Economic Modelling
Lecture 4

Keynes-Hicks-Samuelson-Mundell-Fleming Models for Analysis of Macroeconomic Fluctuations (Demand Side)

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Macroeconomic modelling

- Keynes (1936), Hicks (1937), Samuelson (1939),
- Phillips (1958), Friedman (1968), Phelps (1968), Tobin (1969),
- Sargent and Wallace (1975), Lucas (1976), Fisher (1977), Kydland and Prescott (1977) ,Wallis (1980), King and Plosser (1984) Mankiw (1989), Prescott (1986), Taylor (1987)
- Blanchard and Kiyotaki (1987), Manning (1995), Rankin (1992)
- Barro and Gordon (1983), Sargent (1986) Goodhart (1989), Nickell (1990), Mankiw and Romer(1993), Lockwood Miller and Zhang (1998)
- Wallis (1989), MPC (1999), Pagan and Wickens (1989), Hendry (1995), Holly and Weale (2000)
- Taylor (1993), Sargent and Ljungqvists (2000), Minford and Peel (2002), Blake and Weal (2003), Garratt, Lee, Pesaran and Shin (2003)
- Solow (1956), Lucas (1988), Romer (1990), Mankiw, Romer and Weil (1992),
- Harrod (1939), Domar (1947) and Solow (1956), Parente and Prescott (1993)
- Fullerton, Shoven and Whalley (1983), Auerbach and Kotlikoff (1987), Perroni (1995), Rutherford (1995), Bank of England, NIESR) Kehoe, Srinivasan and Whalley (2005), Bhattarai (1997, 1999)

Classical View: Free Market and Minimum Government

(Ideas of Adam Smith (1776), Ricardo (1817), Say (1821) ,Malthus (1798), Mill (1873), Marshall (1925)

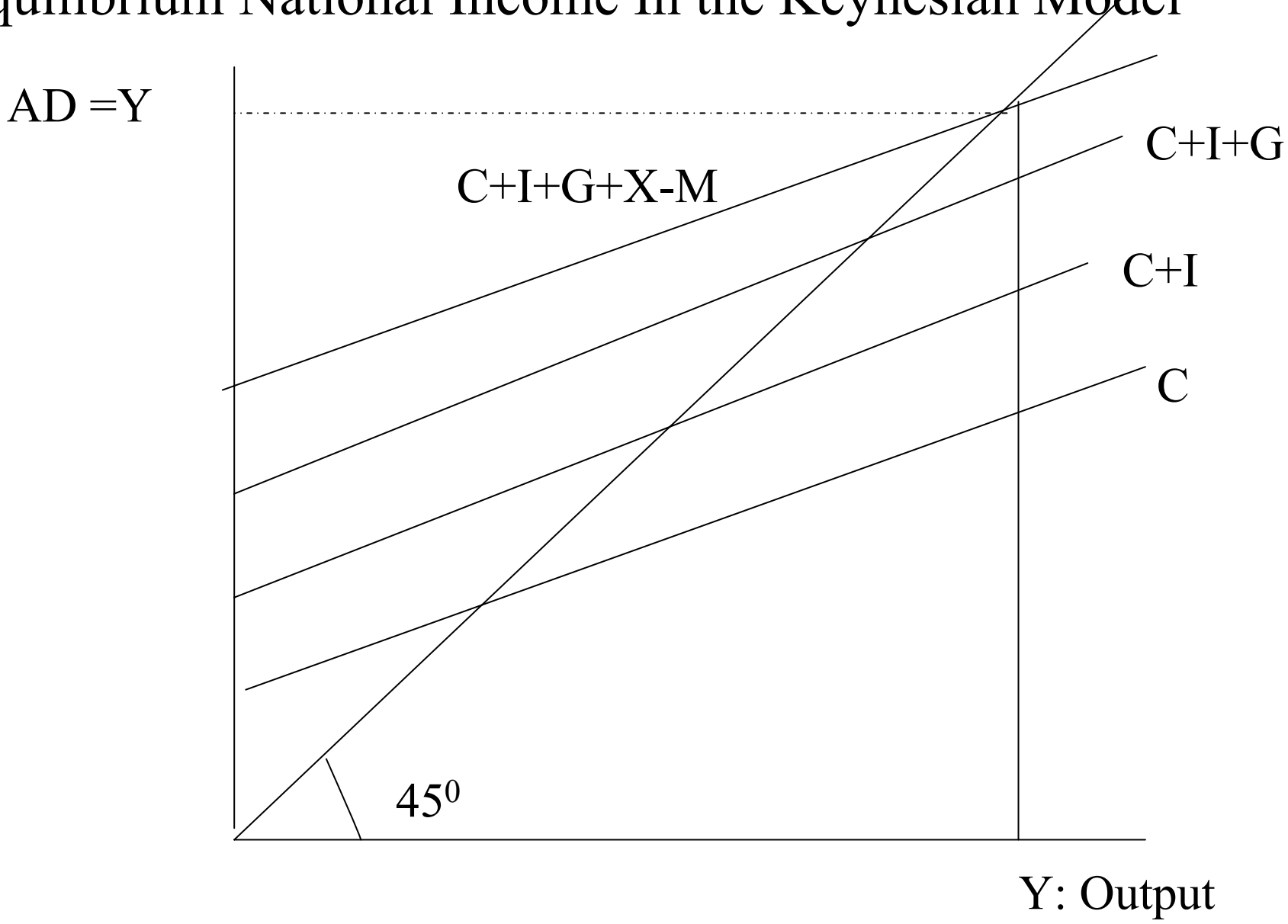
- Market is always in equilibrium: Demand = Supply both in goods and factor markets; No excess demand or no excess supply can persist.
- Perfectly flexible prices (Invisible hand) make this happen.
- No glut or shortages in goods market.
- No unemployment or labour pressure in the labour market.
- It is long run view (growth model)
- Prices proportional to money supply.
- Money is neutral (quantity theory of money).
- Balance budget recommended.
- Laisser faire: minimum government is the best government.
- Downward sloping aggregate demand and vertical supply curve

- See http://socserv2.socsci.mcmaster.ca/~econ/ugcm/3ll3/

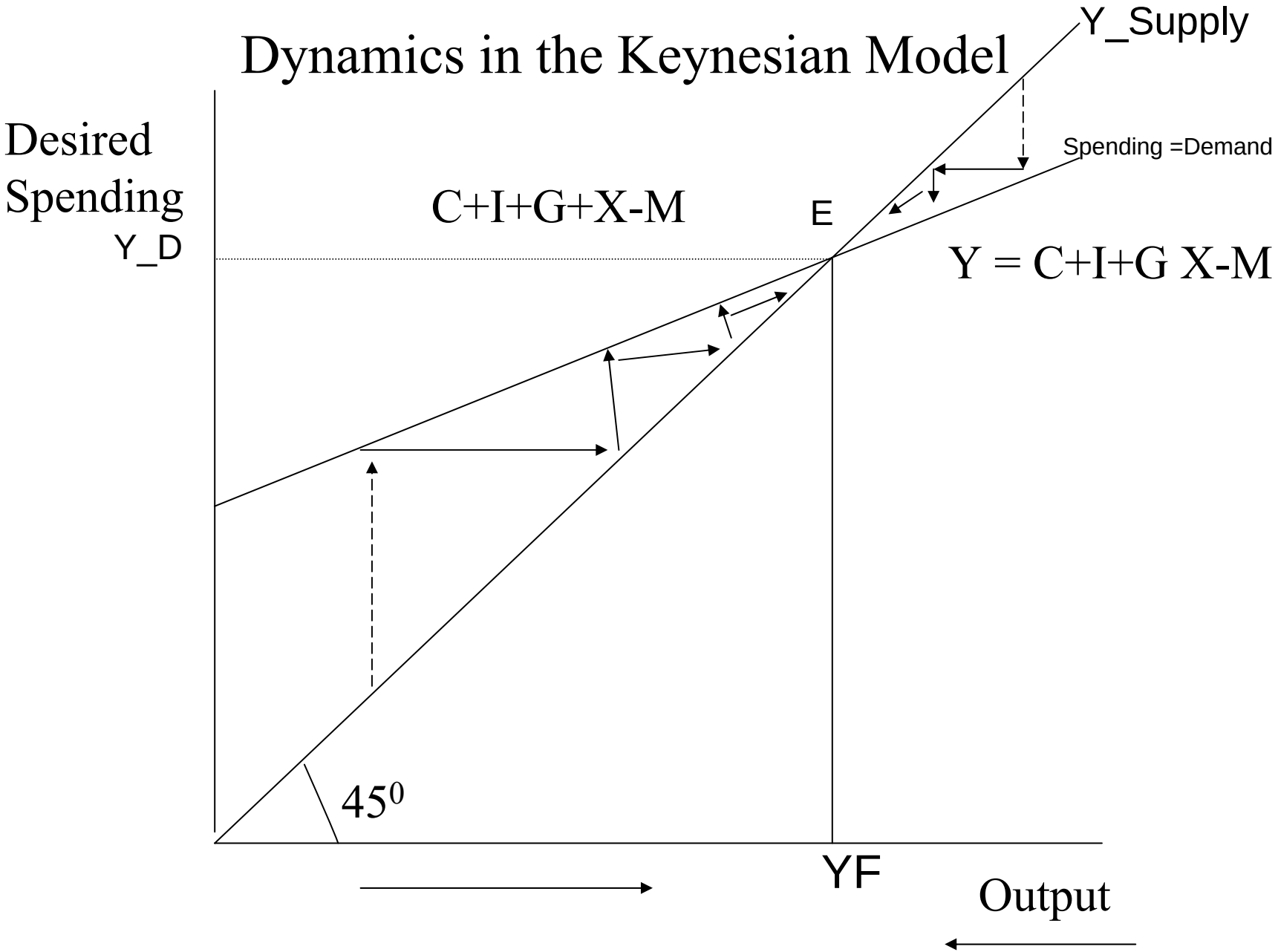
Why Keynesian Economics?

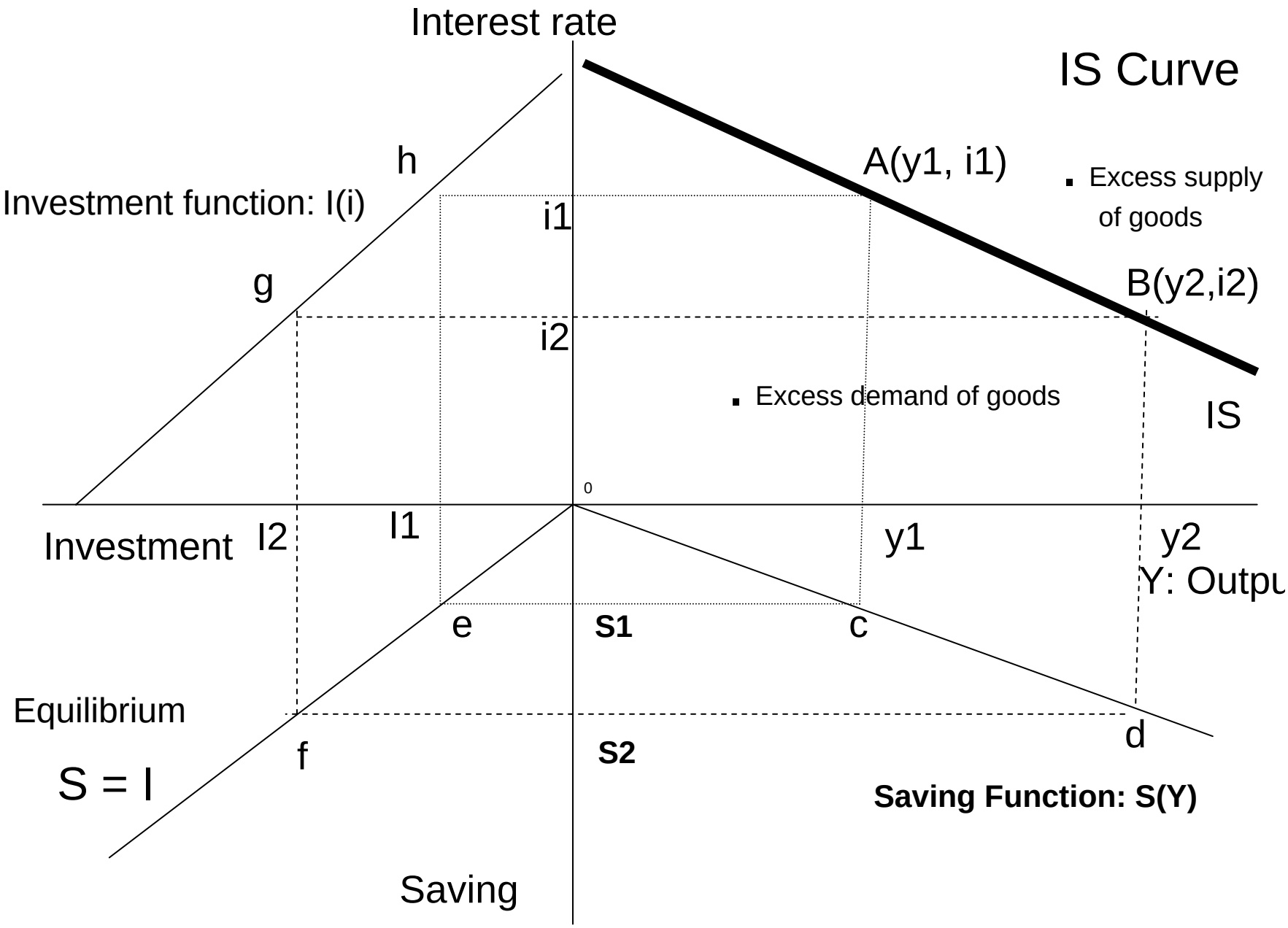
- Automatic equilibrium is not guaranteed - animal spirits not the rational choices dominate the economy.
- Labour market imbalance: rigid labour market, nominal wages not flexible upwards
  - unemployment may persist for a long period if the deficiency in demand continues. Loss of welfare
- Prices of commodities not flexible because of market power of firms; market fails
- Active fiscal and monetary policy can fine tune the economy
- “We are all dead in the long run” - Keynes
- In time of massive unemployment dig holes and fill them to create jobs and income

