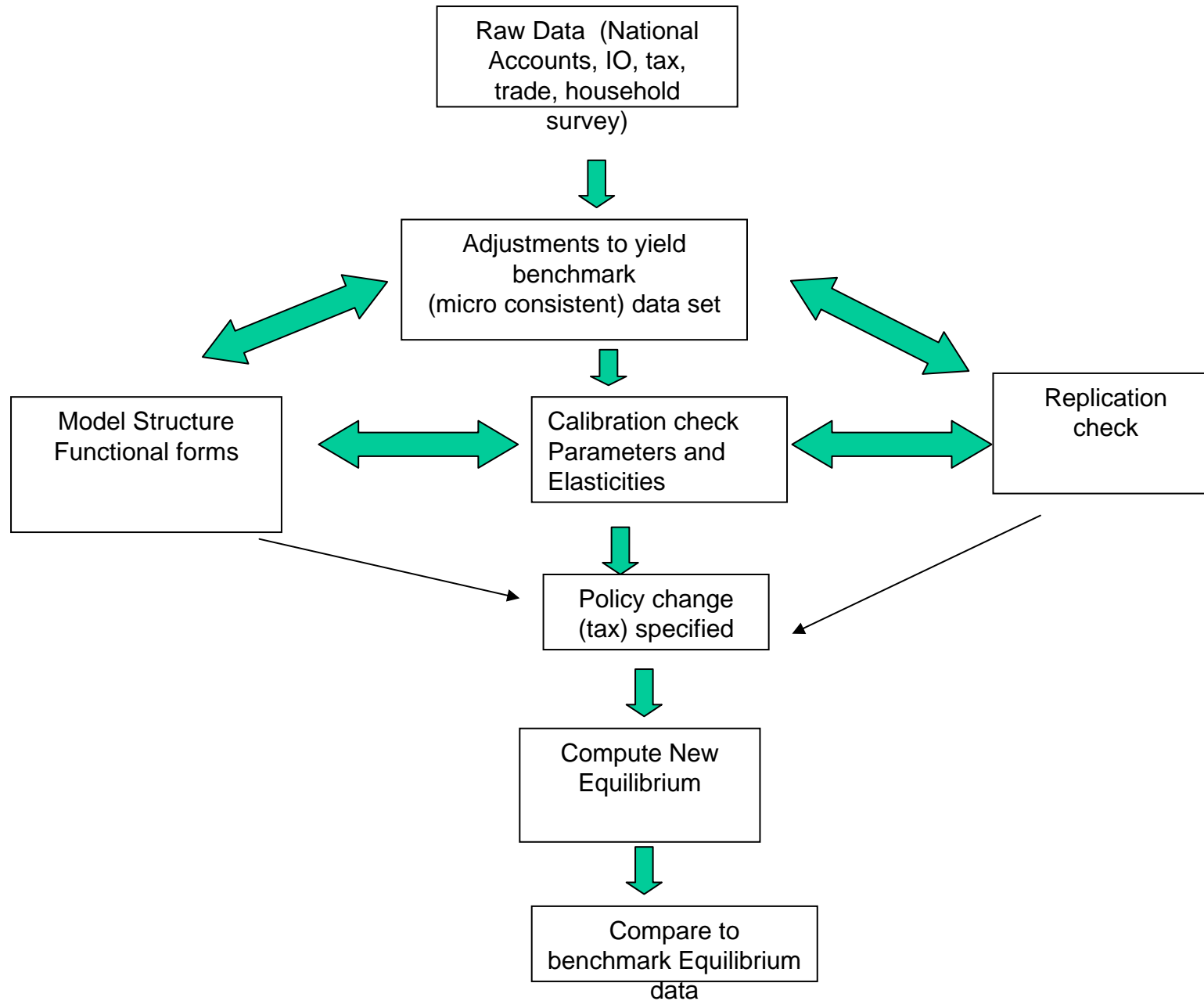
# General Equilibrium Impact of Taxes

- First round effects: incidence of tax
  - Reduction (increase) in
    - household income
    - Profit of firms
    - 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

# General Equilibrium and Knock on Effects in Different Markets

Balance of Payment analysis: Graphical approach





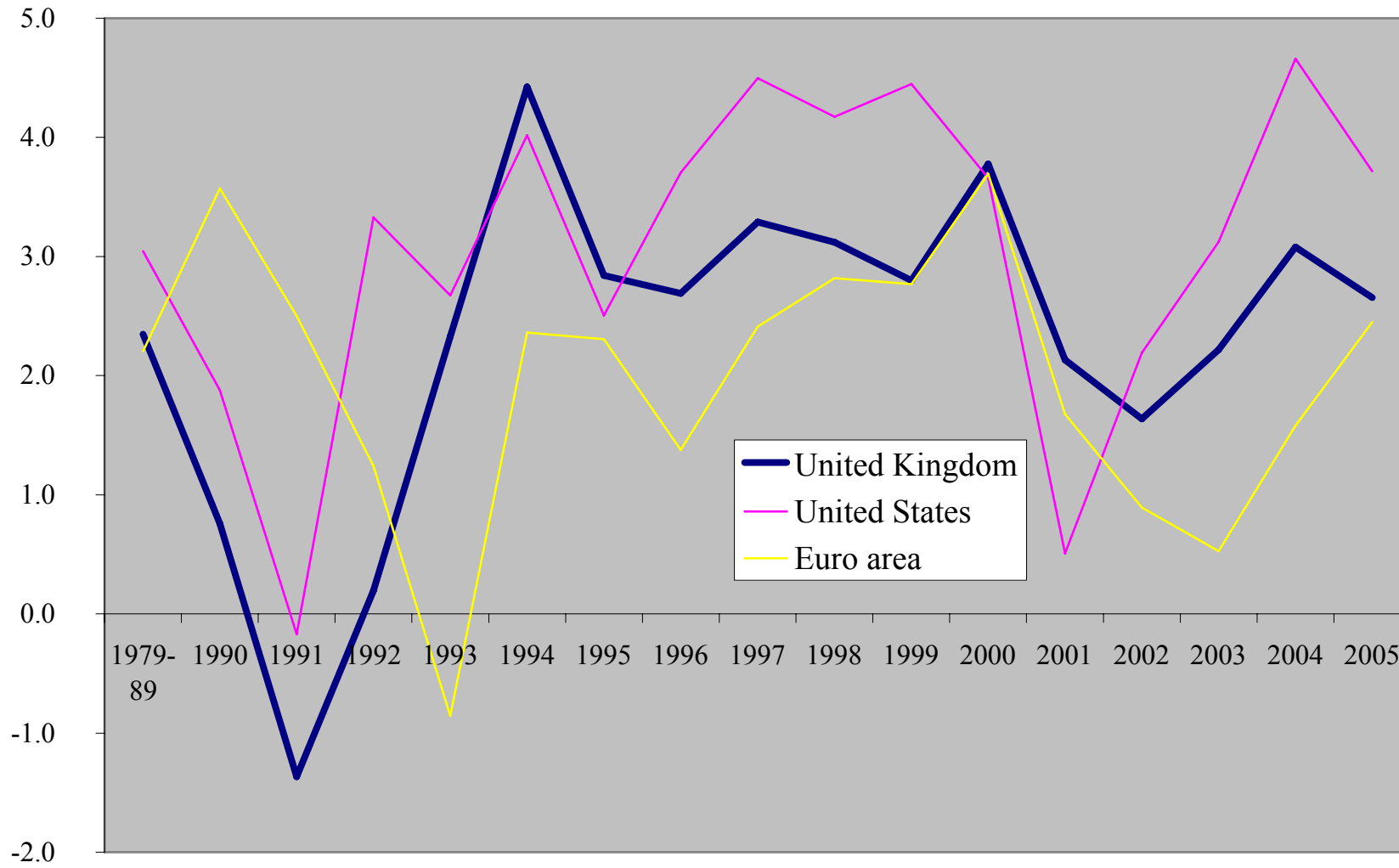
## Steps for Implementation of a General Equilibrium Model

