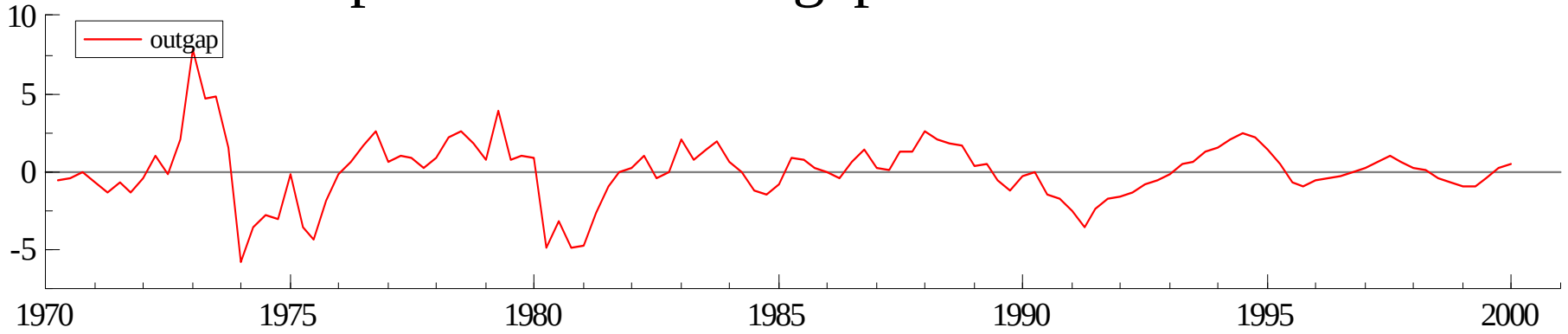
An Analysis of Interest Rate Determination Rule in the UK and Four Other Leading Economies