Equilibrium National Income In the Keynesian Model



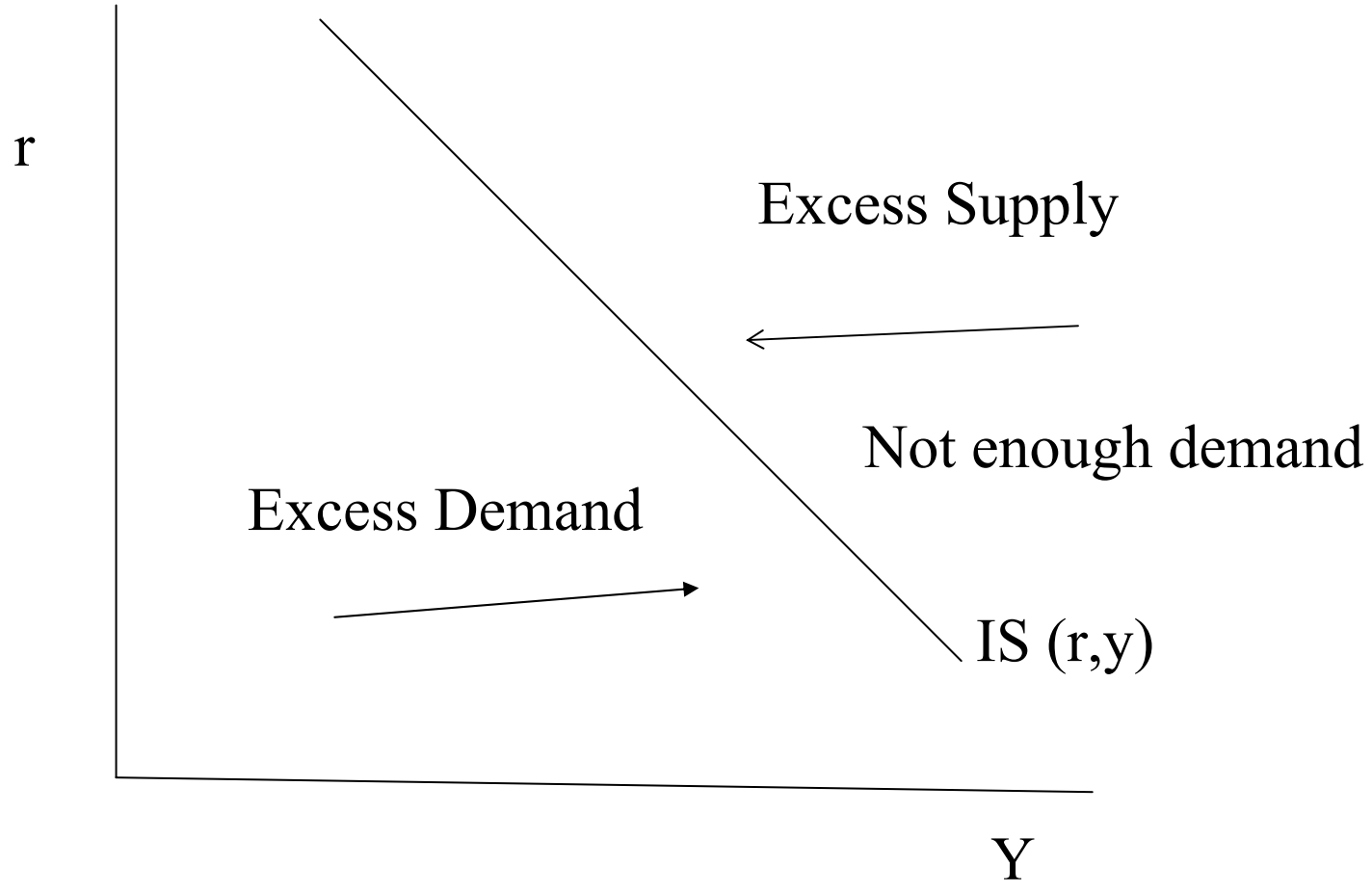
Dynamics in the Keynesian Model





Goods Market Equilibrium in Keynesian Model

Why the IS Curve Represents a Good Market Equilibrium?



A Simple Keynesian Model

MODEL

$$C = C_0 + a(Y - T)$$

$$I = b - dr$$

$$Z = mY$$

T=100 G =100 X =50

$$Y = C + I + G + X - Z$$

Numerical Example

$$C = 200 + 0.8(Y - 100)$$

$$I = 100 - 200(0.05)$$

$$Z = 0.2Y$$

$$Y = \frac{C_0 - aT + b - dr + G + X}{1 - a + m}$$

$$Y = \frac{200 - 0.8*100 + 100 - 200*0.05 + 100 + 50}{1 - 0.8 + 0.2}$$

Model Solutions

- Y = 900
- C = 840
- I = 90
- T=G= 100;X=50
- M = 180
- X-M = -130
- S=Y-T-C=-40
- S-I=-40-90=-130

$$C = 200 + 0.8(Y - 100)$$

$$I = 100 - 200(0.05)$$

$$Z = 0.2Y$$

Macro Balance:

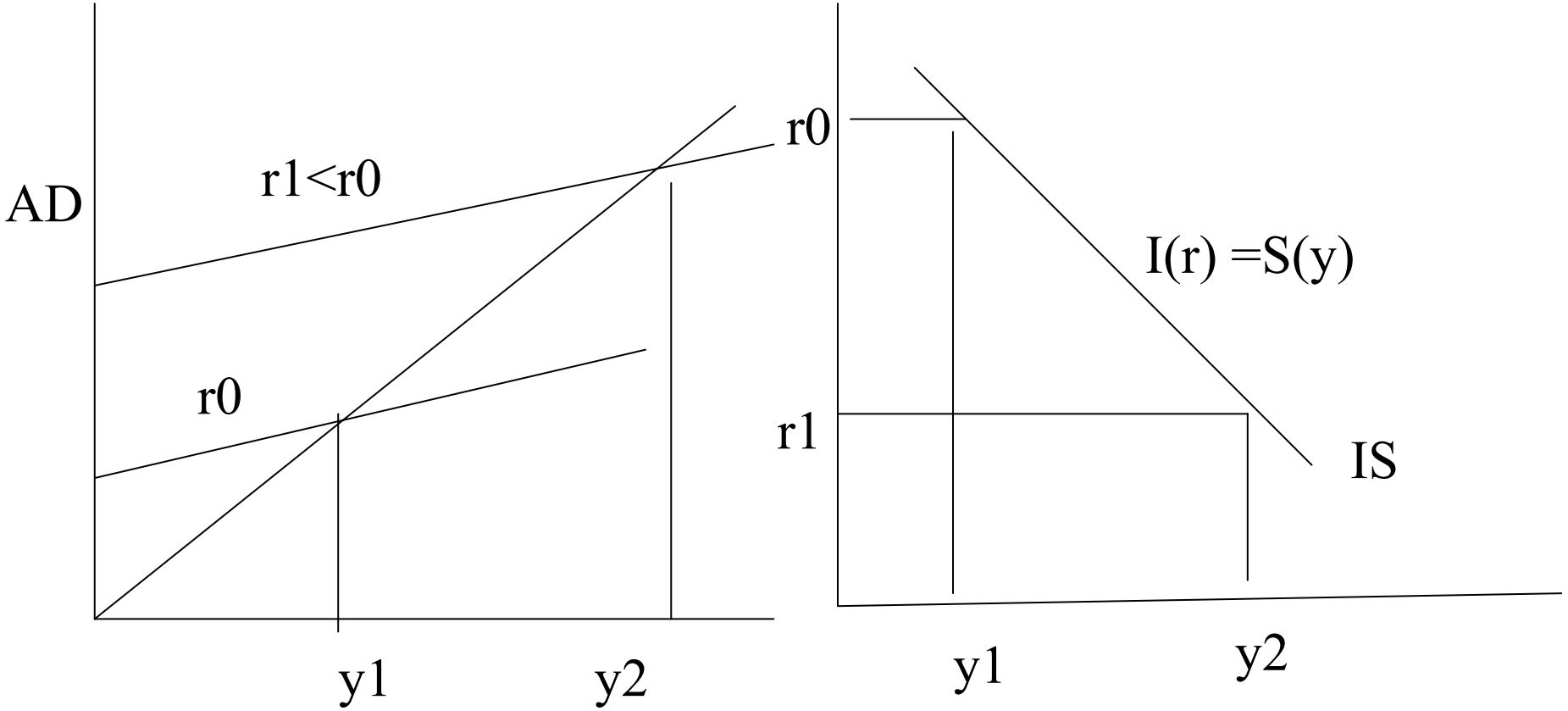
Income = Expenditure

C+S+T = Y = C+I+G+X-M

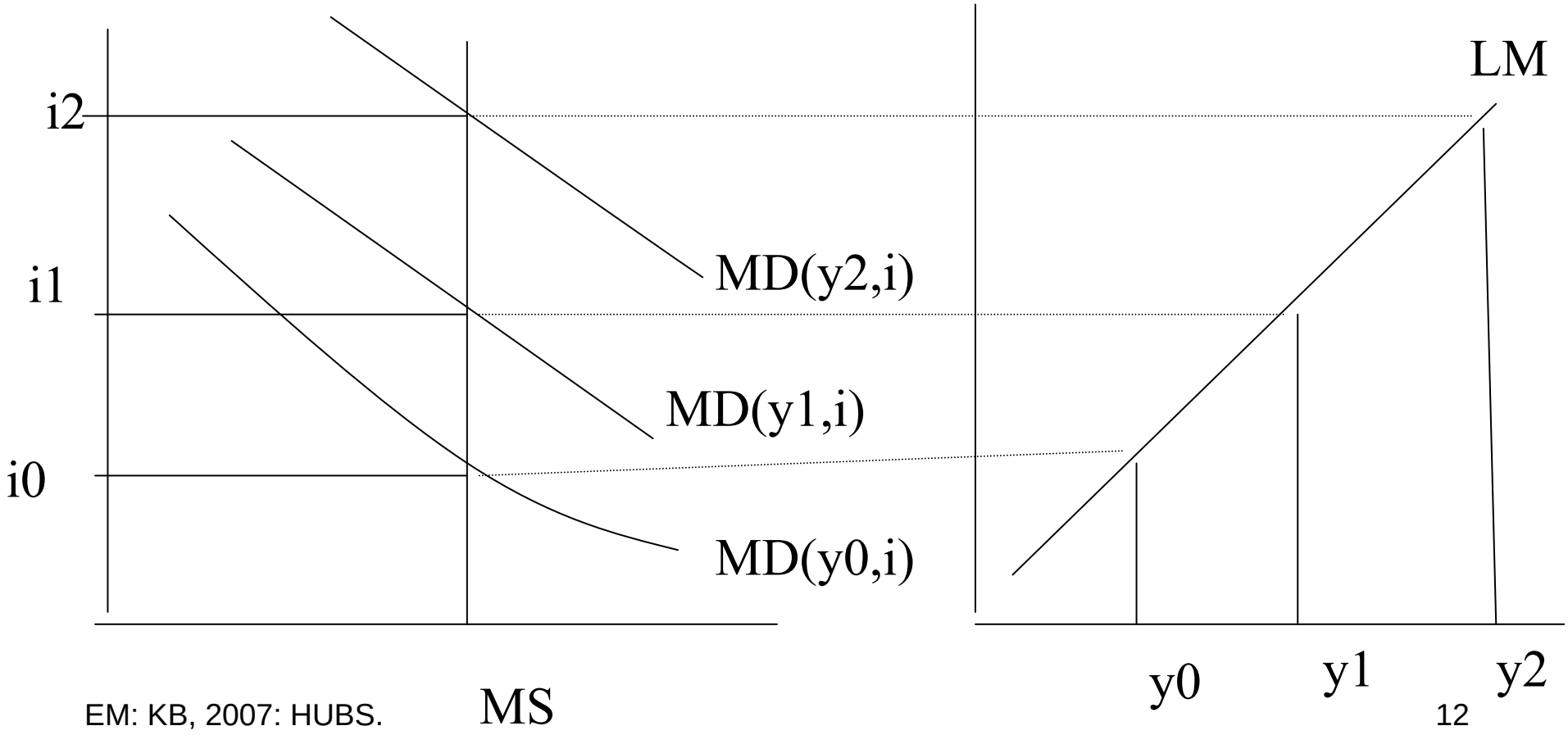
(S - I) +(T-G) = (X-M)

-130 + 0 = -130

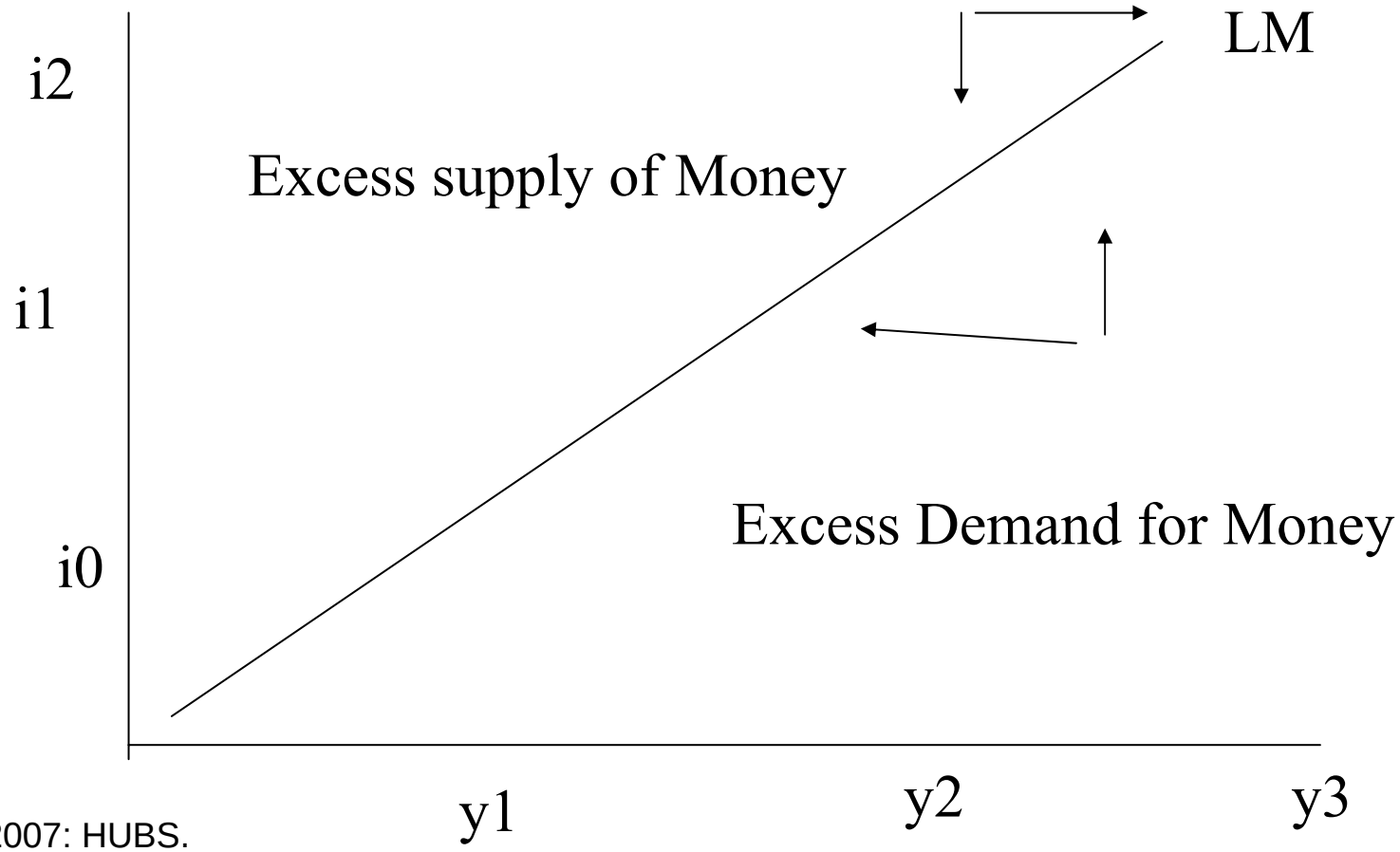
Goods Market Equilibrium in a Closed Economy
Saving = Investment
Derivation of the IS Curve in the Keynesian Model