## Mirrlees' (1971) Theory of Optimal Taxation

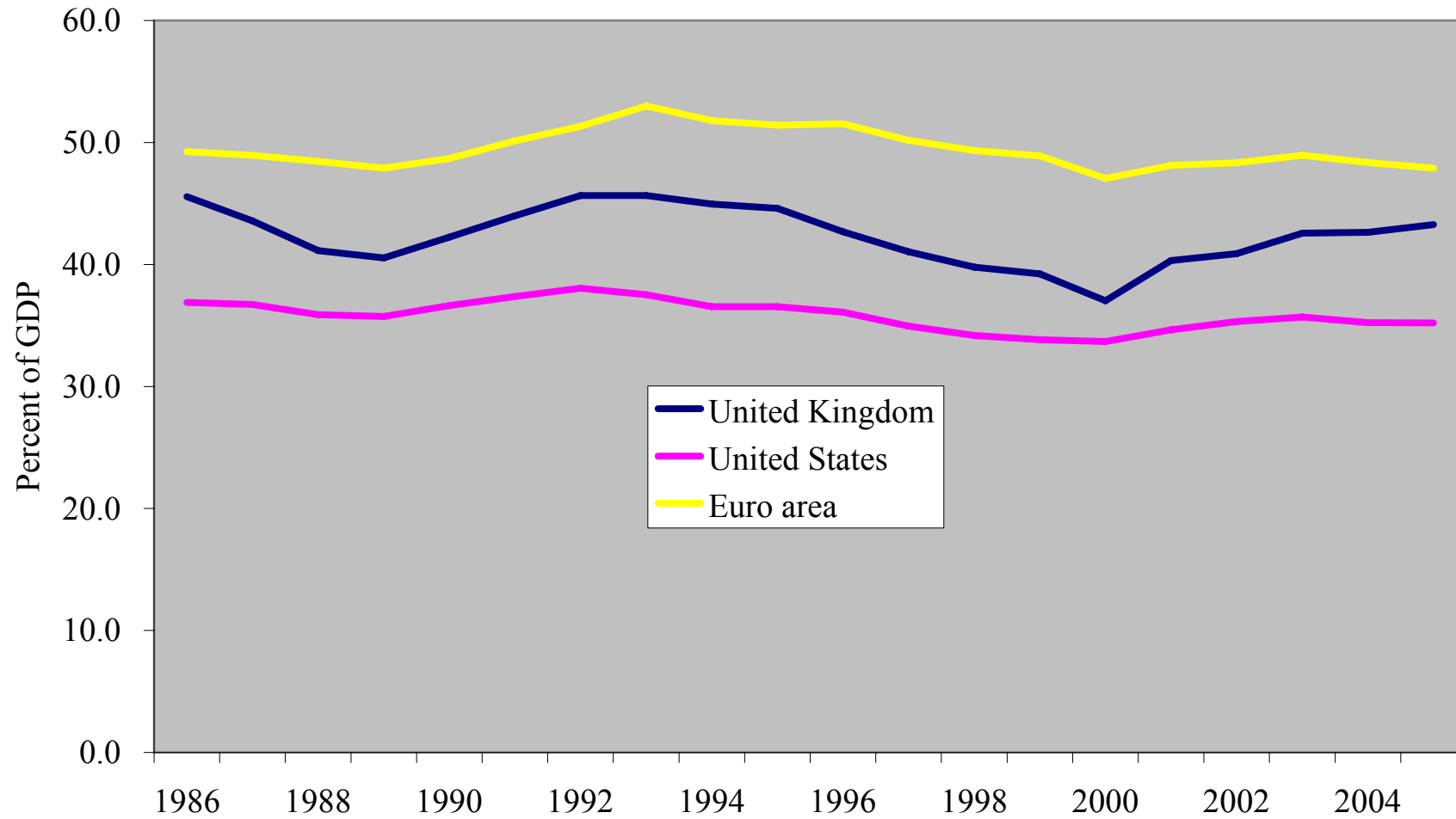
- Society has distribution of highly skilled people and non-skilled people
- There is an incentive compatible allocation in which highly productive people earn more and pay higher taxes
- Highly productive individuals have material incentive to work hard even though their net of tax income may not be proportional to their labour
- Incentive compatible consumption maximise the social welfare and tax system can be designed to obtain this

# Fiscal Policy Affects Growth Rates of Output

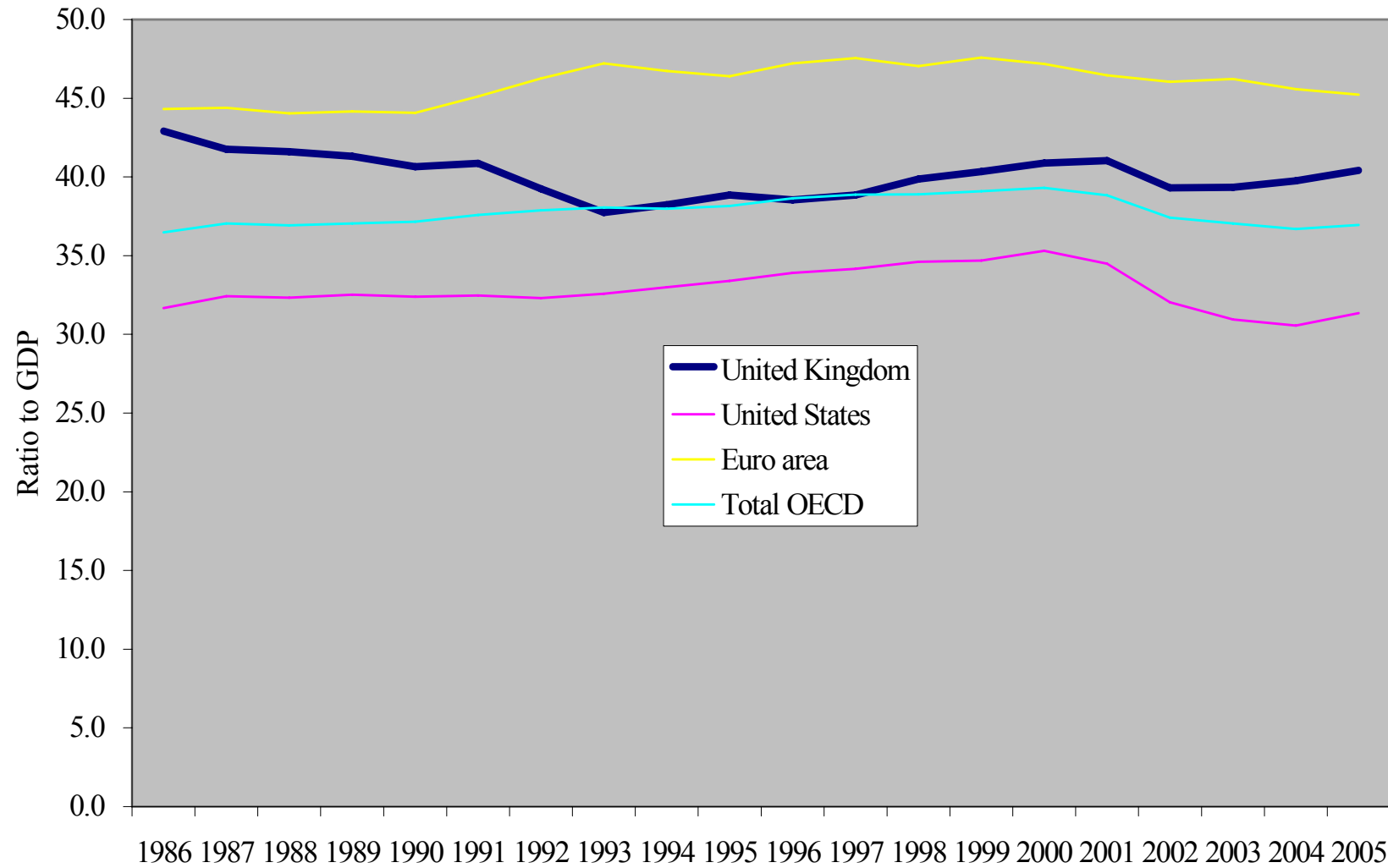
## Growth Rates in the UK, USA and Euro Area