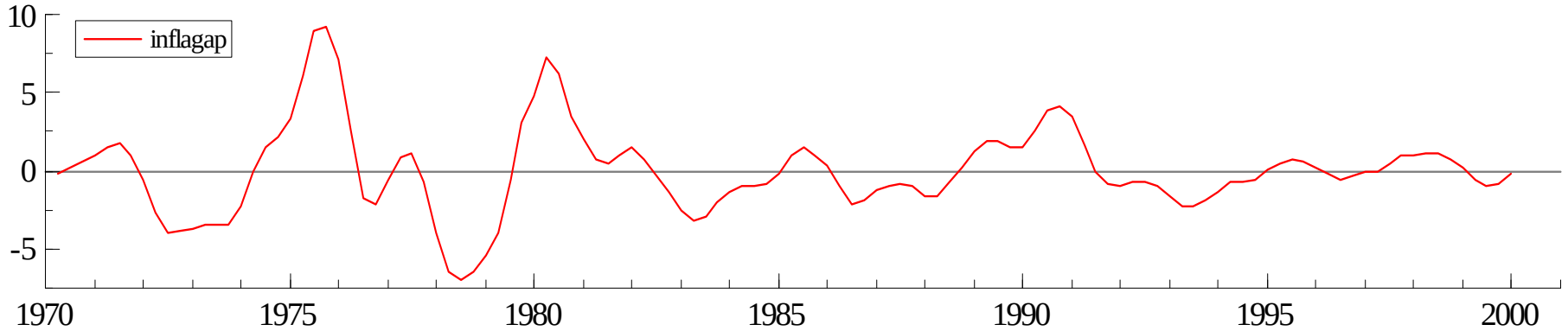
Dr. Keshab R Bhattarai

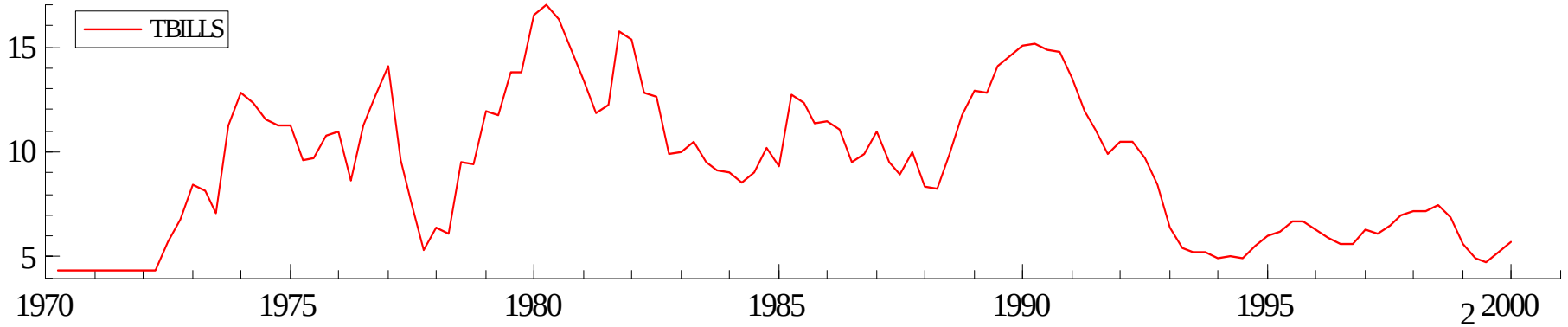
University of Hull

March 2004

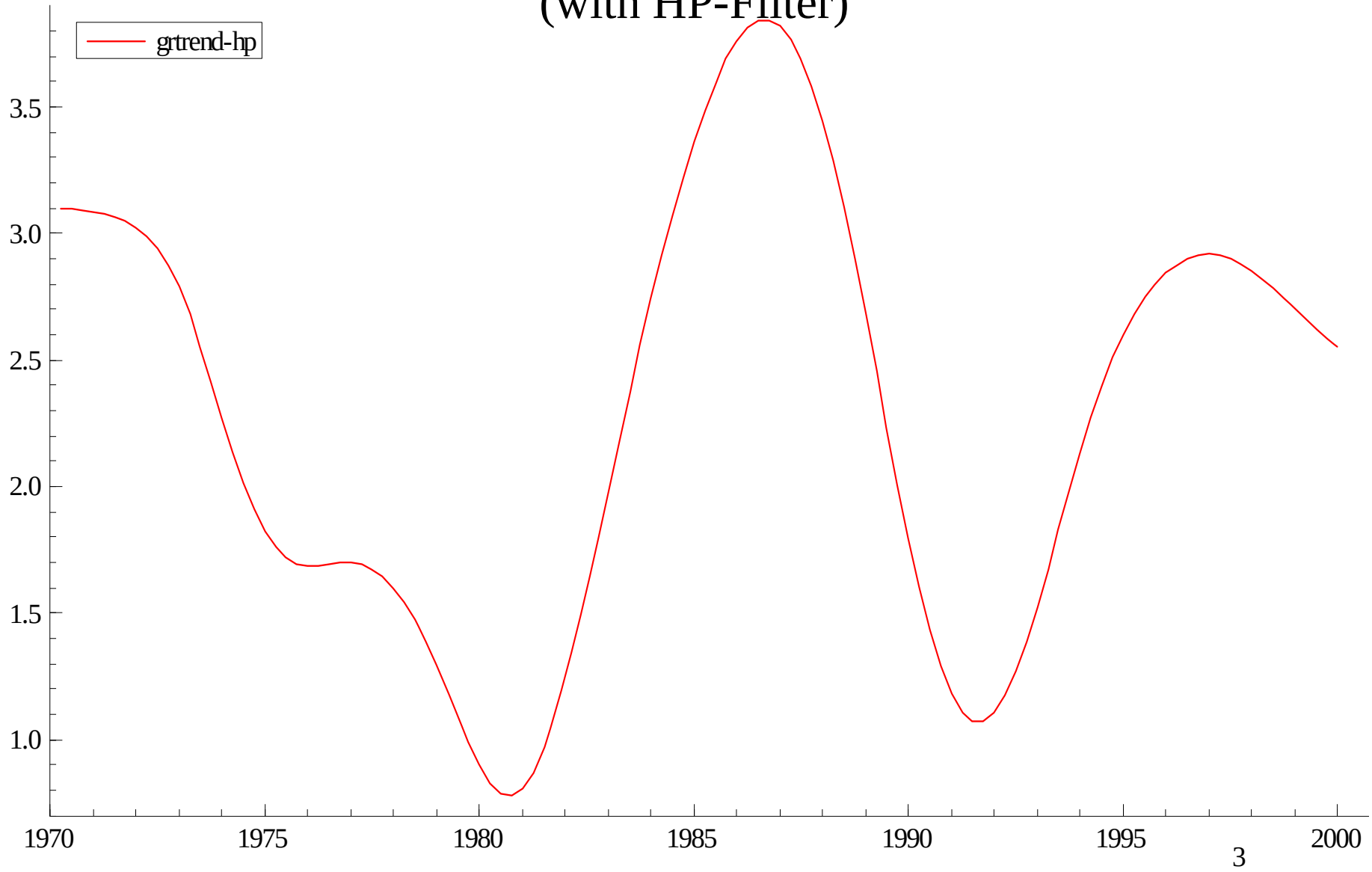
Question: Is there any systematic link between output and inflation gaps and the interest rate?