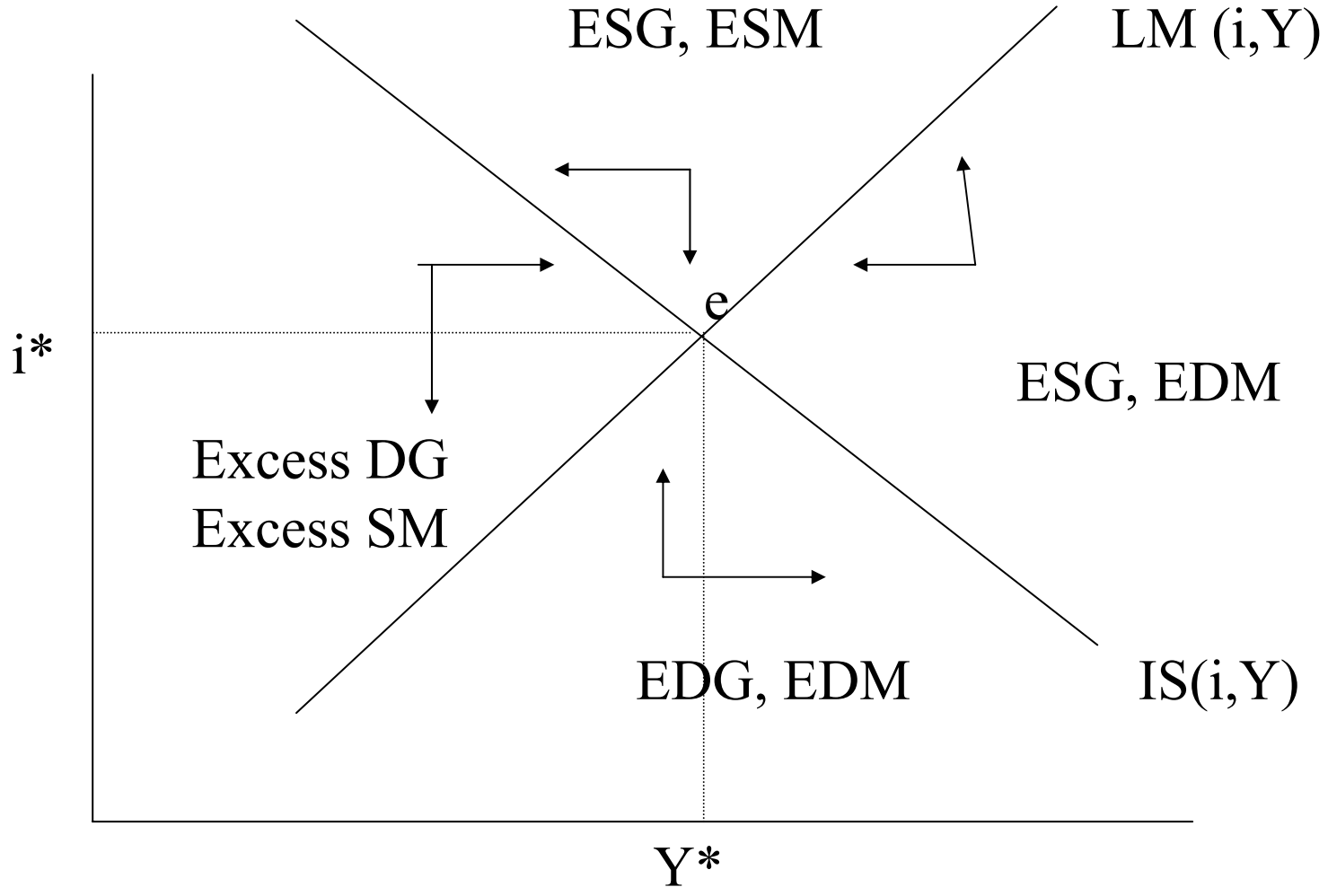
Money Market Equilibrium: LM Curve



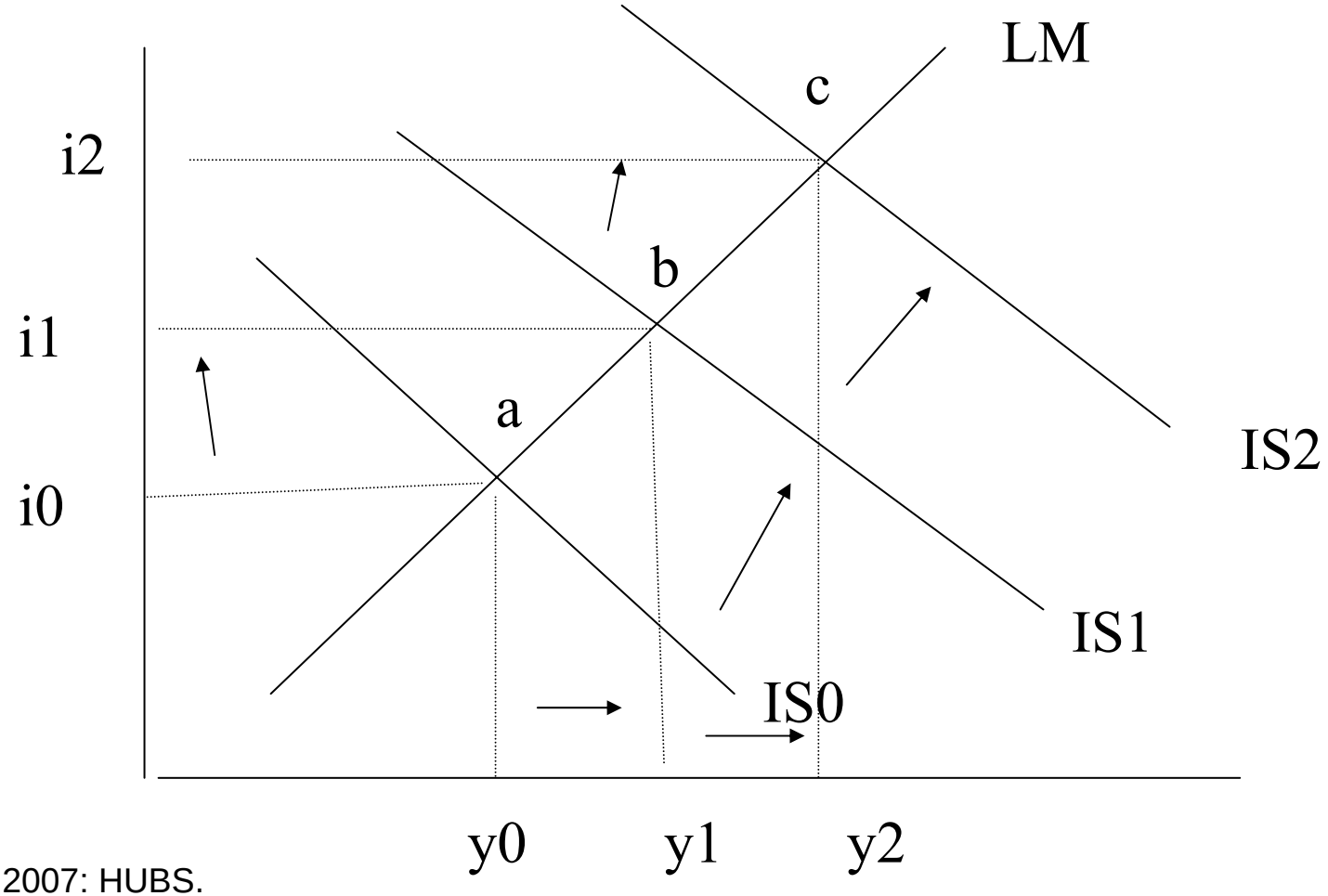
Equilibrium and Disequilibrium in the Money Market



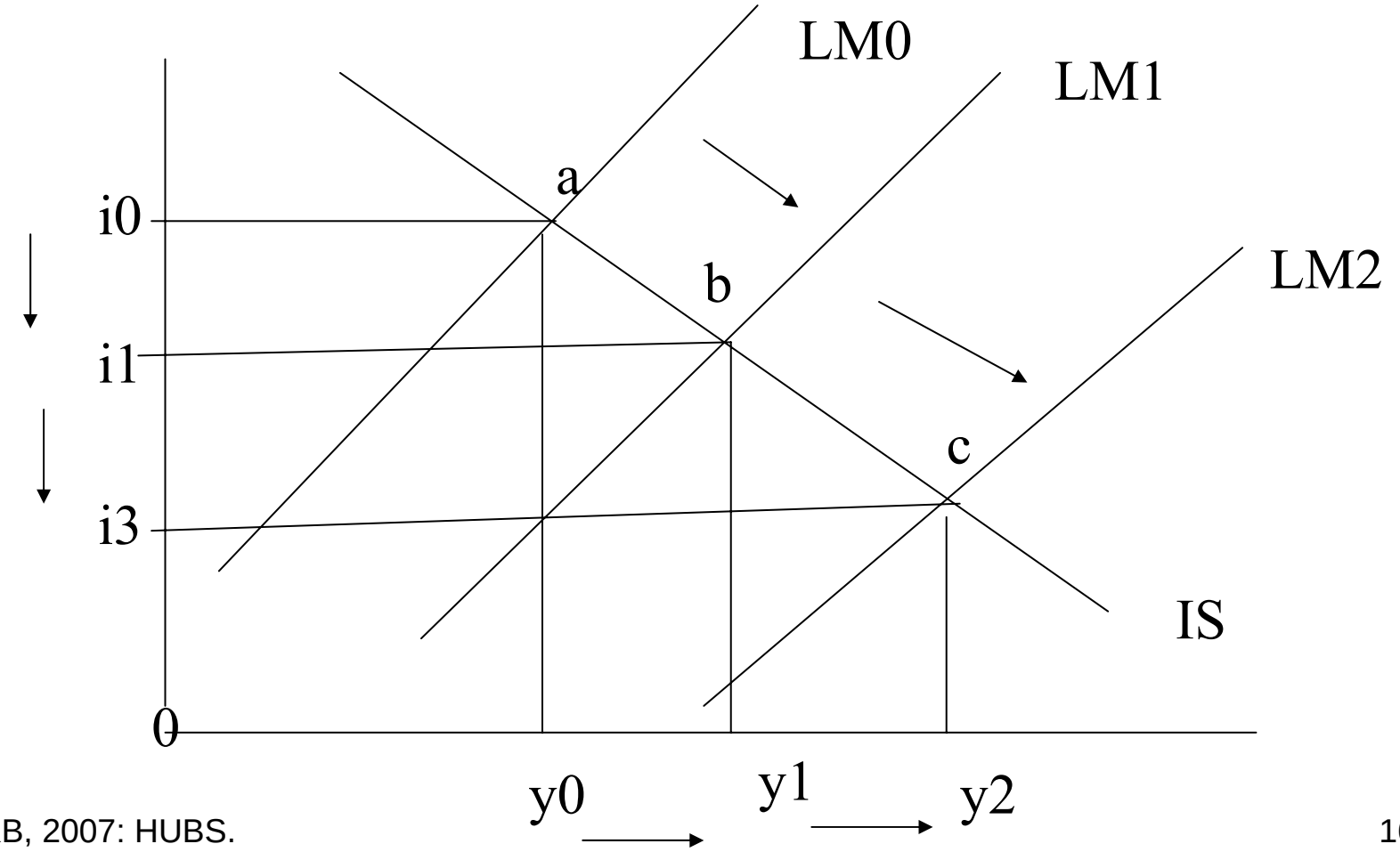
Economy Wide Equilibrium in a IS-LM Model