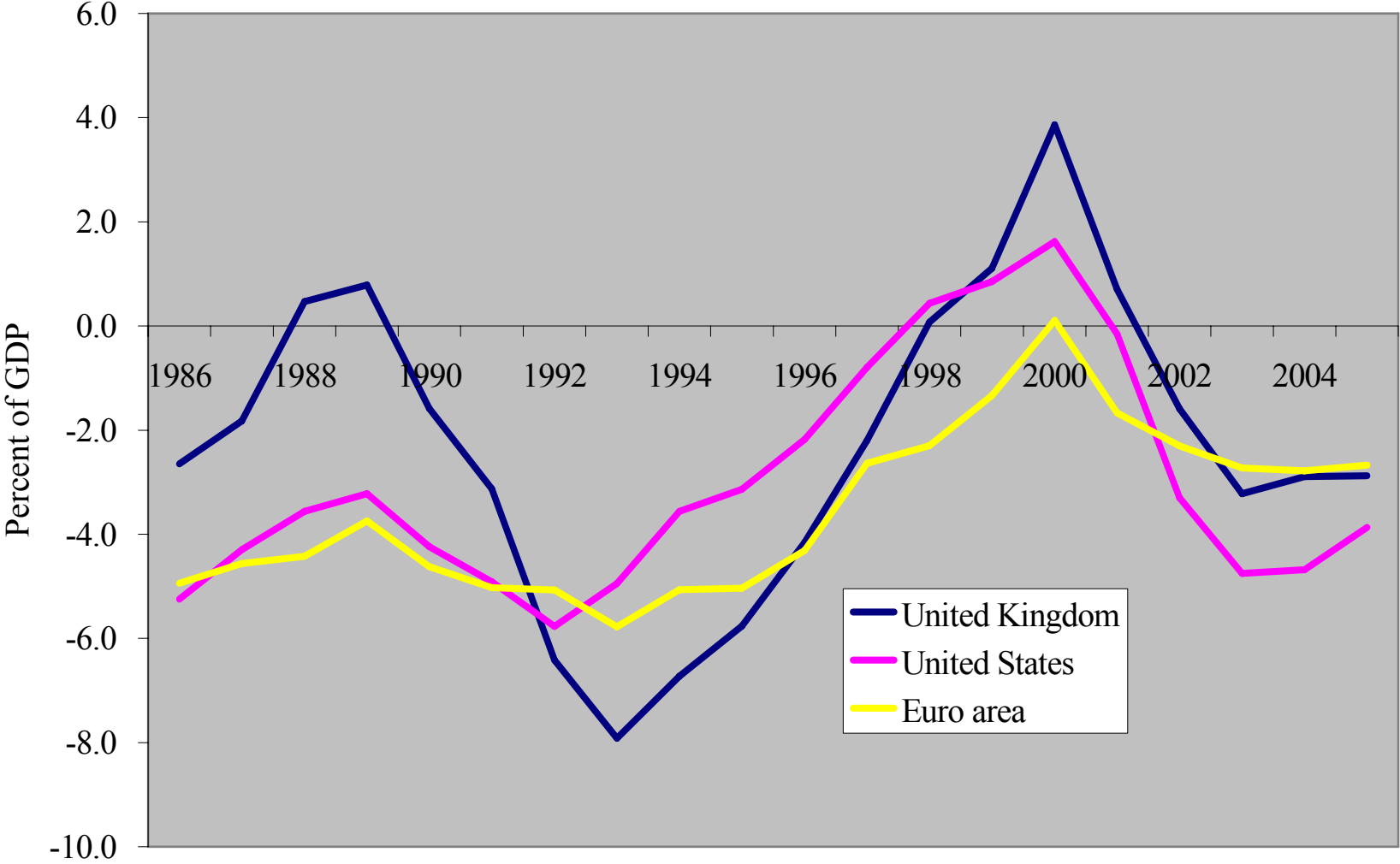
## Ratio of General Government Expenditure to GDP



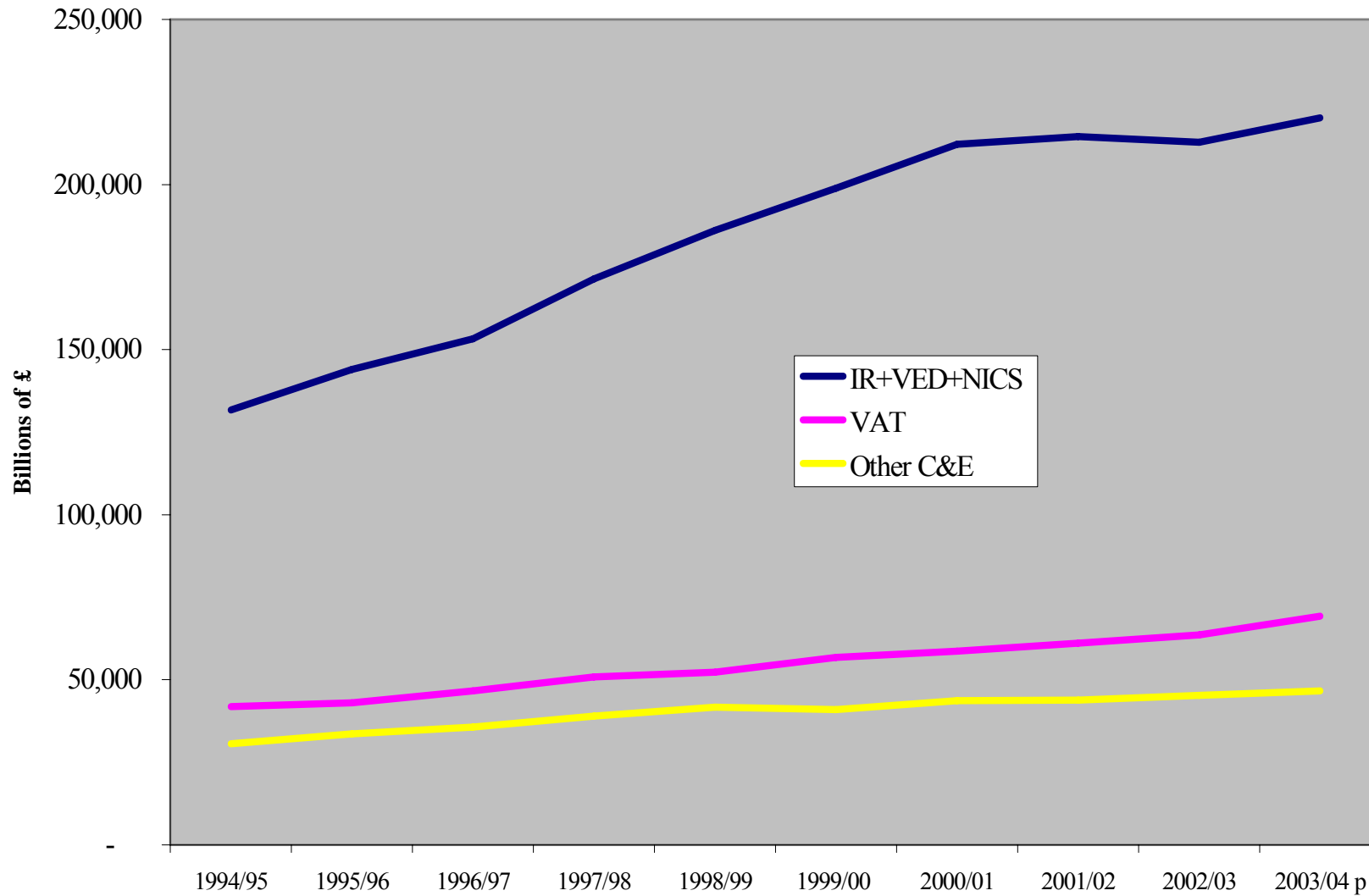
# General Governmental Tax and Non-tax Receipt