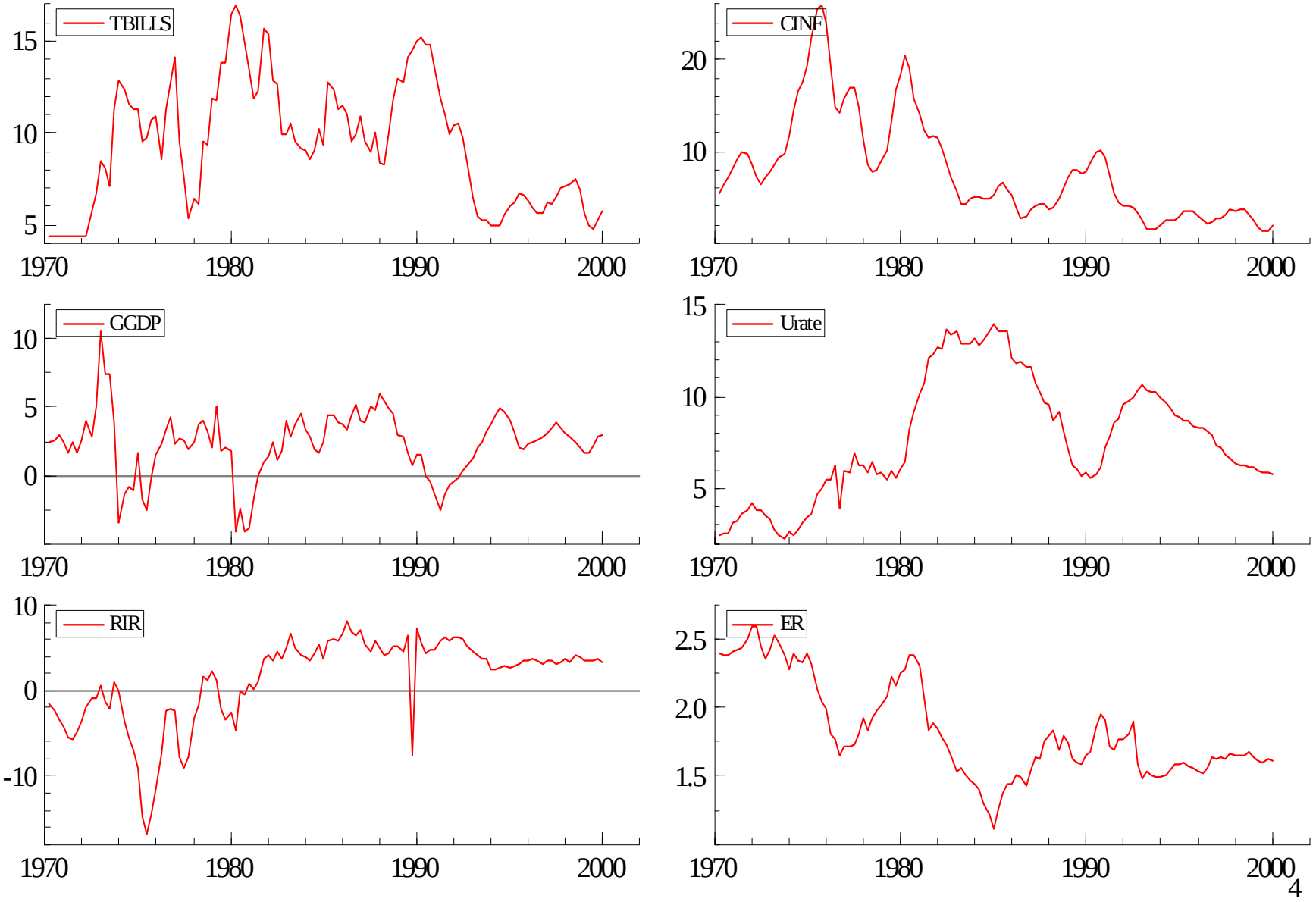




Does Changes in the interest remove fluctuations in output?
Quarterly Trend Growth Rate in the UK:1970:2-2000:1
(with HP-Filter)

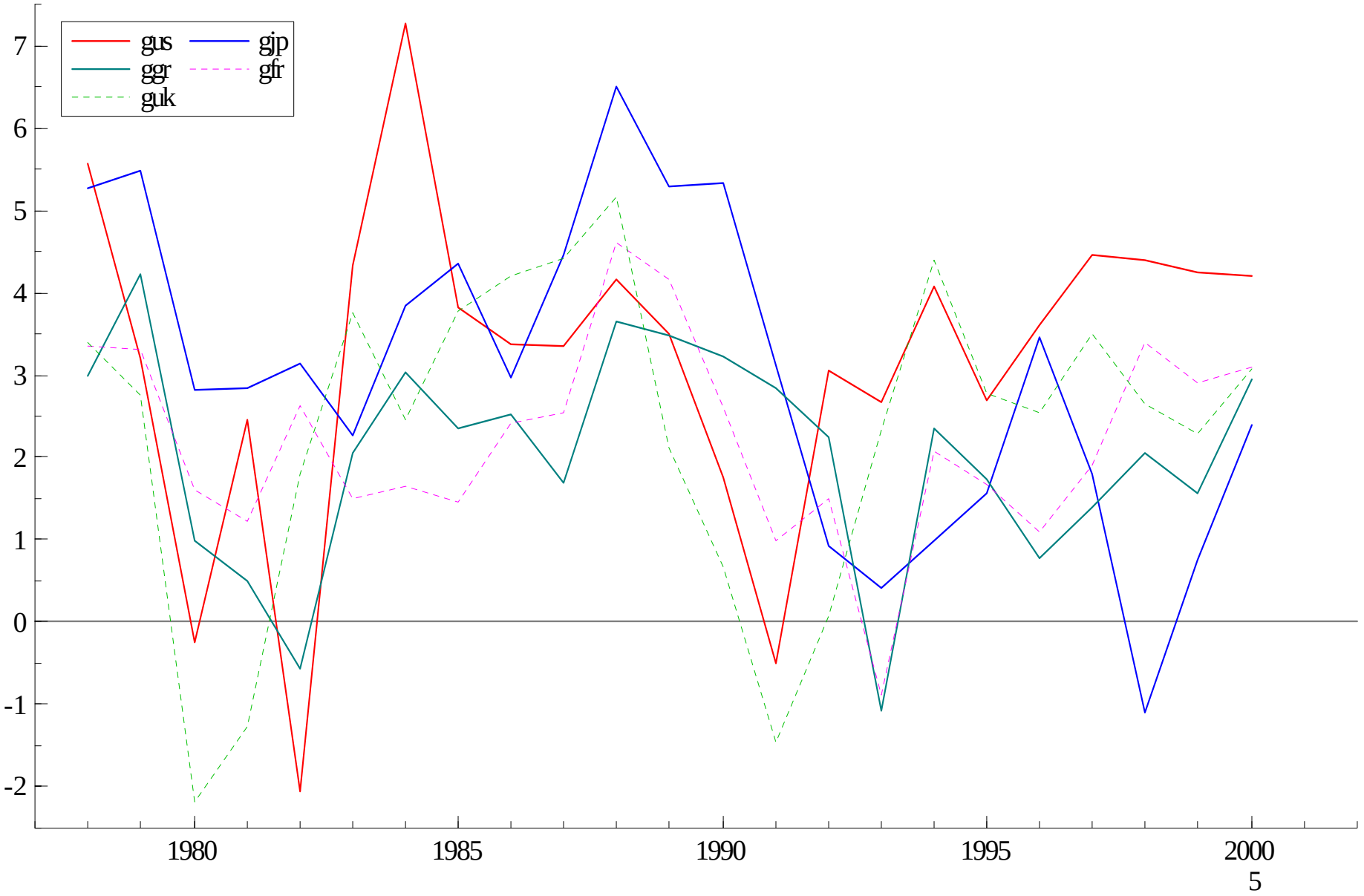


Interest Rate, Inflation, Growth Rate, Unemployment and Exchange Rate in the UK 1970:2-2000:1