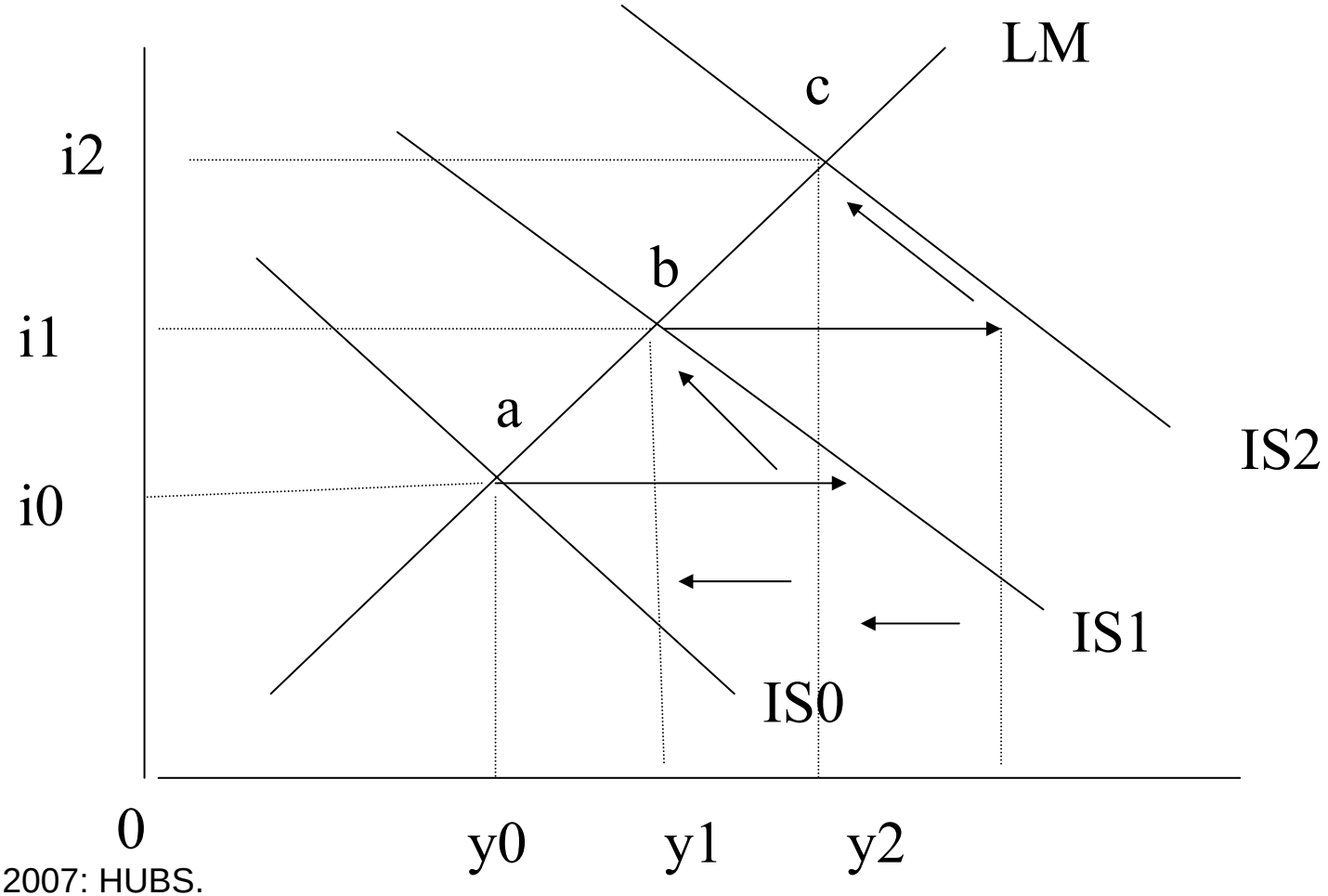
Impact of expansionary fiscal policy in the interest rate and output



Impact of expansionary monetary policy in the interest rate and output

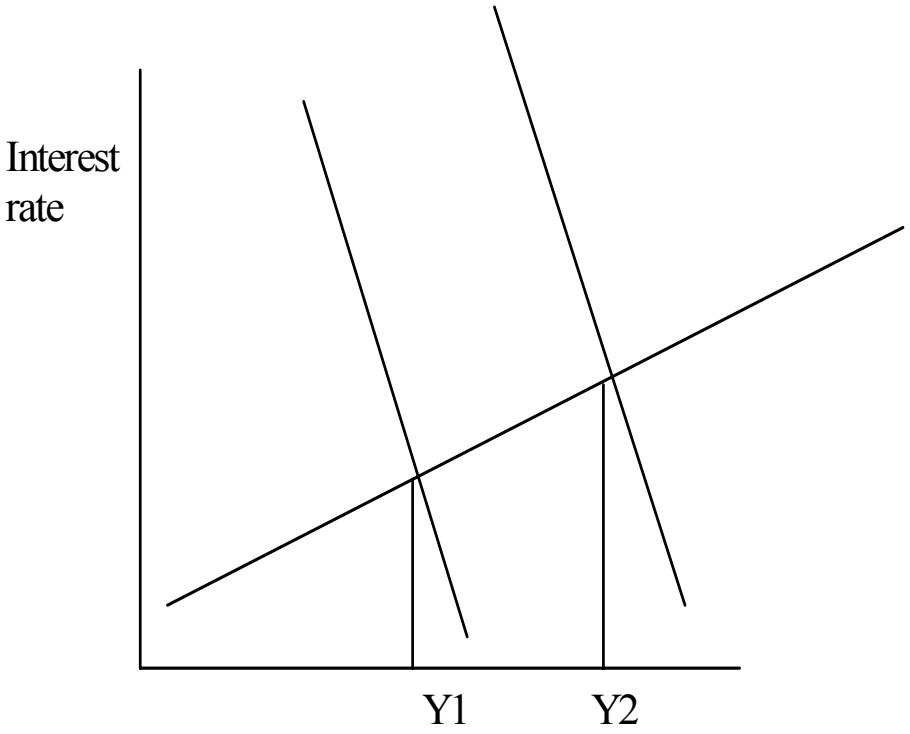


Crowding Out Effect of an Expansionary Fiscal Policy



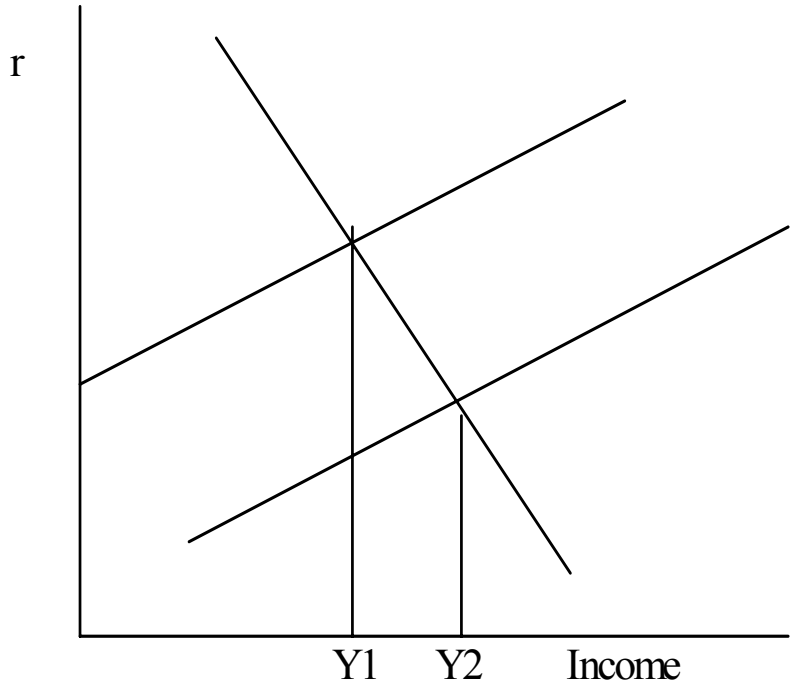
Keynesian View on Impacts of Fiscal and Monetary Policies

Keynesian view on Fiscal Policy



Fiscal policy is more effective (Flat LM)
Large output effect of fiscal policy (Steep IS)

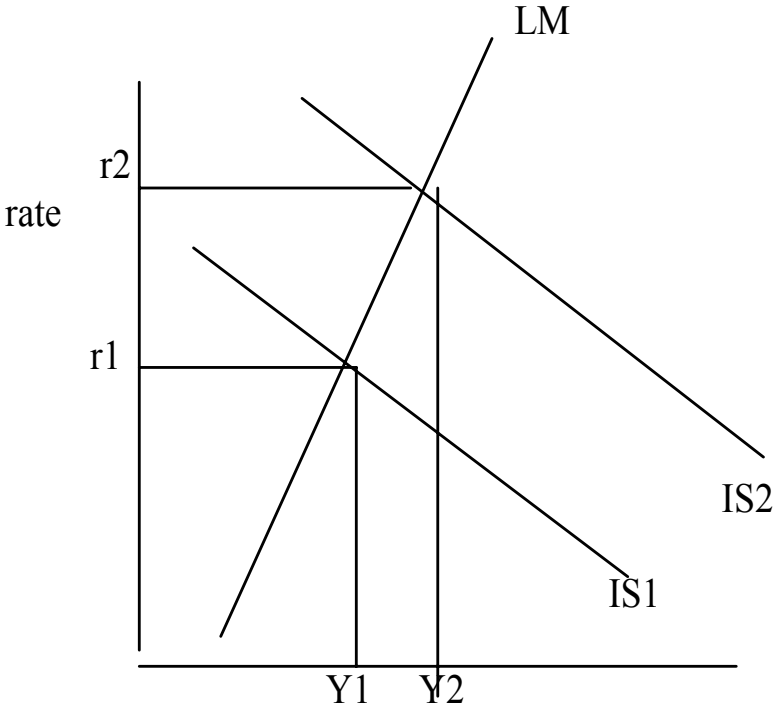
Keynesian view on Monetary Policy



Monetary policy is effective (Flat LM) and
Small output effect of Monetary policy (Steep IS)

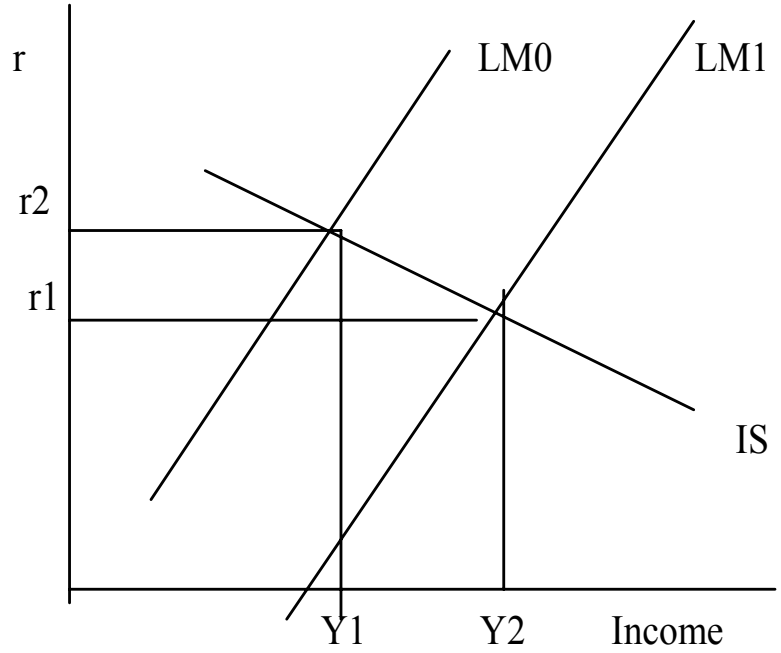
Monetarist's View on Impacts of Fiscal and Monetary Policies

Monetarist view on Fiscal Policy



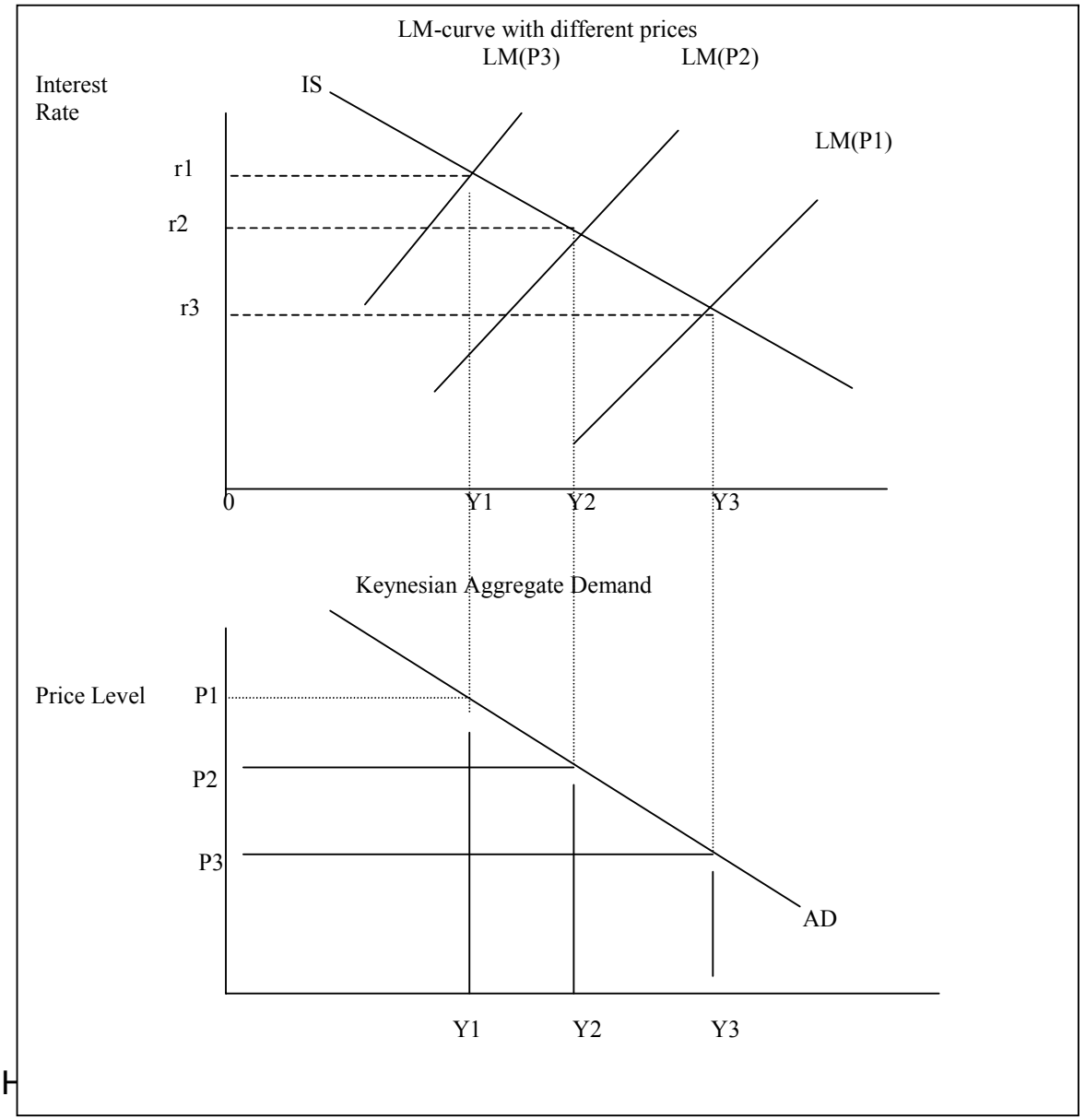
Fiscal policy is in effective (Steep LM)
Small output large interest effect of fiscal policy (Flat IS)