# Government Budget Deficit or Surplus



# Composition of the Public Revenue in the UK



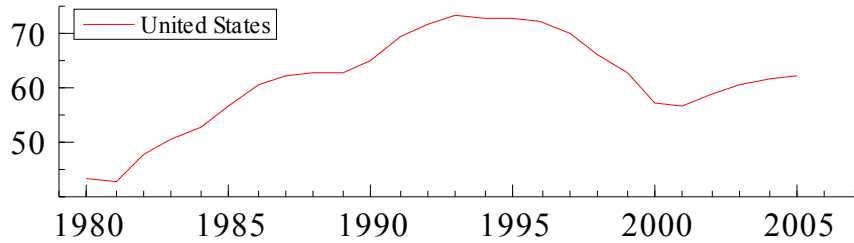
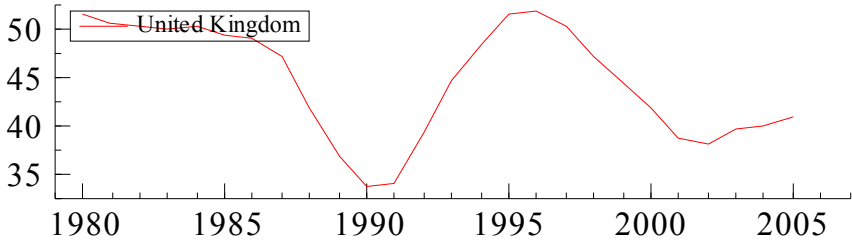
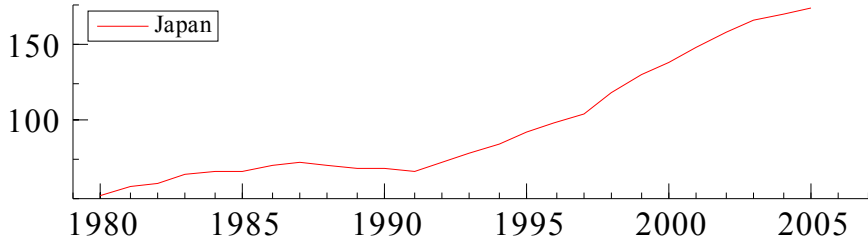
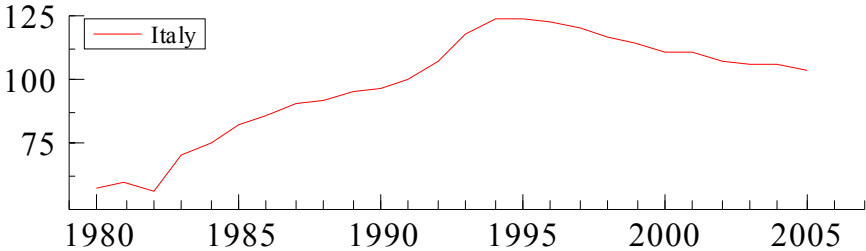
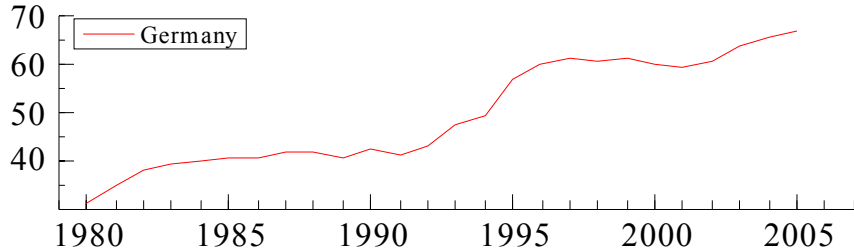
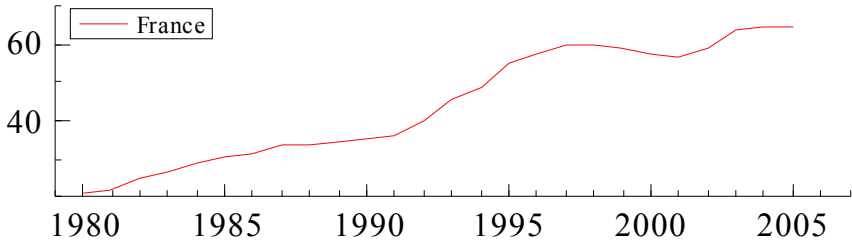
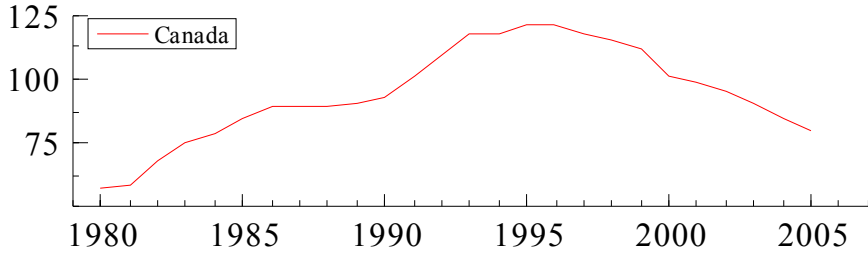
# National Debt

$\text{Borrowing} = \text{Spending} - \text{Revenue}$

$\text{Debt} = \text{Borrowing} + \text{Net Debt Stock}$

**How much a government can finance from Inflationary taxes?**

# Ratio of National Debt to GDP in Advance Countries



# Reasons for Public Debt

- No debt if the budget is balanced every time:  $G - T = 0$   
→  $\Delta B = 0$
- Debt ( $B$ ) accumulates when  $G > T$ .
- Change in debt has two components

Primary deficit  $(\Delta B = G - T)$

Debt servicing  $rB$

$$\Delta B = (G - T) + r B \quad (1)$$

## Debt and Primary Surplus

In terms of GDP

$$\frac{\Delta B}{Y} = \frac{(G - T)}{Y} + \frac{rB}{Y} \quad (2)$$

If the primary budget is balanced  $G - T = 0$

Then the debt increases by the rate of interest:

$$\frac{\Delta B}{B} = r \quad (3)$$

A primary surplus is required to pay the interest if debt is to remain constant

$$\Delta B = 0 \Rightarrow (T - G) = rB \quad (4)$$

## Debt Dynamics: Determinants of Debt/GDP Ratio

$$\Delta \left( \frac{B}{Y} \right) = \frac{G - T}{Y} + (r - g) \frac{B}{Y} \quad (5)$$

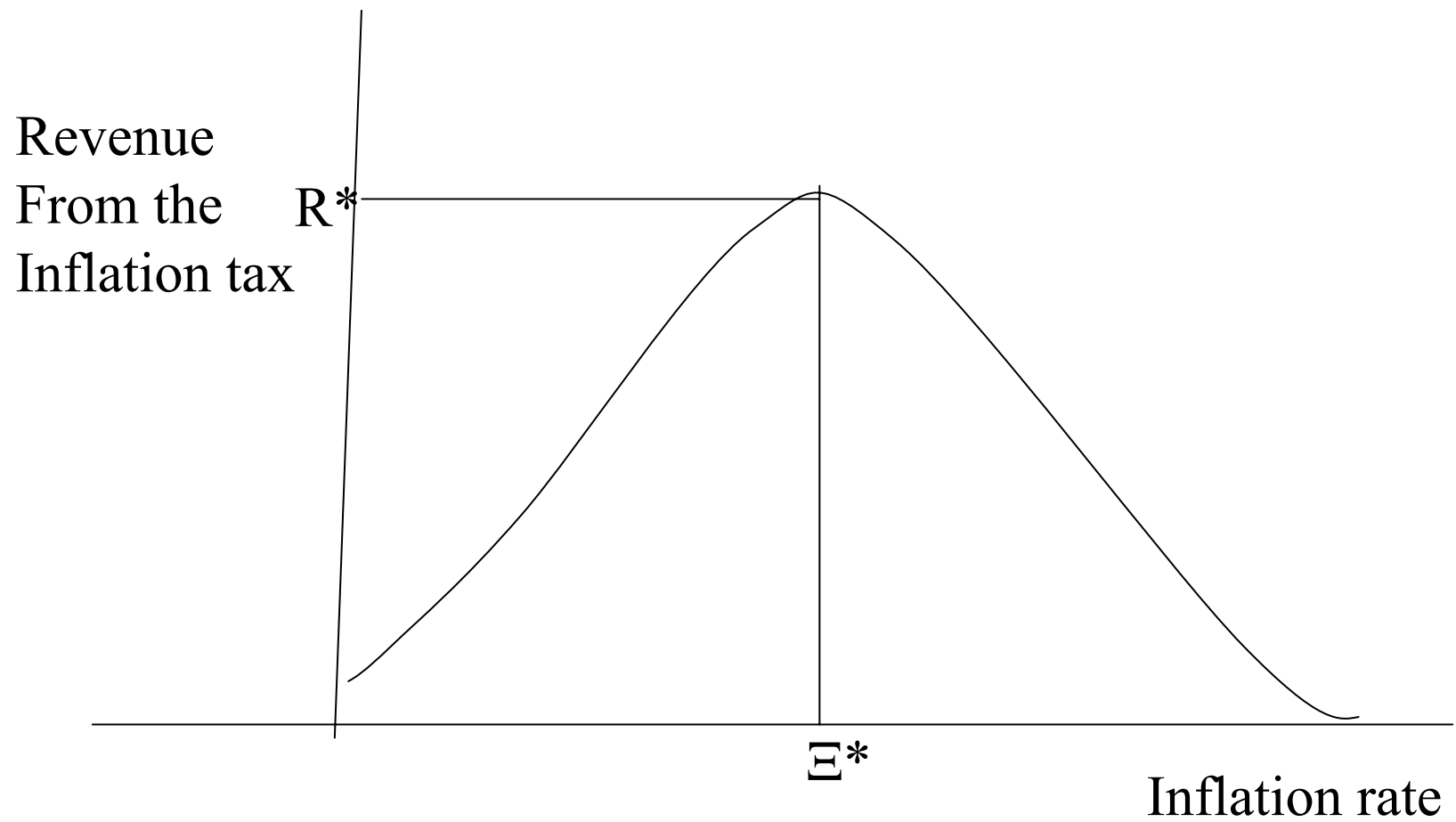
- Higher the interest rate causes a rise in B/Y
- Lower the growth rate of output causes a rise in B/Y
- Higher the current deficit (G - T) leads to higher B/Y
- Higher initial B/Y implies higher B/Y in subsequent years