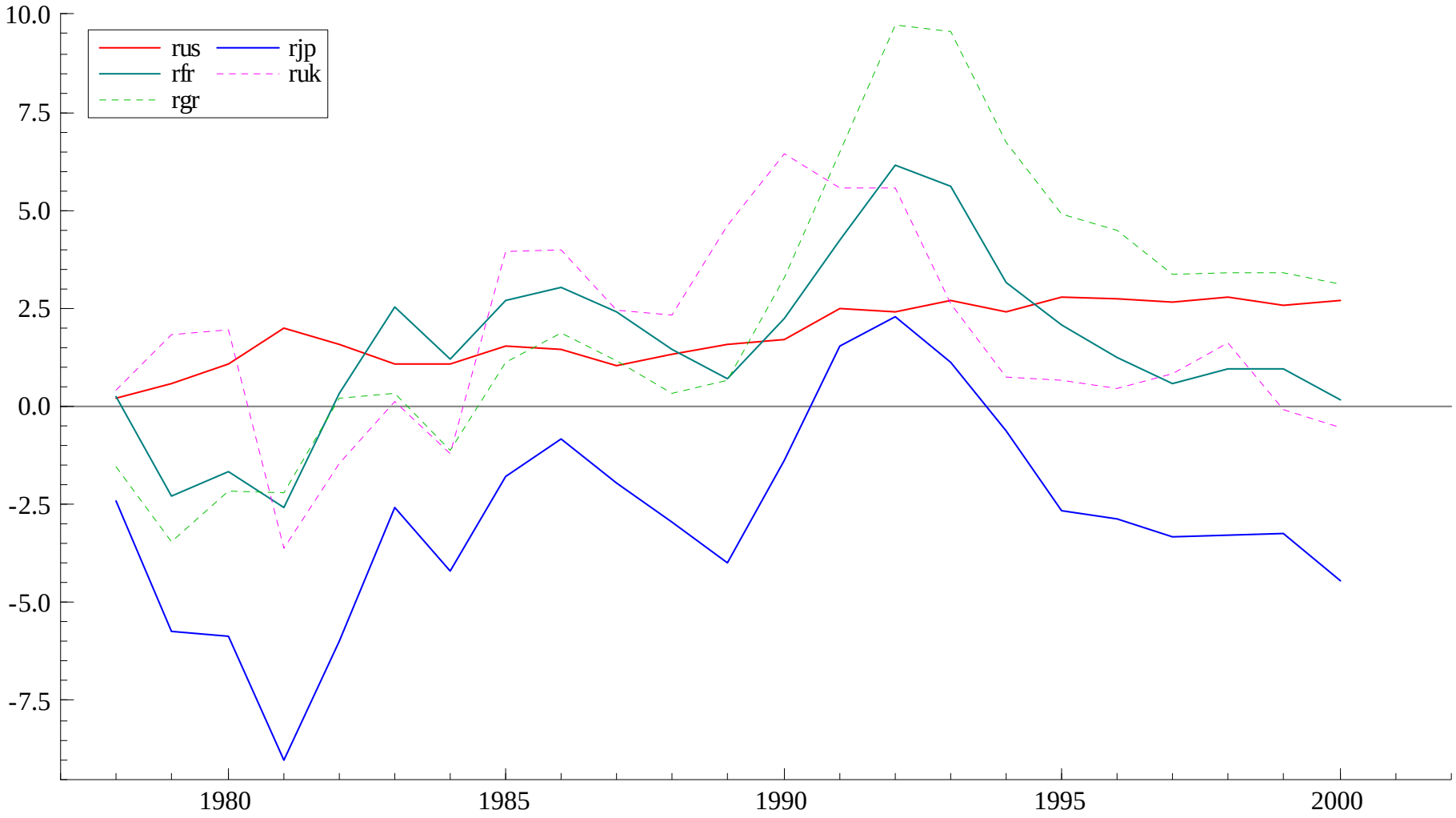


Source: Office of National Statistics. Navidata

Growth Rate of Output in Germany, France, Japan, UK and the US

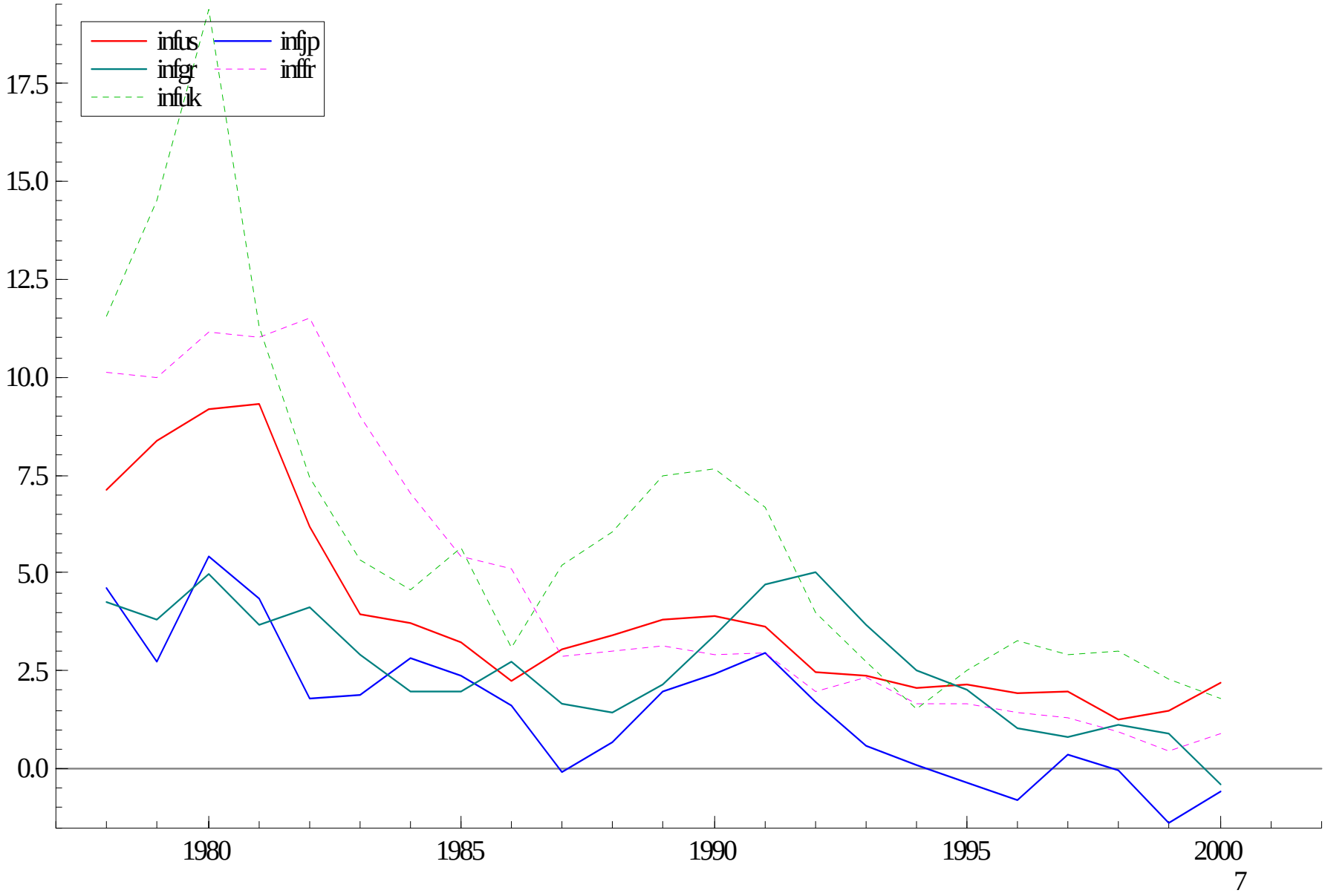


Real Interest Rate in Germany, France, Japan, UK and the US



Source: World Bank CD Database

Inflation Rate in Germany, France, Japan, UK and the US



Background Literature

General Literature on Role of Money in the Economy

Keynes (1936), Hicks (1937), Bailey(1956) Phillips (1958), Friedman (1968), Phelps (1968),Tobin (1969)) Taylor (1972). Taylor (1993), Laidler and Parkin (1975) Kydland and Prescott (1977), Phelps and Taylor (1977) Aghevli (1977), Gordon (1983), Barro and Gordon (1983), Sargent (1986) Goodhart (1989), Nickell (1990), Buiter and Patel (1992), Ball and Romer (1990) Dornbusch (1992), MPC (1999), Lockwood Miller and Zhang (1998), MPC (1999).

Natural Rate of Unemployment Hypothesis

Friedman (1968), Phelps (1968)

Research in Time Inconsistency, Policy Co-ordination and

Time inconsistency

Kydland and Prescott (1977), Phelps and Taylor (1977), Gordon (1983), Barro and Gordon (1983)
Lockwood Miller and Zhang (1998), Rogoff (1985), Miller and Salmon (1985)),

Policy Co-ordination at National and International Level

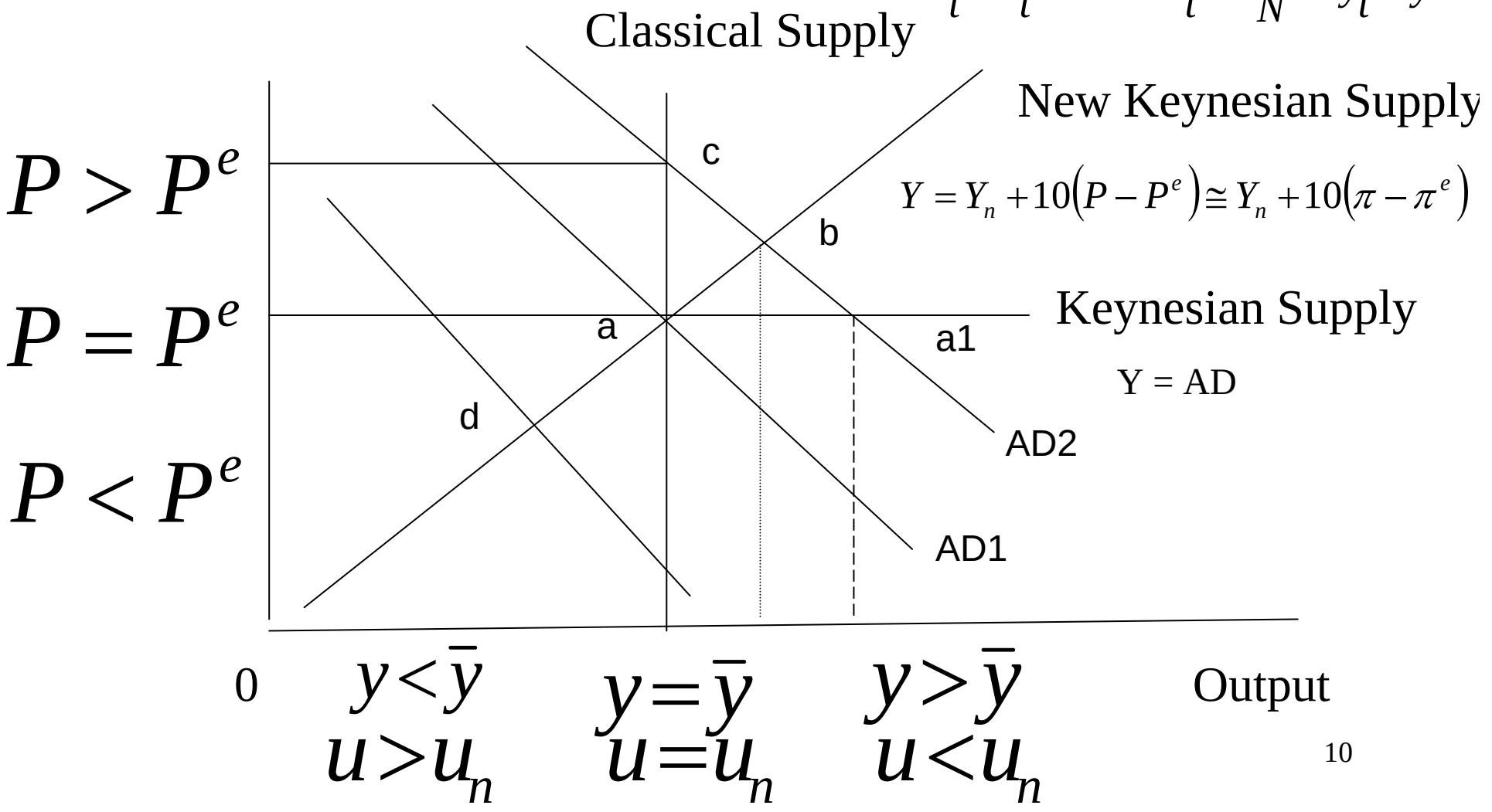
Krugman (1979), Barro and Gordon (1983), Canzoneri M. B. and J A Gray (1985), Cukierman (1994), Goodhart (1994), Nardhaus (1994) Eijffinger SCW and J.D. Haan (2000)