Monetarist view on Monetary Policy



Monetary policy is effective (Steep LM) and
Large output small interest rate effect of monetary policy (FLAT IS)

Derivation of Keynesian Aggregate Demand Curve



Derivation of AD form an ISLM Model: a Numerical Example

Supply-demand: $Y = C + I + G$ (12)

Consumption: $C = 250 + 0.75(Y - T)$ (13)

Investment: $I = 200 - 25r$ (14)

Balanced budget: $T = G = 100$ (15)

Derive IS curve:

$$Y = 250 + 0.75(Y - T) + 200 - 25r + 100 \quad (16)$$

$$Y = 1900 - 100r$$

$\frac{\partial y}{\partial r} = -100$:

a negatively sloped IS curve (17)

ISLM Model: Example 2

Money demand: $(M/P)^d = Y - 100r$;

Money supply $\overline{M} = 1000$ (18)

Money market equilibrium:

$$1000 = Y - 100r \quad (19)$$

Or $r = -10 + 0.01Y$

$$\Rightarrow \frac{\partial r}{\partial y} = 0.01 > 0$$

Positive slope of the LM (20)

Economy wide Equilibrium

It is given by the intersection point of the IS and LM curves.

$$Y = 1900 - 100r$$

or $$Y = 1900 - 100(-10 + 0.01Y)$$

$$Y = \frac{2900}{2} \rightarrow Y = 1450 \qquad (21)$$

$$r = -10 + 0.01Y \Rightarrow$$

$$r = -10 + 0.01(1450) = 4.5\% \qquad (22)$$

Impact of an Expansionary Fiscal Policy

G rises from 100 to 150

$$Y = 250 + 0.75(Y - T) + 200 - 25r + 150$$

$$0.25Y = 525 - 25r \rightarrow Y = 2100 - 100r \quad (16')$$

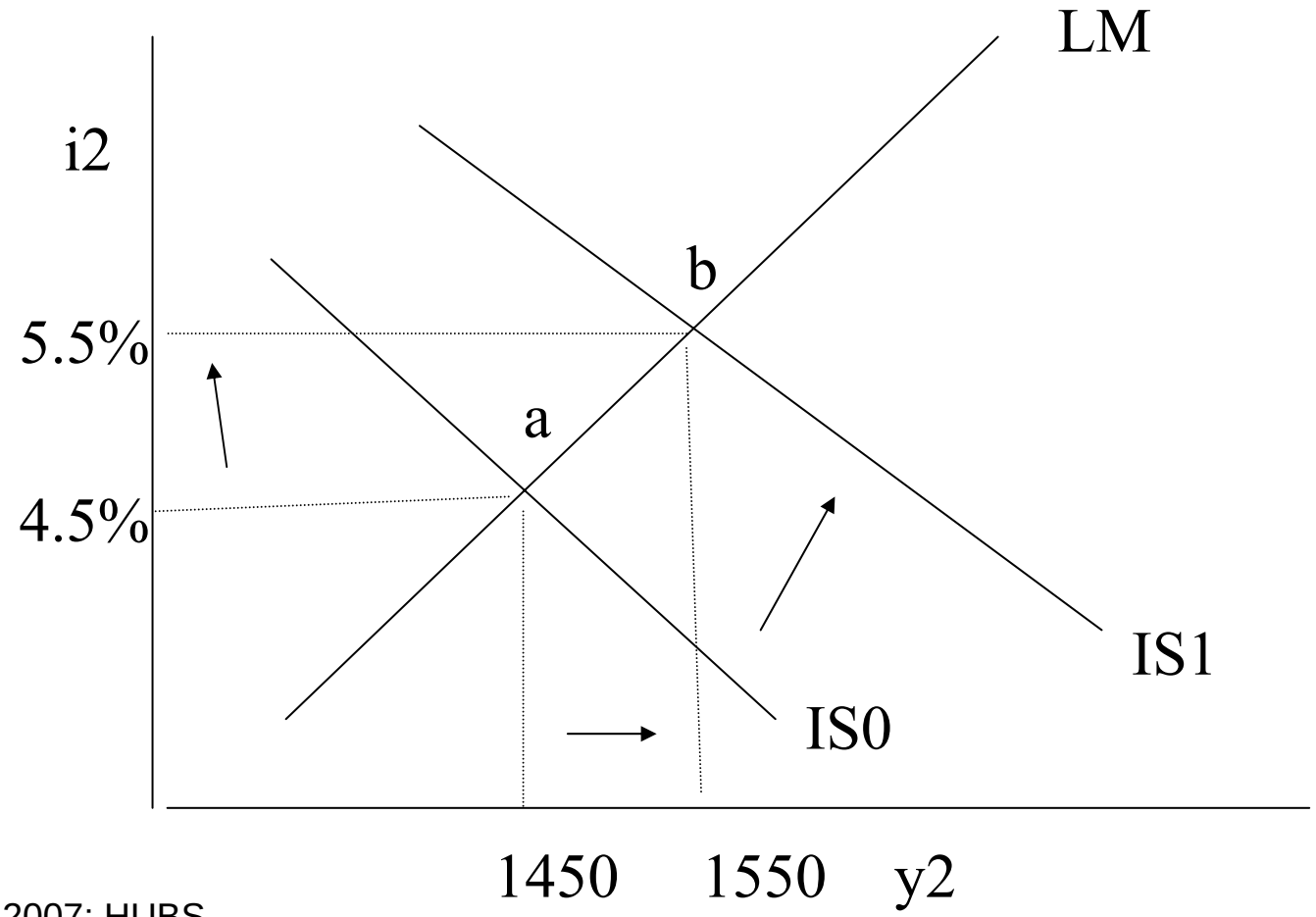
$$Y = 2100 - 100(-10 + 0.01Y) \rightarrow$$

$$Y = 3100 - Y \rightarrow Y = \frac{3100}{2} = 1550$$

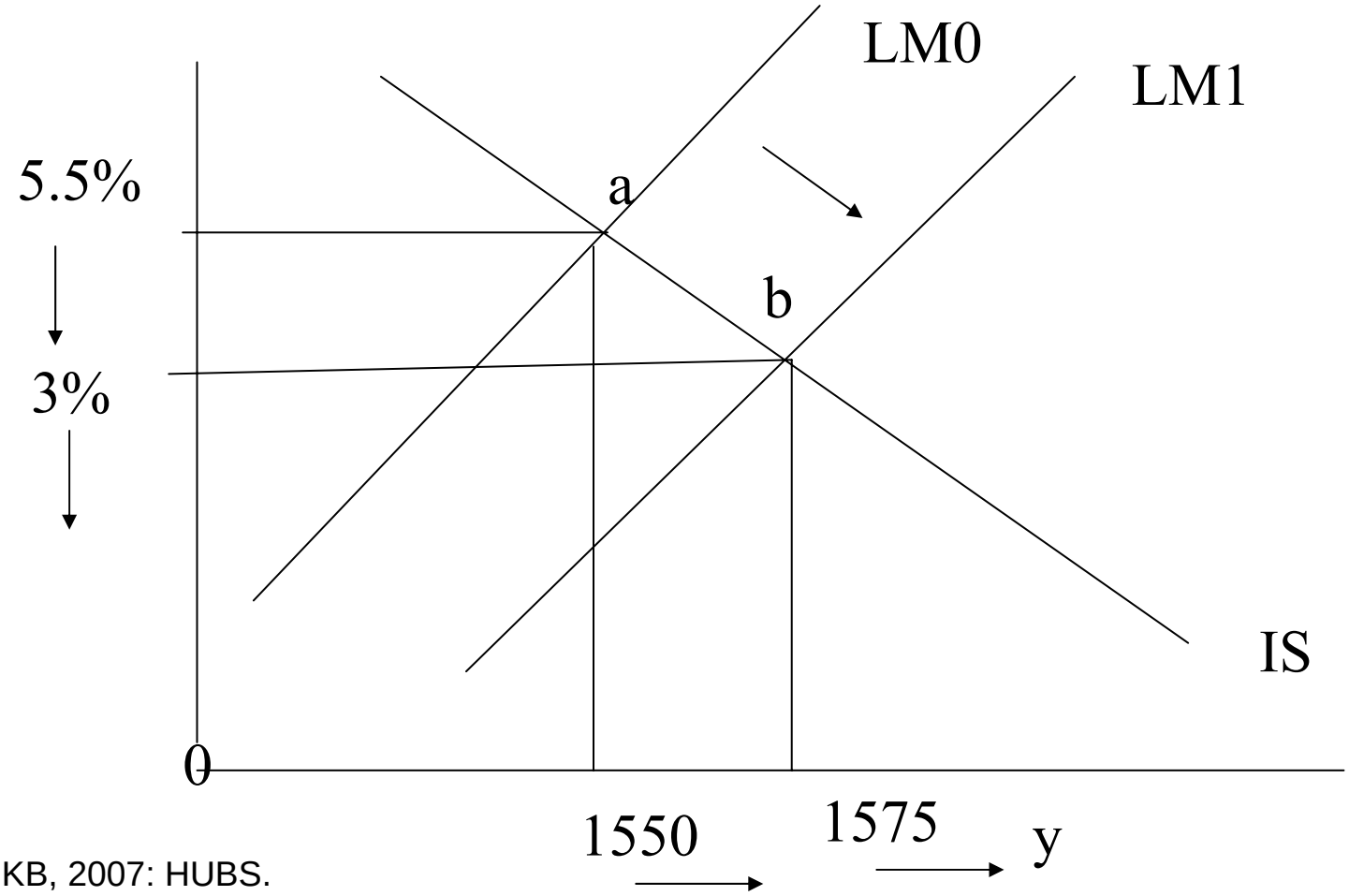
$$r = -10 + 0.01Y \rightarrow r = -10 + 0.01(1550)$$

$$\rightarrow r = 5.5\%$$

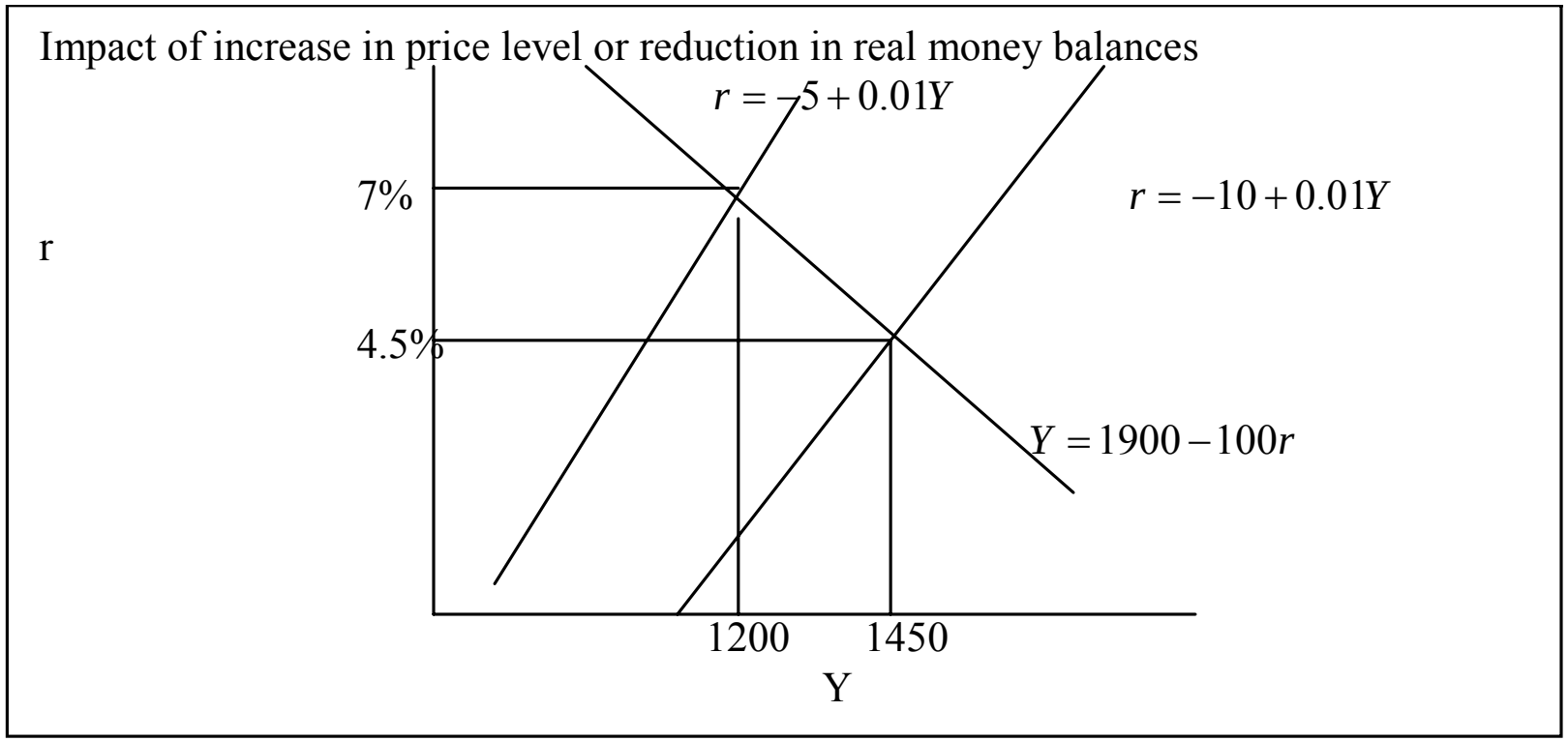
Impact of expansionary fiscal policy in the interest rate and output (G rises from 100 to 150)



Impact of an Increase in Money Supply from 1000 to 1250 on the interest rate and output



Real Balance Effect in the IS-LM Model with an increase in the price level from 1 to 2



Why is an AD Downward Sloping?