### Example

**Debt ratio = 100%  $r = 3%$   $g = 2%$**

**$T - G = 1%$  is required to keep B/Y constant**

# Inflation Tax: Seigniorage



## Inflationary Finance of Public Budget Deficit

$$\Delta\left(\frac{B}{Y}\right) = \frac{G-T}{Y} + (i - \pi - g)\frac{B}{Y} - \frac{\Delta M}{PY}$$

- Higher the interest rate causes a rise in B/Y
- Higher inflation rate lowers the debt/GDP ratio
- Lower the growth rate of output causes a rise in B/Y
- Higher the current deficit (G -T) leads to higher B/Y
- Higher initial B/Y implies higher B/Y in subsequent years
- Higher growth rate of money supply lowers the debt/gdp ratio.

### Example

**Debt ratio = 100%  $i = 5%$   $g = 2%$   $\pi = 2%$**

***G-T = 4% then money supply should increase by 3% to keep B/Y constant***

## Inflationary Finance of Public Budget Deficit

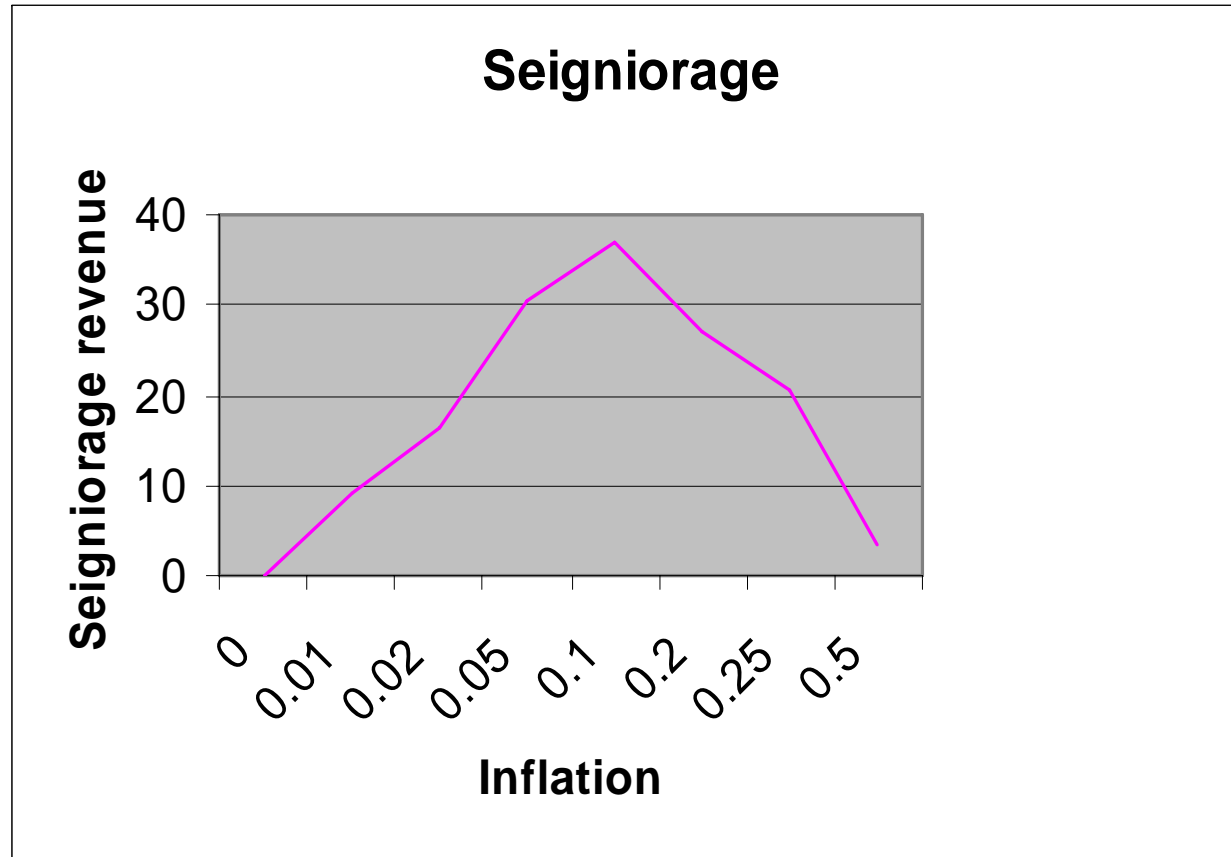
$$\frac{\Delta(PB)}{PY} + \frac{\Delta M}{PY} = \frac{PG}{PY} - \frac{PT}{PY} + i \frac{PB}{PY}$$

$$\Delta\left(\frac{B}{Y}\right) = \frac{G - T}{Y} + (i - \pi - g) \frac{B}{Y} - \frac{\Delta M}{PY}$$

$$\Delta\left(\frac{B}{Y}\right) = 0 = \frac{G - T}{Y} + (i - \pi - g) \frac{B}{Y} - \frac{\Delta M}{PY}$$