Money in General Equilibrium

Tobin (1969) Altig D E, C.T. Carlstrom and K.L. Lansing (1995), Lockwood Miller and Zhang (1998), Holly and Weale (2000), Corsetti and Pesenti (2001), Benigno(2002)

Classical, Keynesian and New Keynesian Aggregate Supply curves

$$P_t > P_t^e \Rightarrow u_t < u_N \Rightarrow y_t > \bar{y}$$
$$P_t < P_t^e \Rightarrow u_t > u_N \Rightarrow y_t < \bar{y}$$
$$P_t = P_t^e \Rightarrow u_t = u_N \Rightarrow y_t = \bar{y}$$



Main Points on Interest Determination Rule

- Higher interest rate is contractionary. Effect of interest rate in output is felt after some lag.

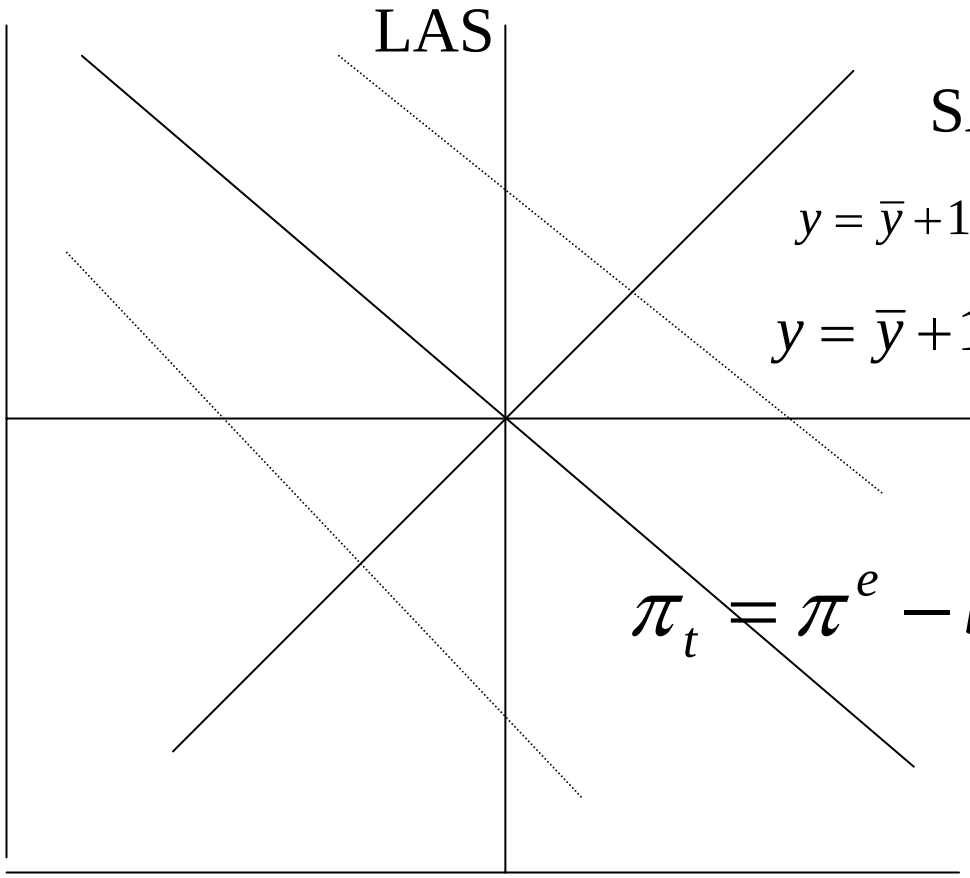
- Higher level of output puts pressure in the price level. Increase in the output at the current period may raise the rate of inflation in the next period (Aggregate supply curve).

- Interest should be raised when the economy is overheating: output is above the trend to reduce the inflationary pressure.

- It should be raised also when the rate of inflation is above the target inflation to reduce aggregate demand.

- Interest rate should be lowered in recession.
- Interest rates should be determined based on economic facts but not according to whims of the policy makers.
- An independent central can take such an independent decision.