- Real balance effect (M/P)
- Interest rate effect (i)
- Exchange rate effect (£/$)
- Market expectations (Pe, Ye….)

Simulations with a basic Keynesian Model

$$C_t = \beta_0 + \beta_1 \left(Y_t - T_t \right)$$

$$I_t = \mu_0 + \mu_1 R_t + \phi \Delta Y_{t-1}$$

$$T_t = t_0 + t_1 Y_t$$

$$M_t = m_0 + m_1 Y_t + m_2 \lambda_t$$

$$C_t + T_t + S_t = Y_t = C_t + I_t + G_t + X_t - M_t$$

$$\left(T_t - G_t \right) + \left(S_t - I_t \right) = \left(X_t - M_t \right)$$

$$Y_t = \frac{\beta_0 - \beta_1 c_0 + \mu_0 - m_0 + G_t + X_t}{1 - \beta_1 + \beta_1 t_1 + m_1} + \frac{\mu_1 R_t}{1 - \beta_1 + \beta_1 t_1 + m_1} + \frac{\phi \Delta Y_{t-1}}{1 - \beta_1 + \beta_1 t_1 + m_1}$$

Parametric Specification of the Keynesian Model for Scenarios (Change one thing at a time (Excel file Keynesian1.xls))

	Parameters	Base Case	Tax cut	Spending	MPC	T &G	High X	High I	MMM
G	200	200	200	400	200	400	200	200	200
X	100	100	100	100	100	100	300	100	100
r	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
C0	300	300	300	300	300	300	300	300	300
b	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8
I0	50	50	50	50	50	50	50	200	50
d	10	10	10	10	10	10	10	10	10
t0	30	30	30	30	30	30	30	30	30
t	0.3	0.3	0.2	0.2	0.3	0.2	0.3	0.3	0.3
m0	20	20	20	20	20	20	20	20	20
m1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.4

Solutions of the Basic Keynesian Model from Keynesian1. XLS

	Y	T	C	I	G	X	M	S	T-G	X-M	S-I	Bal
Base case	876.8	293.0	767.0	49.0	200.0	100.0	239.2	-183.2	93.0	-139.2	-232.2	-139.2
Tax cut	991.8	228.4	910.8	49.0	200.0	100.0	268.0	-147.3	28.4	-168.0	-196.3	-168.0
Spending	1166.7	380.0	929.3	49.0	400.0	100.0	311.7	-142.7	-20.0	-211.7	-191.7	-211.7
MPC	971.0	321.3	884.7	49.0	200.0	100.0	262.7	-235.0	121.3	-162.7	-284.0	-162.7
T&G	1319.7	293.9	1120.6	49.0	400.0	100.0	349.9	-94.9	-106.1	-249.9	-143.9	-249.9
High X	1166.7	380.0	929.3	49.0	200.0	300.0	311.7	-142.7	180.0	-11.7	-191.7	-11.7
High I	1094.2	358.3	888.8	199.0	200.0	100.0	293.6	-152.8	158.3	-193.6	-351.8	-193.6
MMM	720.2	246.1	679.3	49.0	200.0	100.0	308.1	-205.2	46.1	-208.1	-254.2	-208.1

Keynes-Hicks IS-LM Model (Introduce Money Market)

$$\left(\frac{\overline{MM}}{P}\right)_t = b_0 + b_1 Y_t - b_2 R_t$$

$$R_t = \frac{b_0}{b_2} - \frac{1}{b_2}\left(\frac{\overline{MM}}{P}\right)_t + \frac{b_1}{b_2} Y_t$$

$$Y_t = \frac{b_2\left(\beta_0 - \beta_{10} t + \mu_0 - m_0 + G_t + X_t\right)}{\left(1 - \beta_1 + \beta_{11} t + m_1\right) b_2 - \mu_{11} b} + \frac{b_2 \phi \Delta Y_{t-1}}{\left(1 - \beta_1 + \beta_{11} t + m_1\right) b_2 - \mu_{11} b} + \frac{b_2 \mu_1}{\left(1 - \beta_1 + \beta_{11} t + m_1\right) b_2 - \mu_{11} b}\left[\frac{b_0}{b_2} - \frac{1}{b_2}\left(\frac{\overline{MM}}{P}\right)_t\right]$$

$$R_t = \frac{b_0}{b_2} - \frac{1}{b_2}\left(\frac{\overline{MM}}{P}\right)_t + \frac{b_1}{b_2}\left[\frac{b_2\left(\beta_0 - \beta_{10} t + \mu_0 - m_0 + G_t + X_t\right)}{\left(1 - \beta_1 + \beta_{11} t + m_1\right) b_2 - \mu_{11} b} + \frac{b_2 \phi \Delta Y_{t-1}}{\left(1 - \beta_1 + \beta_{11} t + m_1\right) b_2 - \mu_{11} b} + \frac{b_2 \mu_1}{\left(1 - \beta_1 + \beta_{11} t + m_1\right) b_2 - \mu_{11} b}\left[\frac{b_0}{b_2} - \frac{1}{b_2}\left(\frac{\overline{MM}}{P}\right)_t\right]\right]$$

Parameters of the IS-LM Model

beta0	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	22114.16
beta1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.6	0.9	0.459078
mu0	500	500	500	500	500	500	1000	500	500	500	105457
m0	100	100	100	100	100	100	100	100	100	100	-65167
t0	200	500	200	500	200	200	200	200	200	200	-201384
t1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.476403
m1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	1.387408
mu1	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1720.051
phi	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
G	20000	20000	25000	25000	20000	20000	20000	20000	20000	20000	155880
X	8000	8000	8000	8000	8000	8000	8000	10000	10000	8000	289225
y0	500	500	500	500	500	500	500	500	500	500	500
b0	800	800	800	800	800	800	800	800	800	800	-78809
b1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.333992
b2	300000	300000	300000	300000	300000	600000	300000	300000	300000	300000	-1829.75
M4	10000	10000	10000	10000	15000	10000	10000	10000	10000	10000	10000
P	1	1	1	1	1	1	1	1	1	1	1

Solution of the IS-LM Model

	R	Y	C	I	G	T	M	X	S	X-M	S-I	T-G
Base case	0.0251	66901	51968	525	20000	20270	13480	8000	-5337	-5480	-5862	270
More Tax	0.024	65640	50453	524	20000	20692	13228	8000	-5505	-5228	-6029	692
More Spending	0.0324	75660	57486	532	25000	22898	15232	8000	-4724	-7232	-5256	-2102
Tax and Spend	0.032	75187	56918	532	25000	23056	15137	8000	-4787	-7137	-5319	-1944
More money supply	0.0084	66872	51949	508	20000	20262	13474	8000	-5339	-5474	-5847	262
More Sensitive Asset demand	0.0126	66977	52015	513	20000	20293	13495	8000	-5332	-5495	-5844	293
More investment	0.026	67777	52519	1026	20000	20533	13655	8000	-5276	-5655	-6301	533
More Exports	0.028	70405	54175	528	20000	21321	14181	10000	-5092	-4181	-5620	1321
Low MPC	0.01	48985	30454	510	20000	14896	9897	8000	3636	-1897	3126	-5104
High MPM	0.017	56928	45685	517	20000	17278	17178	8000	-6035	-9178	-6552	-2722

Keynes- Hicks-Samuelson Multiplier-accelerator model (Samuelson (1939))

Market Clearing $$Y_t = C_t + I_t + G_0$$

Consumption $$C_t = \gamma Y_{t-1} \qquad 0 < \gamma < 1$$

Investment $$I_t = \alpha\left(C_t - C_{t-1}\right) \qquad \alpha > 0$$

Equilibrium $$Y_t = \gamma\left(1+\alpha\right)Y_{t-1} - \alpha\gamma Y_{t-2} + G_0$$

Steady State $$\bar{Y} = \frac{G_0}{1-\gamma\left(1+\alpha\right)+\alpha\gamma} = \frac{G_0}{1-\gamma}$$

$Y_t = Y_{t-1} = Y_{t-2} = \bar{Y}$

EM: KB, 2007: HUBS.

Transitional Dynamics (Business Cycle)

$$Y_t - \gamma(1+\alpha)Y_{t-1} + \alpha\gamma Y_{t-2} = 0$$

Assume $Y_t = Ab^t$

$$Ab^t - \gamma(1+\alpha)Ab^{t-1} + \alpha\gamma Ab^{t-2} = 0$$

$$b^{t+2} - \gamma(1+\alpha)b^{t+1} + \alpha\gamma b^t = 0$$

$$b_1, b_2 = \frac{\gamma(1+\alpha) \pm \sqrt{\gamma^2(1+\alpha)^2 - 4\alpha\gamma}}{2}$$

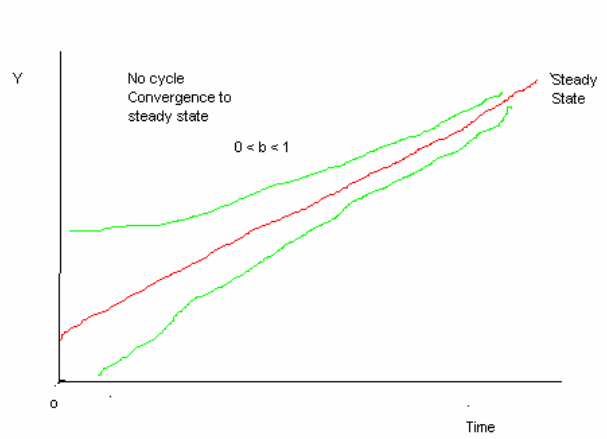
$$Y_t = A_1 b_1^t + A_2 b_2^t$$

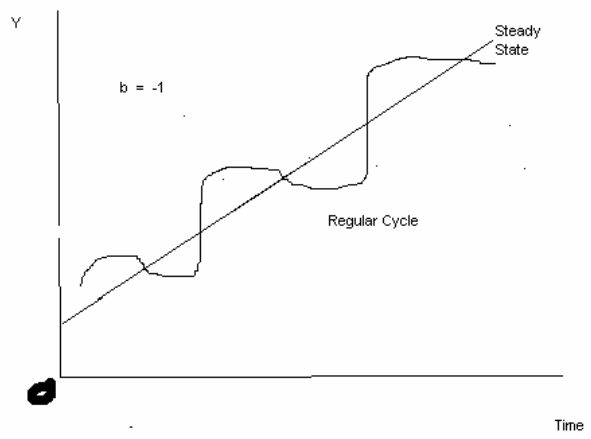
Three cases:

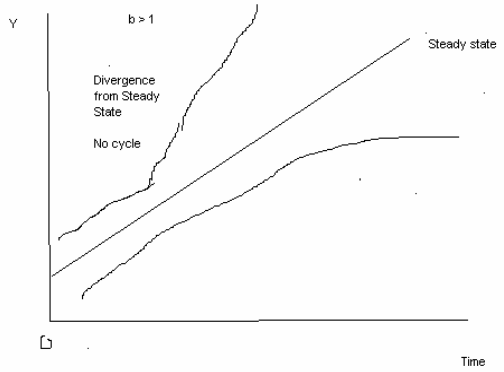
Distinct real roots: $\gamma^2(1+\alpha)^2 > 4\alpha\gamma$ No cycle

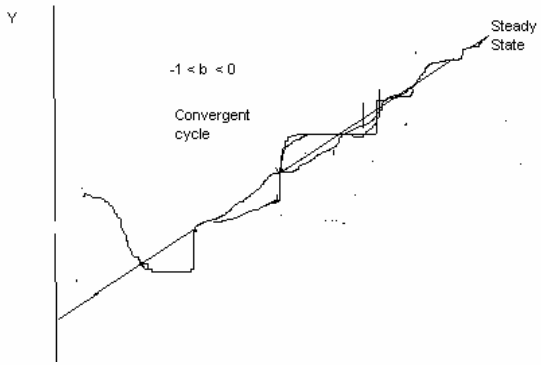
Repeated real root: $\gamma^2(1+\alpha)^2 = 4\alpha\gamma$ No cycle

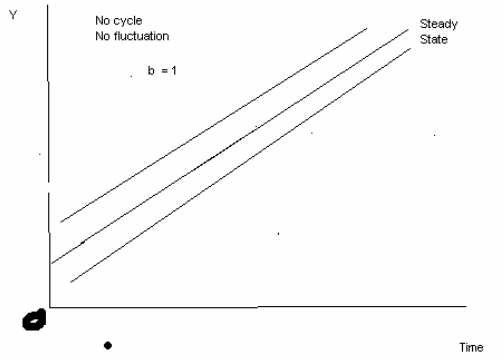
Complex root: $\gamma^2(1+\alpha)^2 < 4\alpha\gamma$ Fluctuation, cycles