$$\frac{T - G}{Y} + \frac{\Delta M}{PY} = (i - \pi - g) \frac{B}{Y}$$

# Seigniorage (Inflation Tax) : A Numerical Example

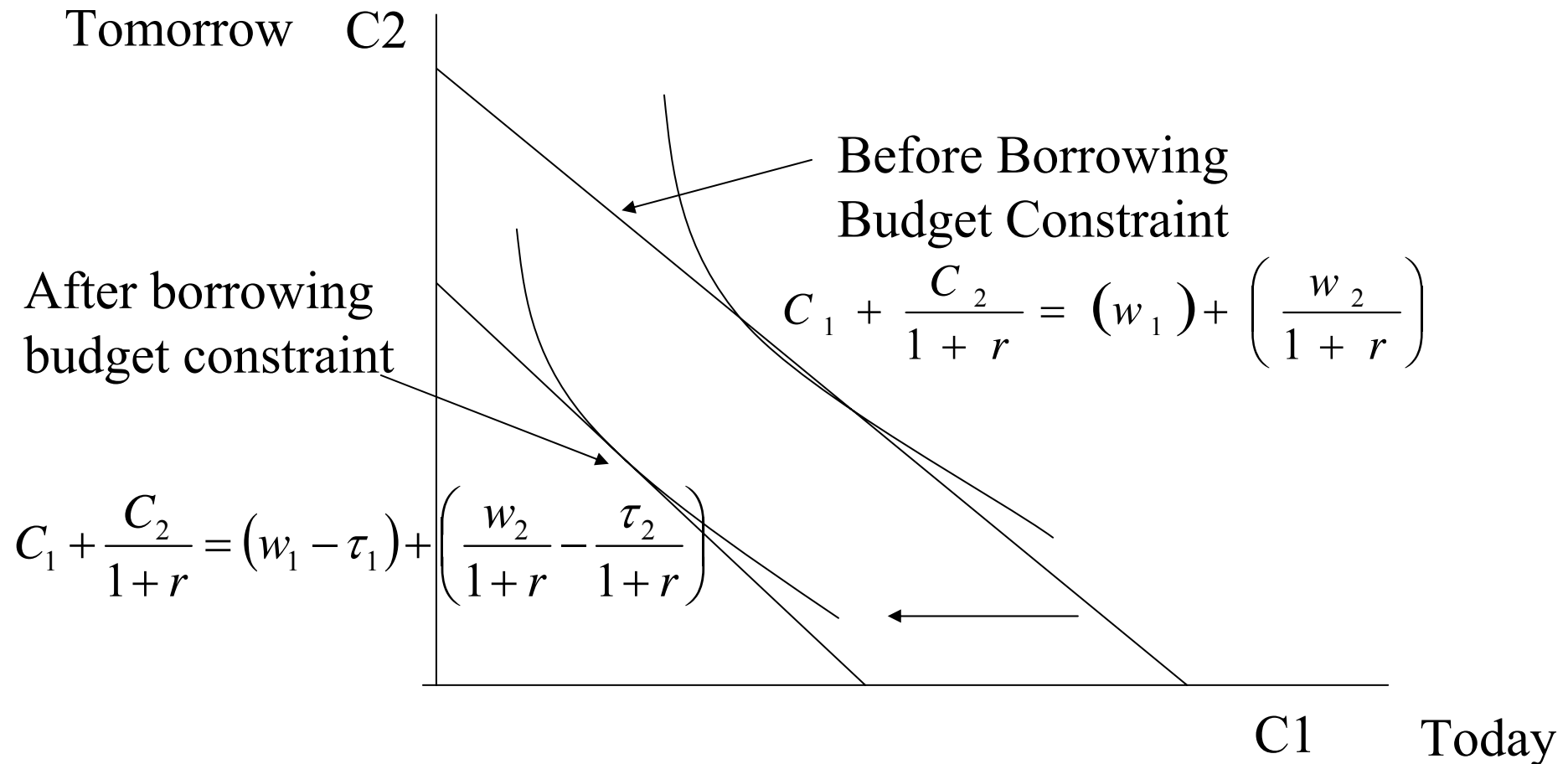


M/P	$\pi$	Si
1000	0	0
905	0.01	9.05
819	0.02	16.38
607	0.05	30.35
<b>368</b>	<b>0.1</b>	<b>36.8</b>
135	0.2	27
82	0.25	20.5
7	0.5	3.5

## Ricardian Equivalence Theorem: Questions

- Should government finance public budget deficit by borrowing or by raising taxes?
- is it possible to cut tax rates without a cut in public spending?
- David Ricardo. British economist, who wrote about 180 years ago that it is not.
- Ricardian Equivalence Theorem states that borrowing more from private sector or taxing more have equivalent outcome.

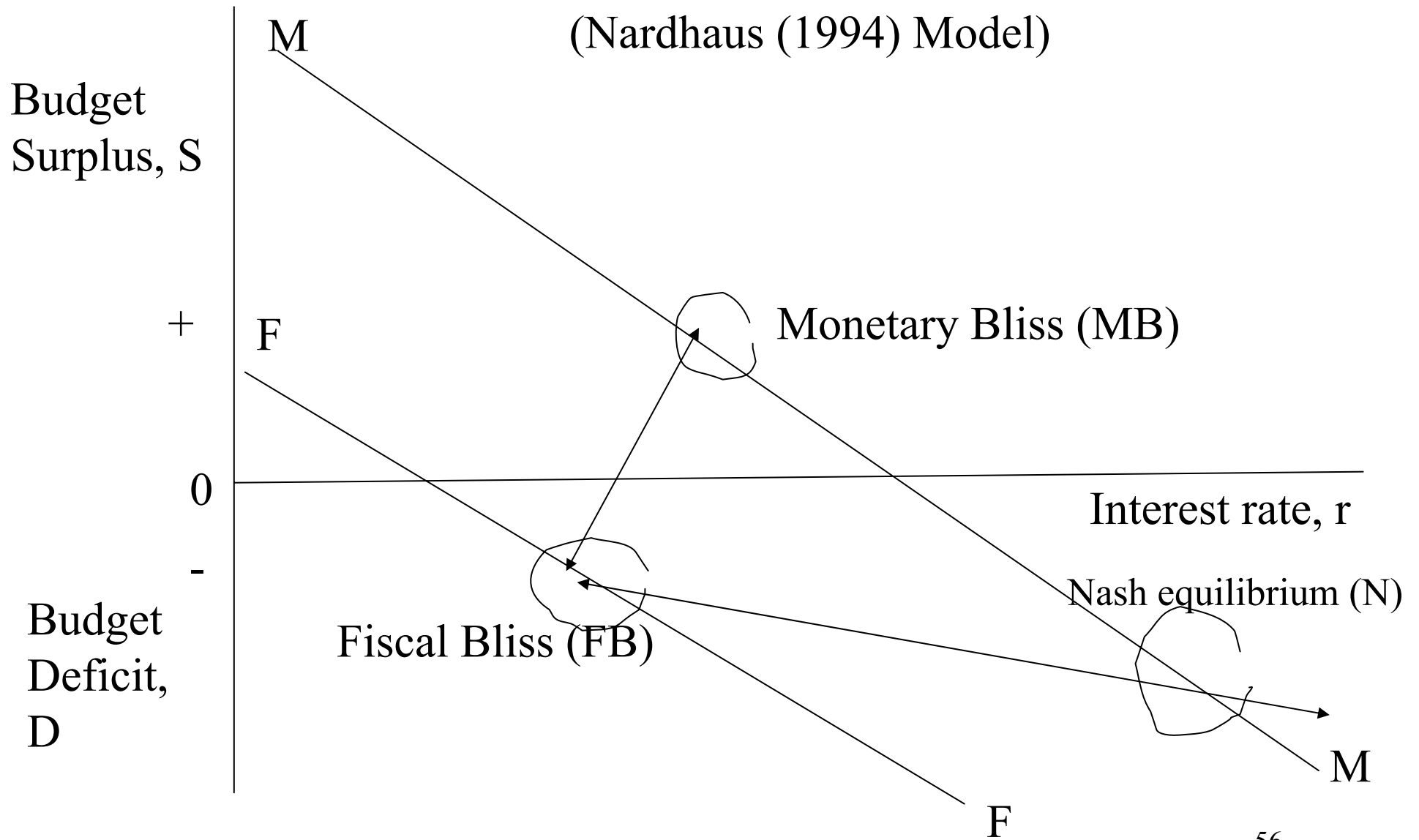
# Basic Proposition of the Ricardian Equivalence Tax or Borrowing Does not Make Any Difference



## Ricardian Equivalence: Main Proposition

- It does not matter whether public deficit is financed by raising tax rates or by borrowing from the private sector.
- More Borrowing now means higher rates of tax in the future for repayment of debt.
- With higher amount of public debt now private households save more in anticipation of higher taxes in the future that government will impose on them to repay the debt.
- Private households optimise intertemporally and completely internalise public policy.
- Borrowing now or raising tax now are equivalent strategies if both the government and household honour their own intertemporal budget constraints.

# Fiscal and Monetary Policy Game in a Diagram



## Inflation-Unemployment Game Between Private and Public Sectors: Normal form

Government chooses actual inflation and private sector makes expectation about it.

H strategy corresponds to high inflation expectation by the private sector

L strategy corresponds to low inflation expectation by the private sector

.....	<i>Private Sector</i>	
	<i>H</i>	<i>L</i>
<i>Government Sector</i>	<i>H</i>	<i>L</i>
	<i>H</i>	<i>L</i>
	(4,4)	(6,3)
	<i>L</i>	<i>L</i>
	(3,6)	(5,5)

First element represents payoff to the row-player (Government).

Second element represents Payoff to the column-player (private sector).