Aggregate Supply, Inflation and natural rate of unemployment hypothesis



Summary:

$\pi_t > \pi_t^e \Rightarrow u_t < u_N \Rightarrow y_t > \bar{y}$

$\pi_t < \pi_t^e \Rightarrow u_t > u_N \Rightarrow y_t < \bar{y}$

$\pi_t = \pi_t^e \Rightarrow u_t = u_N \Rightarrow y_t = \bar{y}$

Three Equations of the Interest Determination Rule: Taylor Rule

$$y_t - y_t^* = -d\left(i_{t-1} - i_{t-1}^*\right) \qquad d > 0 \qquad (1)$$

where i_t and i_t^* are actual and natural level of output, i_t is the actual rate of interest in period *t*, i is the interest target of the monetary authority.

One period lag is assumed between the interest rate decision and the change in the output.

$$\pi_t = \pi_t^* + c\left(y_{t-1} - y_{t-1}^*\right) \quad c > 0 \qquad (2)$$

where π_t and π_t^* are actual and target inflation rates.

$$i_t = i_t^* + a\left(y_t - y_t^*\right) + b\left(\pi_t - \pi_t^*\right) \quad a > 0; b > 0 \qquad (3)$$

Reduced Form Equation of the Interest Determination Model

$$i_t = i_t^* - ad\left(i_{t-1} - i_{t-1}^*\right) - bcd\left(i_{t-2} - i_{t-2}^*\right)$$

$$i_t + adi_{t-1} + bcdi_{t-2} = i_t^* + adi_{t-1}^* + bcdi_{t-2}^* \qquad (4)$$

$\beta_0 = \left(i_t^* + adi_{t-1}^* + bcdi_{t-2}^*\right)$, and $\beta_1 = ad$ and $\beta_2 = bcd.$

Reduced form: $i_t + \beta_1 i_{t-1} + \beta_2 i_{t-2} = \beta_0 \qquad (5)$

Steady State: $i_t = i_{t+1} = i_{t+2} = \ldots = i_{t+n}$:

Natural rate of Interest: Steady State

Natural Rate of Interest: $\bar{i} = \dfrac{i_t^* + adi_{t-1}^* + bcdi_{t-2}^*}{1+\beta_1+\beta_2};$

$\bar{i} = \dfrac{i_t^* + adi_{t-1}^* + bcdi_{t-2}^*}{1+ad+bcd}$ with flexible targets and

$\bar{i} = \dfrac{i_t^* + adi_t^* + bcdi_t^*}{1+ad+bcd}$ with fixed targets (6)

General Solution of the Interest Rule Model

$$\lambda_1^t = \frac{-\beta_1 + \sqrt{\beta_1^2 - 4\beta_2}}{2} \quad \text{and} \quad \lambda_2^t = \frac{-\beta_1 - \sqrt{\beta_1^2 - 4\beta_2}}{2}.$$

$$i_t = A_1\lambda_1^t + A_2\lambda_2^t + \bar{i} \tag{7}$$

$$i_t = A_1\left(\frac{-\beta_1 + \sqrt{\beta_1^2 - 4\beta_2}}{2}\right)^t + A_2\left(\frac{-\beta_1 - \sqrt{\beta_1^2 - 4\beta_2}}{2}\right)^t + \bar{i} \tag{8}$$

$$i_t = A_1\left(\frac{ad + \sqrt{(ad)^2 + 4bcd}}{2}\right)^t + A_2\left(\frac{ad - \sqrt{(ad)^2 + 4bcd}}{2}\right)^t + \bar{i} \tag{9}$$

Convergence or Divergence from the Steady State

Reduced form:

$$i_t + \beta_1 i_{t-1} + \beta_2 i_{t-2} = 0 \qquad (10)$$

(a) real and distinct root if $\beta_1^2 - 4\beta_2 > 0$

(b) real and equal roots case if $\beta_1^2 - 4\beta_2 = 0$

(c) complex roots case if $\beta_1^2 - 4\beta_2 < 0$. The general solutions of the model in these three different cases are :

$$i_t = A_1 \lambda_1^t + A_2 \lambda_2^t + \bar{i} \qquad (11)$$

Estimates of the Interest Rule model by FIML (using uk_r.xls by GiveWin PcGive): The estimation sample is: 1971 (1) to 2000 (1)

Equation for: TBILLS

		Coefficient	Std.Error	t-value	t-prob
TBILLS_1		0.938558	0.04090	22.9	0.000
GGDP_1		0.155536	0.05605	2.77	0.006
CINF_1		0.0321303	0.02456	1.31	0.193
Constant	U	-0.0178904	0.4473	-0.0400	0.968

sigma = 1.2475

Equation for: GGDP

		Coefficient	Std.Error	t-value	t-prob
TBILLS_1		-0.124014	0.04638	-2.67	0.009
GGDP_1		0.689260	0.06356	10.8	0.000
CINF_1		-0.0269151	0.02785	-0.966	0.336
Constant	U	2.09479	0.5073	4.13	0.000