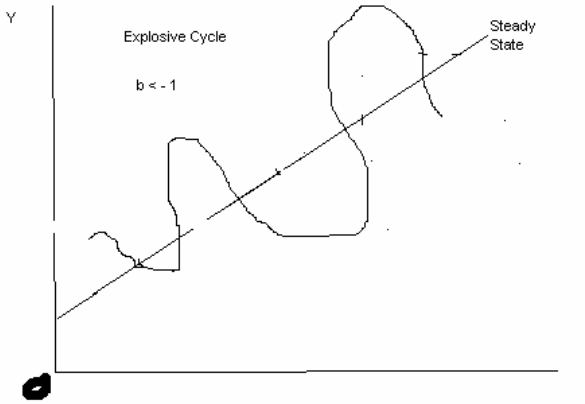






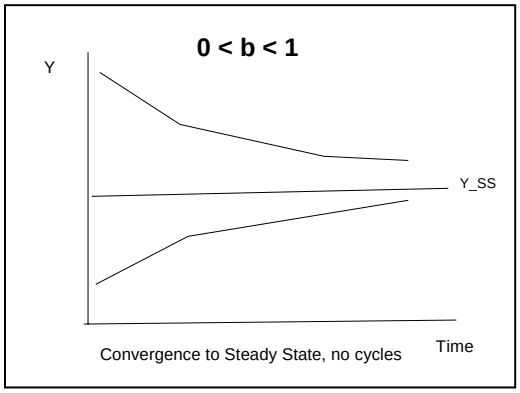


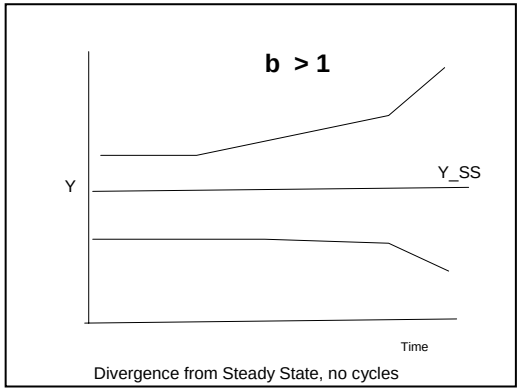


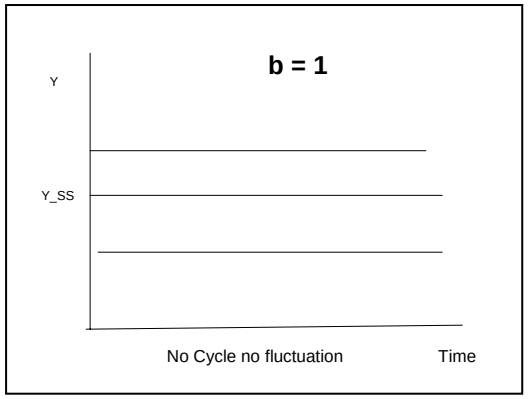


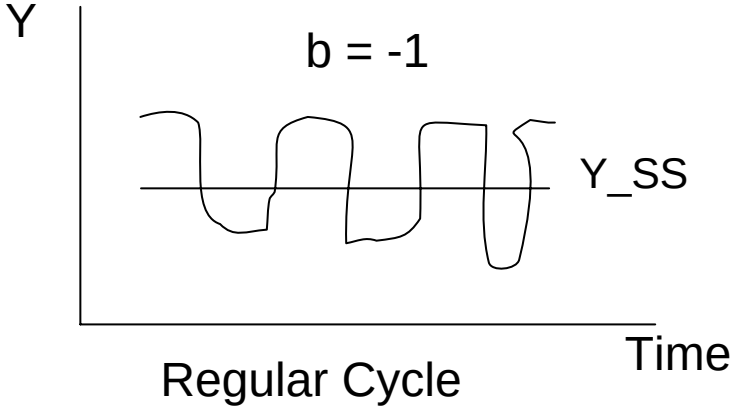
Steady State with Trend Growth and Various Possibilities of Fluctuations

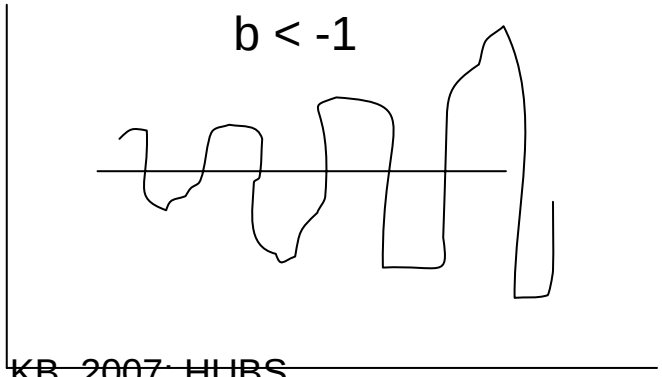
Steady State without Trend Growth and Various Possibilities of Fluctuations

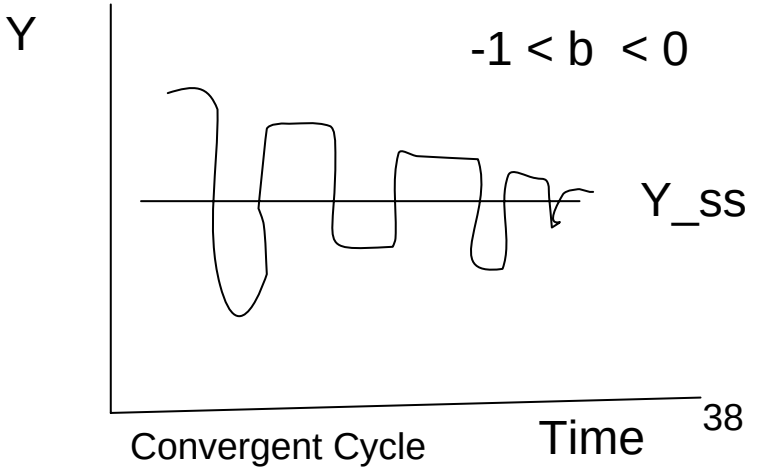




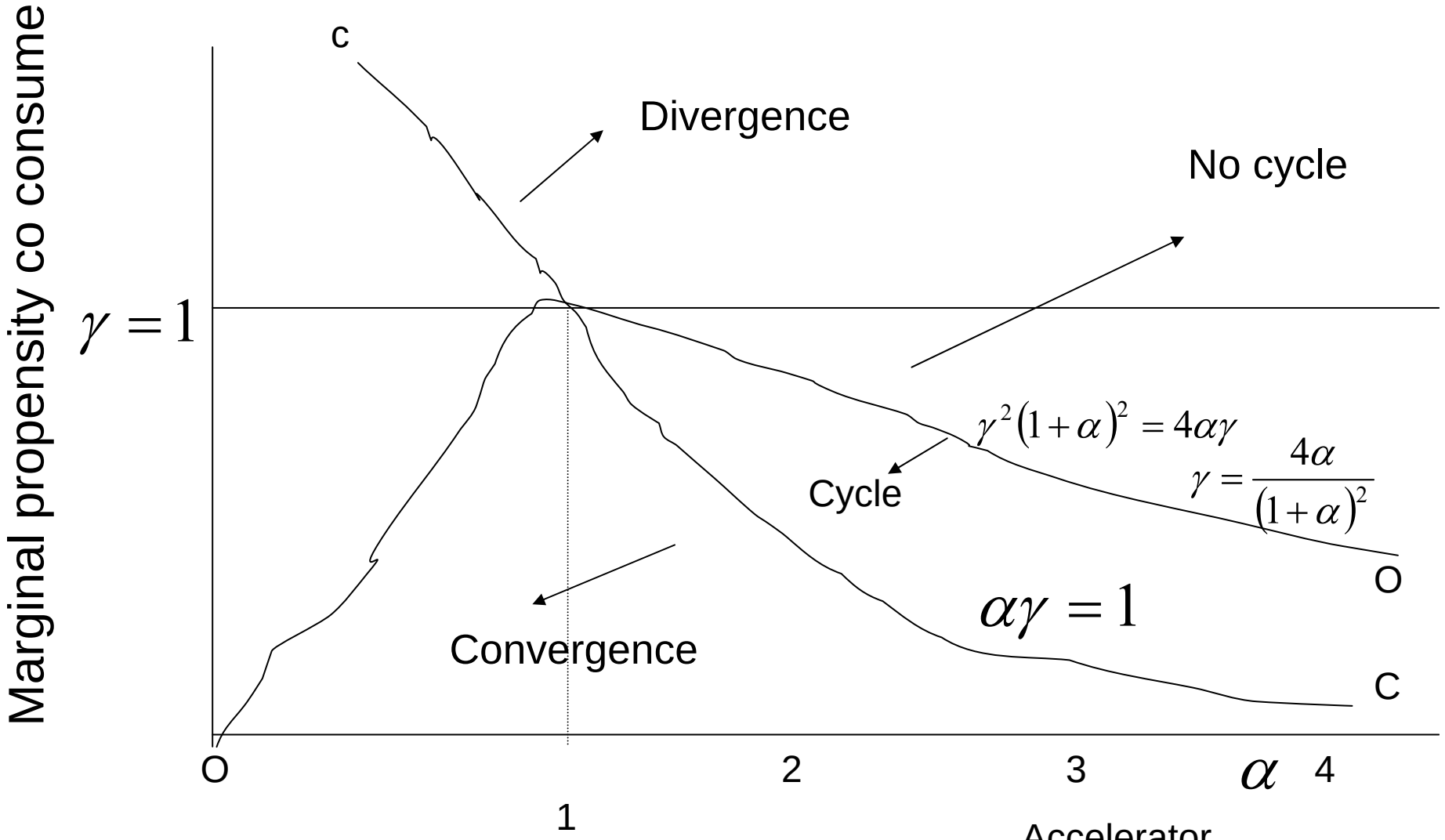








Convergence or divergence , cycle or no cycle



$$Y_t = A_1 R^t\left(\cos\theta \cdot t + i\sin\theta \cdot t\right) + A_2 R^t\left(\cos\theta \cdot t - i\sin\theta \cdot t\right)$$

Issues of an Open Economy

- What is the link between budget deficit and trade imbalance and money supply?
- How do fiscal, monetary and the exchange rate policies affect output and employment in an economy?
- Exchange rates, inflow and outflow of capital?
- Is huge imbalance in trade be a problem?
- What is the best exchange rate system? fixed or flexible exchange rate system?
- What are the golden rules of fiscal, monetary and exchange rate policies?

Mundell-Flemming Type Small Open Economy Macroeconomic Model

National income

$$Y = C(Y-T) + I(Y, i-\pi^e) + G + NX(Y, Y^f, \frac{eP^*}{P}) \quad (1)$$

Money market: $$\frac{M}{P} = L(i, Y) \quad (2)$$

Real and nominal interest rates: $$i = r + \pi^e \quad (3)$$

Real exchange rate: $$\varepsilon = \frac{eP^*}{P} \quad (4)$$

Balance of payment: $$NX = KF(r - r^*) \quad (5)$$

Aggregate supply: $$Y = \bar{Y} + \alpha(P - P^e) \quad (6)$$

Natural rate of output: $$\bar{Y} = F(\bar{K}, \bar{L}) \quad (7)$$

Variables in the Model

Endogenous variables

Y, i, r, ε , P, e $\bar{Y}$

Exogenous Variables

T, G, M, π^e , P*, r*, P^e , $\bar{K}$, $\bar{L}$ and Y^f

Y= output $\bar{Y}$ natural rate of output
i = nominal interest rate r = real interest rate
ε = real exchange rate P = price level,
e = nominal exchange rate.
T = tax rate
G =government expenditure M = imports,
P* = foreign price level r* foreign interest rate
, $\bar{K}$ = capital stock, $\bar{L}$ = labour force, and
Y^f = foreign income P^e = expected domestic

A Numerical Example of the Small Open Economy Model

$$Y = C(Y - T) + I(i - \pi) + G + NX(Y, Y^f, \lambda)$$

$$C = 200 + 0.8(Y - T)$$

$$I = 50 - 200(i - \pi)$$

T =100 G = 100

$$NX = 10 + 0.3Y^f - 0.1Y - 20\lambda$$

$$\lambda = \frac{EP^*}{P}$$

$$\frac{M}{P} = 200 - 50i + 0.5Y$$

$$i = i^* = 5\% \qquad \pi = 0.03$$

Solutions of the Numerical Example of the Small Open Economy Model

$$Y = 200 + 0.8(Y - T) + 50 - 200(i - \pi) + G + 10 + 0.5Y^{f} - 0.1Y - 20\lambda$$

$$Y = \frac{384}{0.3} = 1280$$

$$C = 200 + 0.8(1280 - 100) = 200 + 944 = 1144$$

$$I = 50 - 20(0.05 - 0.03)$$

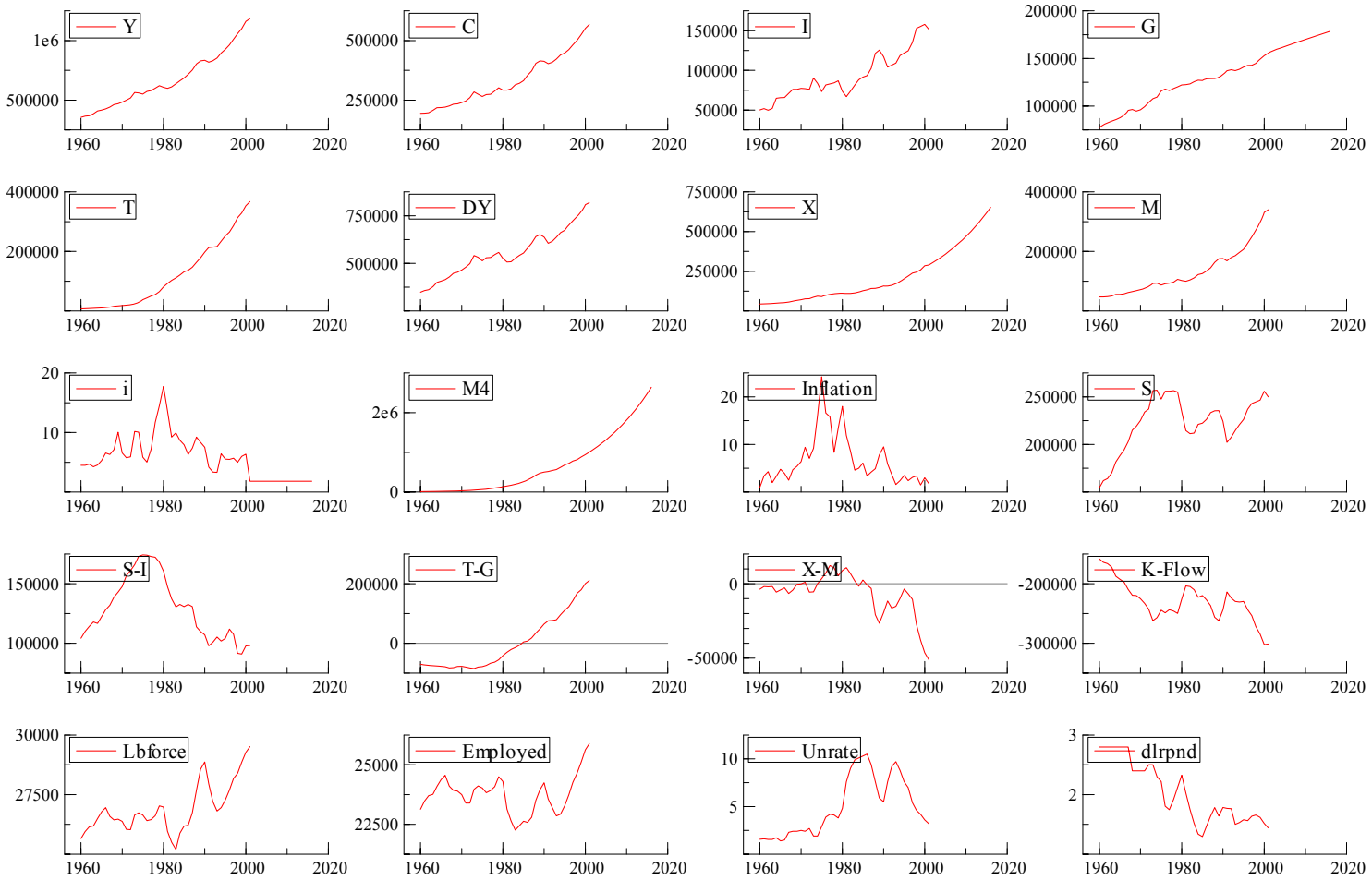
S = Y-T-C = 1280 - 100-1144= 36

$$NX = -10 + 0.3(500) - 0.1(1280) - 20(2)$$

$$NX = 10 + 150 - 128 - 40 = -8$$

$$(T - G) + (S - I) = NX \qquad (100 - 100) + (36 - 44) = -8$$

Macroeconomic Time Series of the UK,1960-2000



EM: KB, 2007: HUBS.