## Process of Finding a Nash Equilibrium

		Private sector		
		H	L	
		<u>4</u> 4	<u>6</u> 3	H
Government		3 6	5 5	L

Government Sector' choice

		Private sector		
			H	L
	H	4 <u>4</u>	6 3	
Government	L	3 <u>6</u>	5 5	

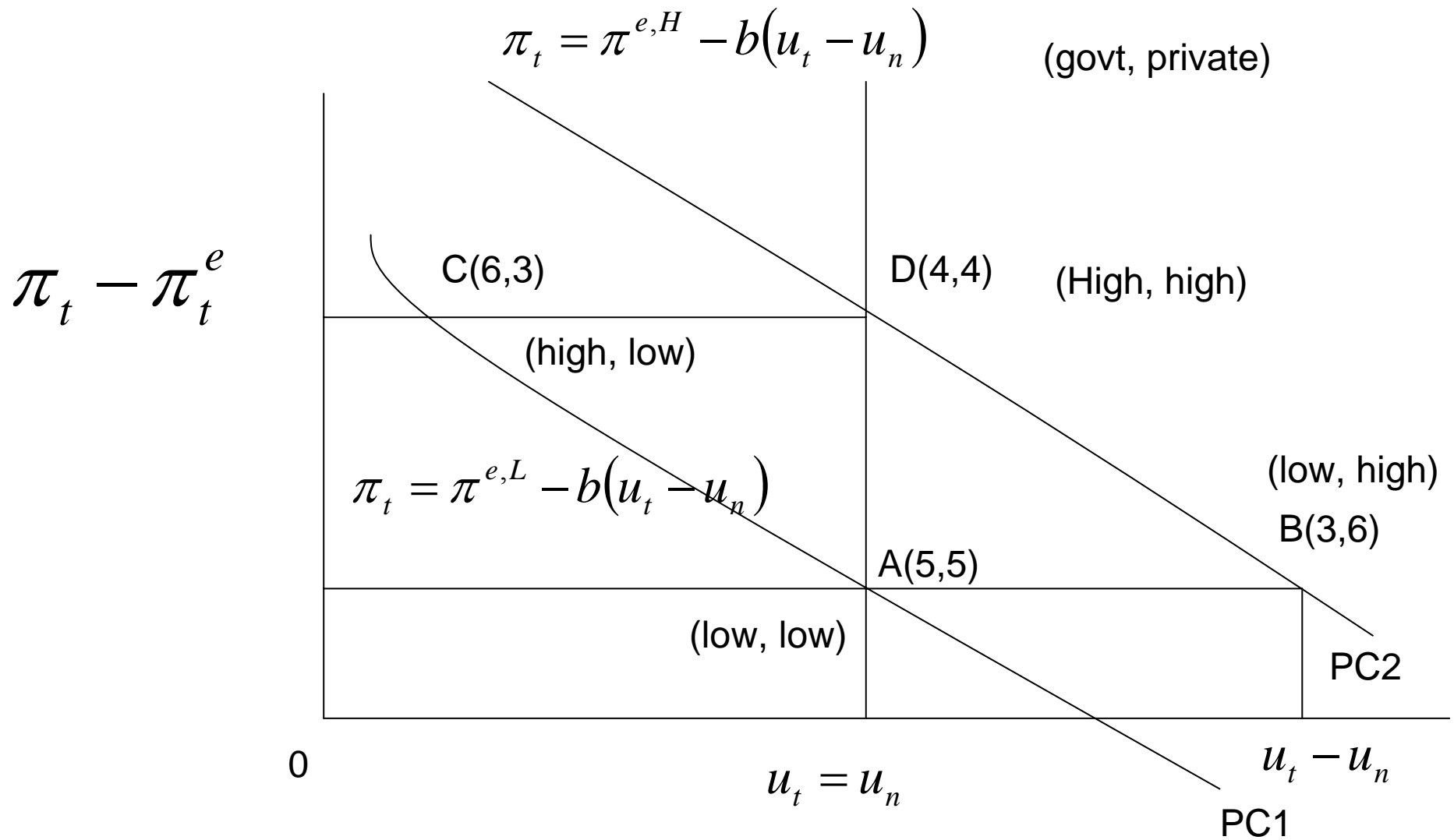
Private Sector' choice

		Private sector		
		H	L	
	H	<u>4</u> <u>4</u>	<u>6</u> 3	
	L	3 <u>6</u>	5 5	

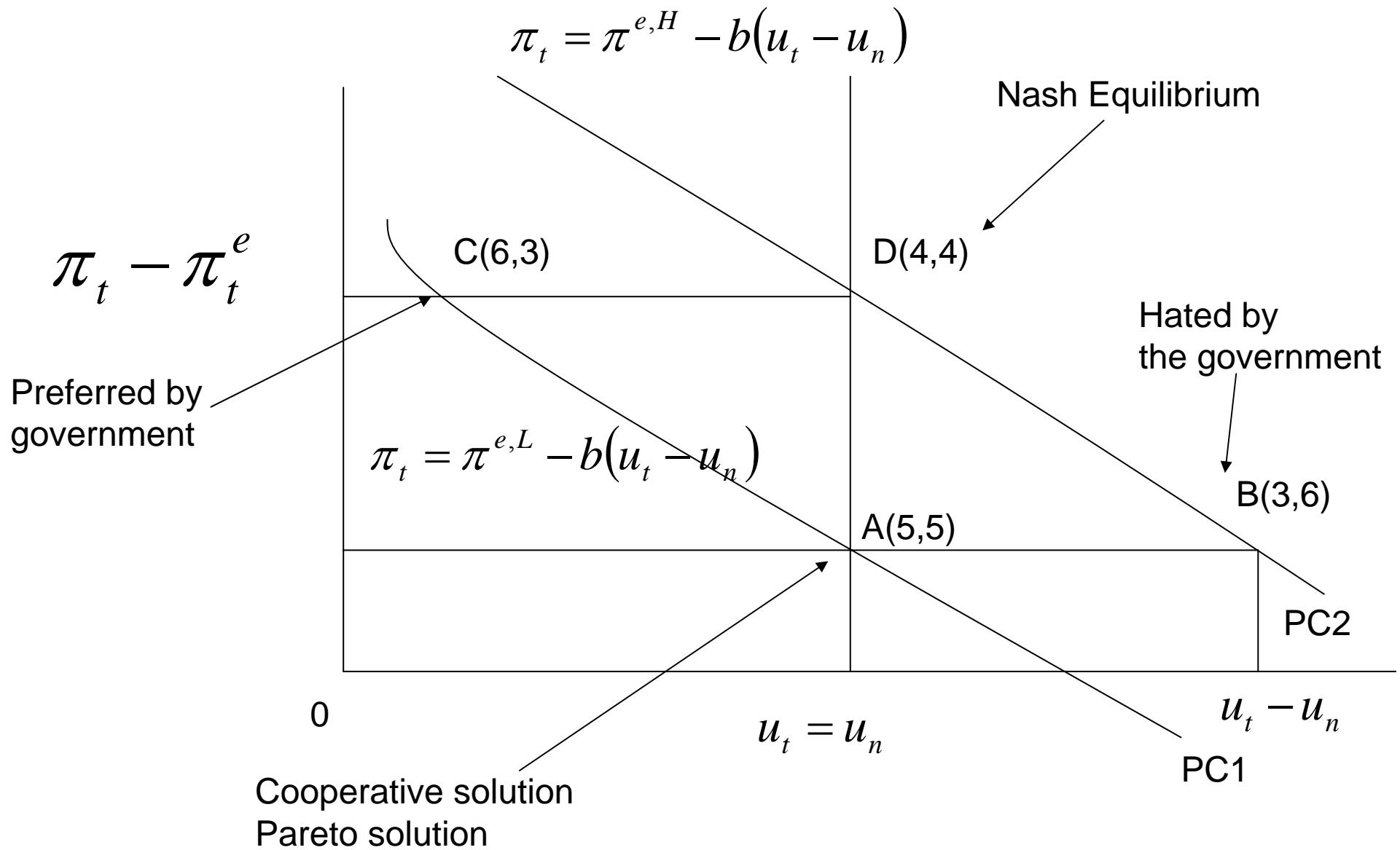
Outcome of the Game

Nash solution is not Pareto optimal. (L,L)=(5,5) would have been better for both.

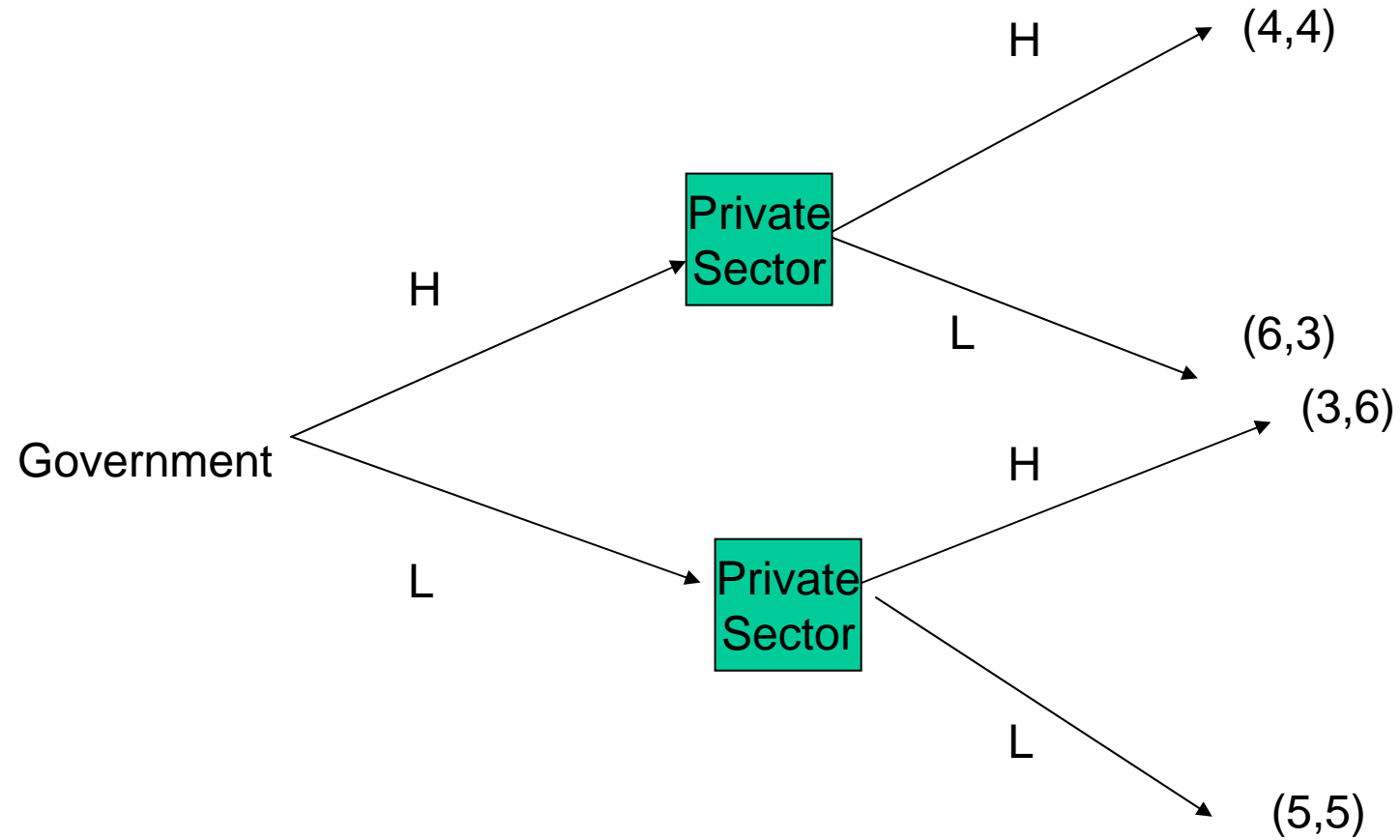
# Inflation-Unemployment Game Between Private and Public Sectors in a diagram



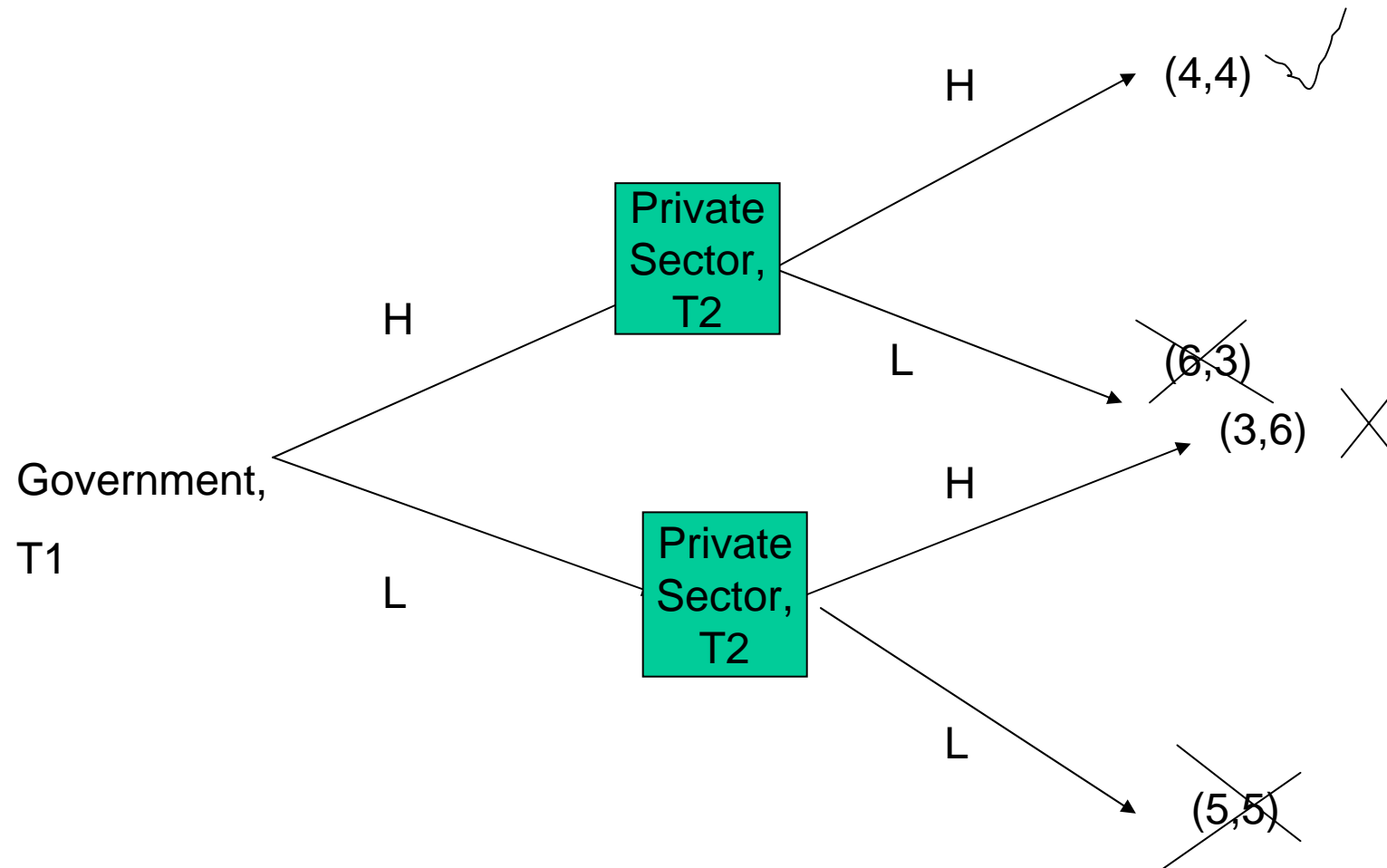
# Inflation-Unemployment Game Between Private and Public Sectors



Extensive Form of Inflation-Unemployment Game: When government moves first



# Dynamic Inflation-Unemployment Game: Solution by Backward Induction



## Credibility Problem, Cheating and Discount Factor of the Game

Both gain by playing (C,C)

But this solution is not credible.

There is incentive to deviate. Trigger Strategy

Game returns to Nash path in absence of credibility.

If the game is played infinite number of times the optimal discount value if the game is calculated as

$$PV(C, C) = 5 + 5\delta + 5\delta^2 + 5\delta^3 + \dots + 5\delta^n = \frac{5}{1-\delta}$$

$$PV(C, C) = \lim_{n \rightarrow \infty} 5 + 5\delta + 5\delta^2 + 5\delta^3 + \dots + 5\delta^n = \frac{5}{1-\delta}$$

$$PV(cheat) = 6 + 4\delta + 4\delta^2 + 4\delta^3 + \dots + 4\delta^n$$

## Solution for the Discount Factor of the Game

$$PV(L, L) = 5 + 5\delta + 5\delta^2 + 5\delta^3 + \dots + 5\delta^n = \frac{5}{1-\delta}$$

*Lim*  $n \rightarrow \infty$

$$PV(cheat) = 6 + 4\delta + 4\delta^2 + 4\delta^3 + \dots + 4\delta^n$$

$$\delta PV(cheat) = 6\delta + 4\delta^2 + 4\delta^3 + \dots + 4\delta^{n+1}$$

$$(1-\delta)PV(cheat) = 6 - 6\delta + 4\delta \quad \delta^{n+1} \underset{\lim n \rightarrow \infty}{\approx} 0$$

$$PV(cheat) = 6 + 4 \frac{\delta}{(1-\delta)}$$

$$\frac{5}{1-\delta} = 6 + 4 \frac{\delta}{(1-\delta)}$$

$$5 = 6(1-\delta) + 4\delta \quad 6 - 5 = 2\delta \quad \delta = \frac{1}{2}$$

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