3SLS Estimation of Reduced form of a Keynesian Model

Consumption function C = 1.407*G + 0.1767*X + 0.2128*M4 + 8.059e+004
(SE) (0.212) (0.154) (0.0266) (1.63e+004)

Investment function: I = 0.0684*G + 0.2681*X + 0.02907*M4 + 4.292e+004
(SE) (0.182) (0.132) (0.0229) (1.4e+004)

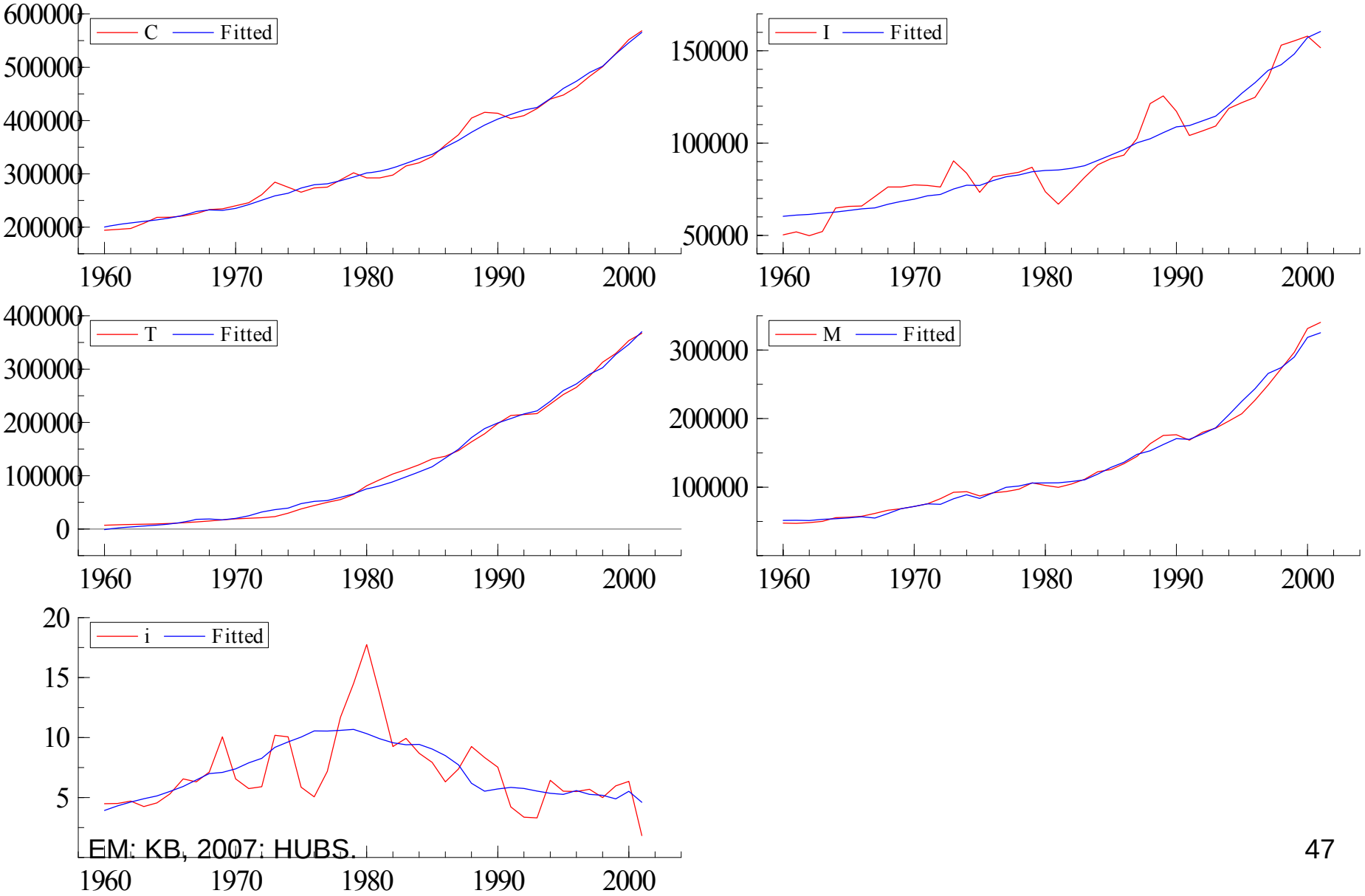
Tax Reveneu: T = + 0.9521*G - 0.08909*X + 0.3204*M4 - 7.533e+004
(SE) (0.159) (0.116) (0.02) (1.23e+004)

Import function: M = - 0.4738*G + 1.003*X + 0.06508*M4 + 4.34e+004
(SE) (0.157) (0.114) (0.0198) (1.21e+004)

Interest rate: i = 0.0001148*G + 6.273e-005*X - 2.384e-005*M4 - 7.408
(SE) (4.93e-005) (3.58e-005) (6.2e-006) (3.79)

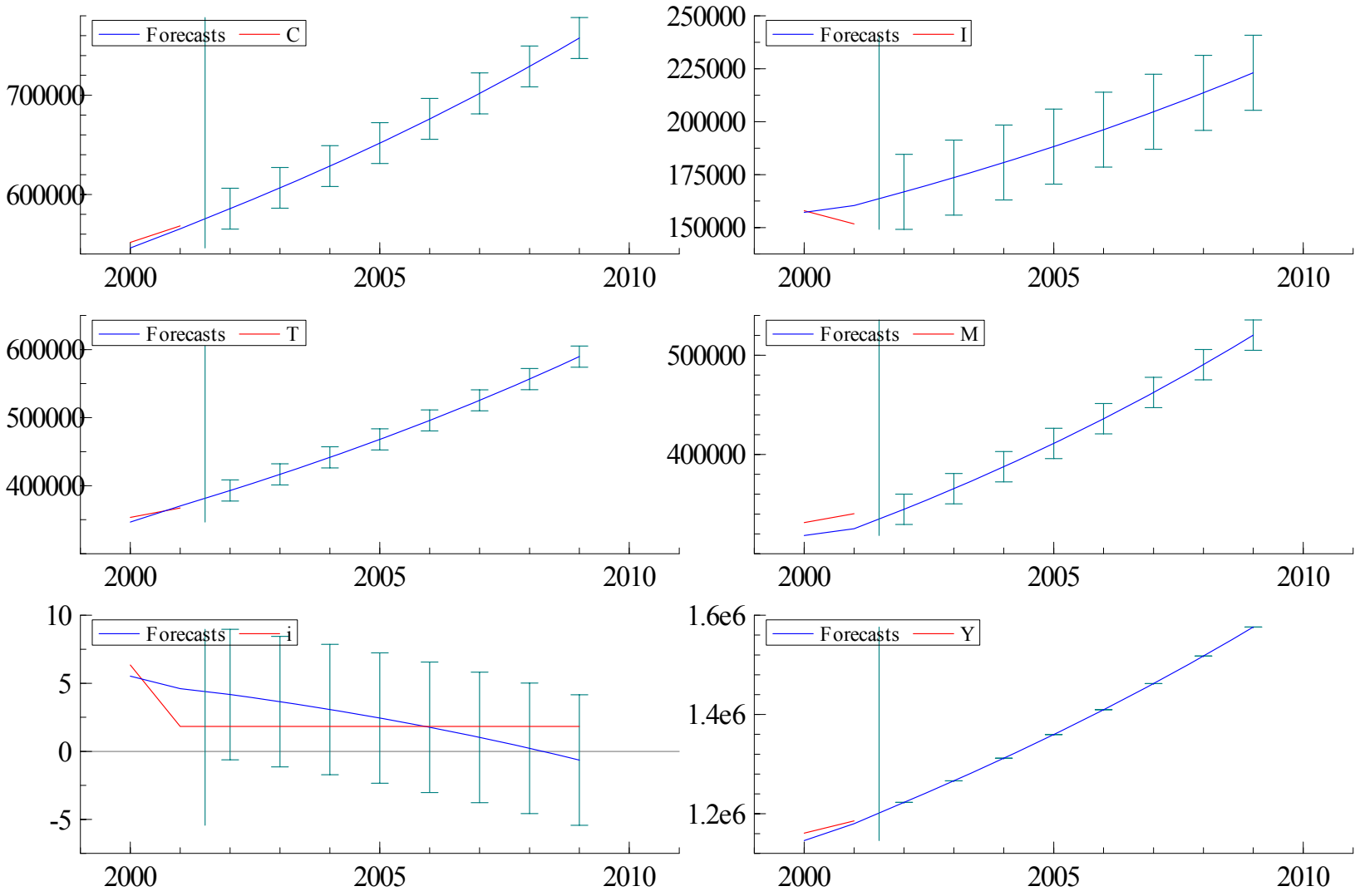
log-likelihood -1798.42246 -T/2log|Omega| -1500.44537
no. of observations 42 no. of parameters 20

Fit of the Simultaneous Equation Model



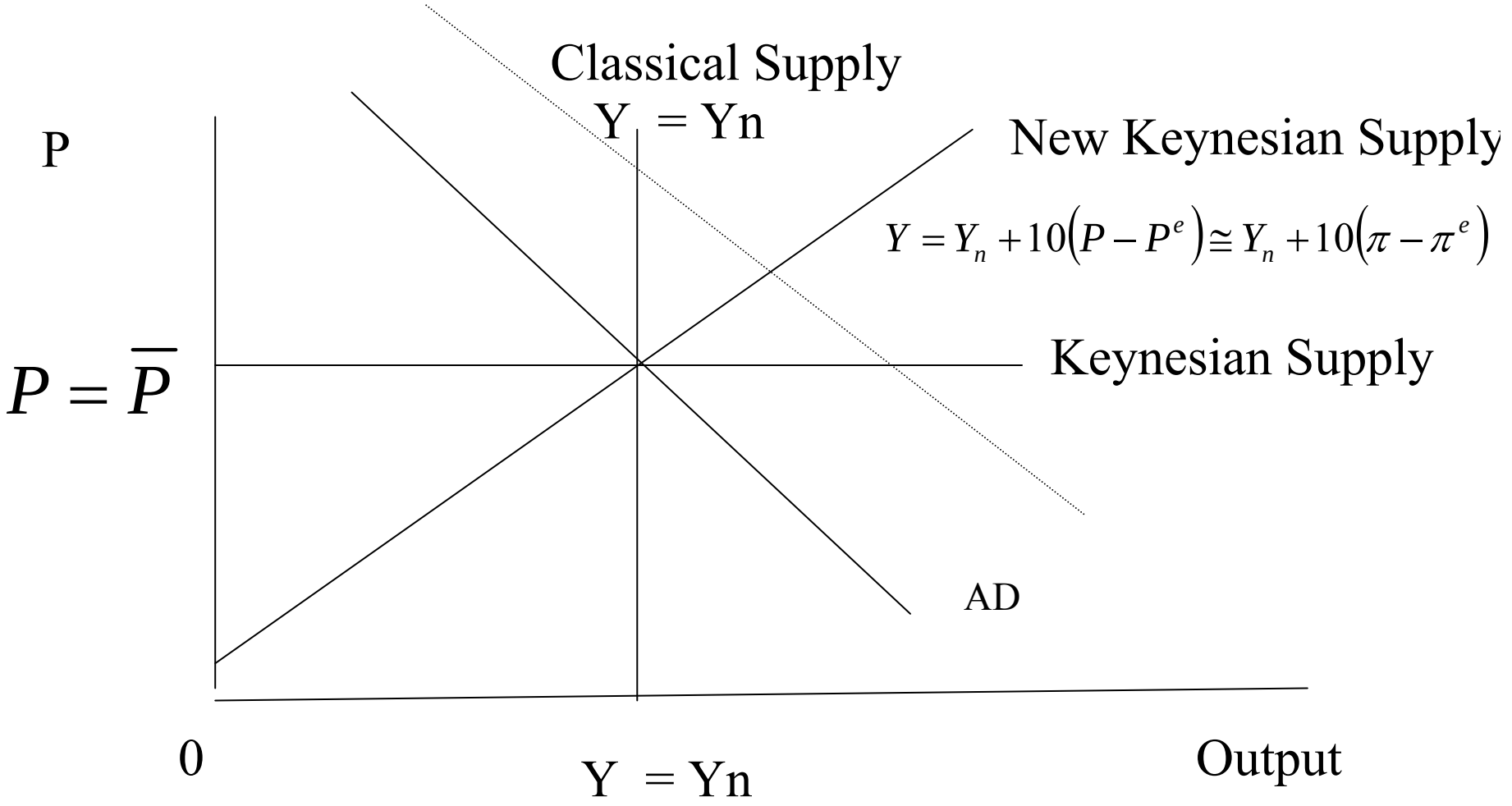
EM: KB, 2007; HUBS.

Ex-Ante Forecast of the Model Economy



EM: KB, 2007: HUBS.

Classical, Keynesian and New Keynesian Aggregate Supply curves



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Lists of my papers (drafts) in macro issues (http://www.hull.ac.uk/php/ecskrb)

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- Interest Determination Rule four UK and Other Four Major Industrial Economies a *Research Memorandum* no. 42 Business School, University of Hull, forthcoming in Applied Financial Economics.