sigma = 1.41472

Equation for: CINF

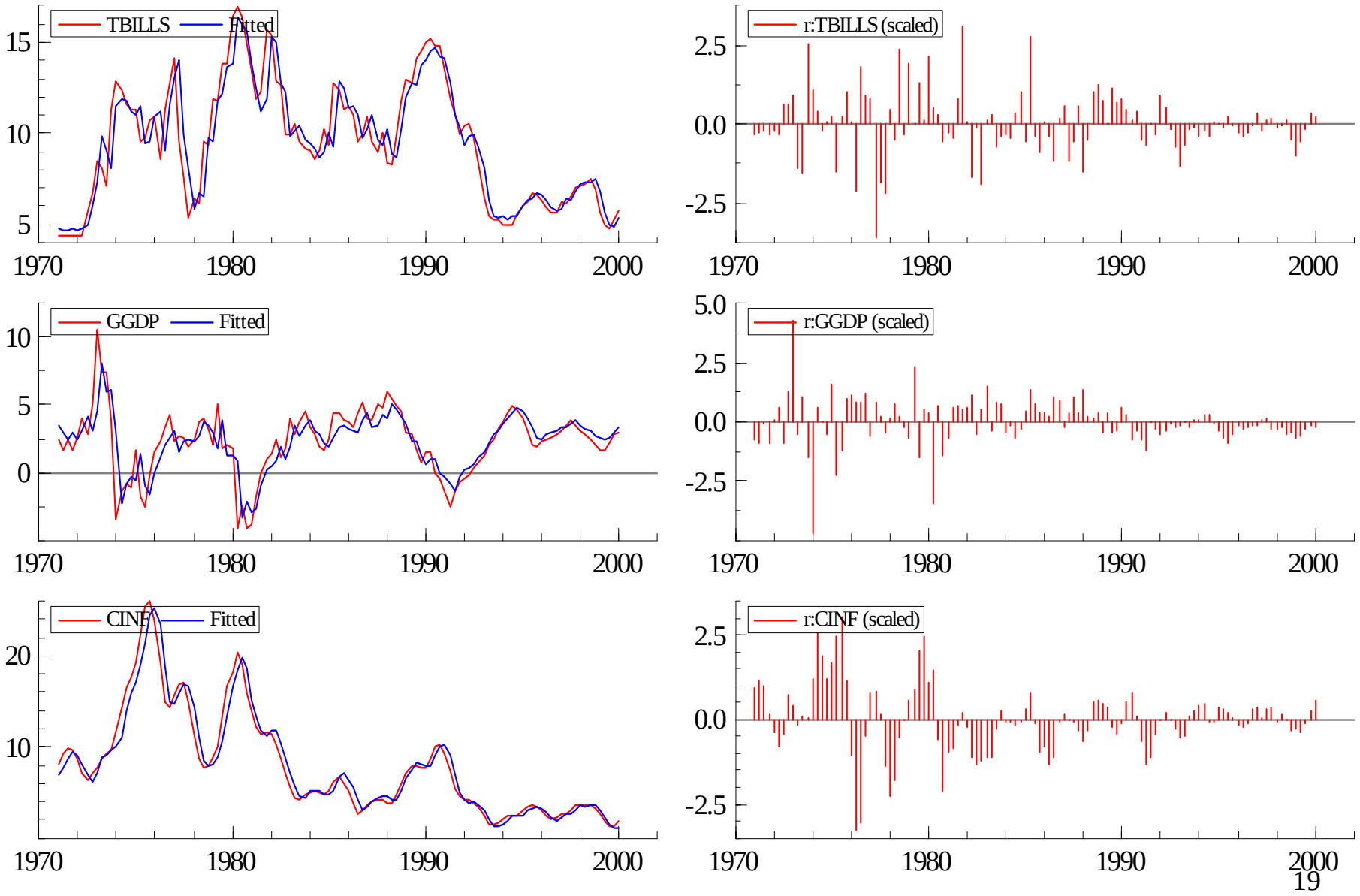
		Coefficient	Std.Error	t-value	t-prob
TBILLS_1		0.0793641	0.04335	1.83	0.070
GGDP_1		0.133732	0.05941	2.25	0.026
CINF_1		0.979589	0.02603	37.6	0.000
Constant	U	-0.936789	0.4741	-1.98	0.051

sigma = 1.32217

log-likelihood -586.063862 -T/2log|Omega| -88.0164366

no. of observations 117 no. of parameters 12

Actual and Fitted Values for Interest Rate, Output and Inflation for UK



Estimates of the Simultaneous Interest Rule model for UK and Four Major Industrial Economies

rus = + 0.2507*infus + 0.04032*infjp - 0.1736*infgr - 0.1627*inffr
(SE) (0.103) (0.102) (0.0767) (0.0489)
- 0.1207*infuk - 0.1136*gus - 0.1429*gjp - 0.004963*ggr
(0.0421) (0.0518) (0.049) (0.0831)
- 0.07644*gfr - 0.08878*guk + 3.946
(0.0798) (0.065) (0.316)

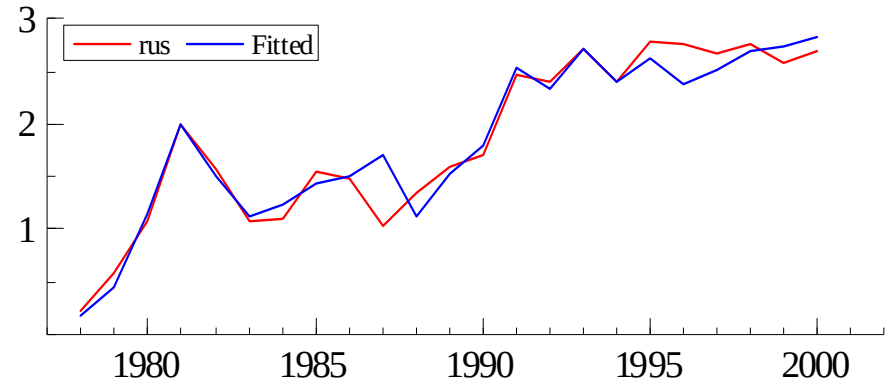
rjp = - 0.9612*infus + 0.2619*infjp + 1.541*infgr - 0.3411*inffr
(SE) (0.278) (0.276) (0.207) (0.132)
+ 0.1209*infuk - 0.01156*gus + 0.1172*gjp + 0.2549*ggr
(0.114) (0.14) (0.132) (0.224)
- 0.5457*gfr + 0.468*guk - 3.367
(0.215) (0.175) (0.85)

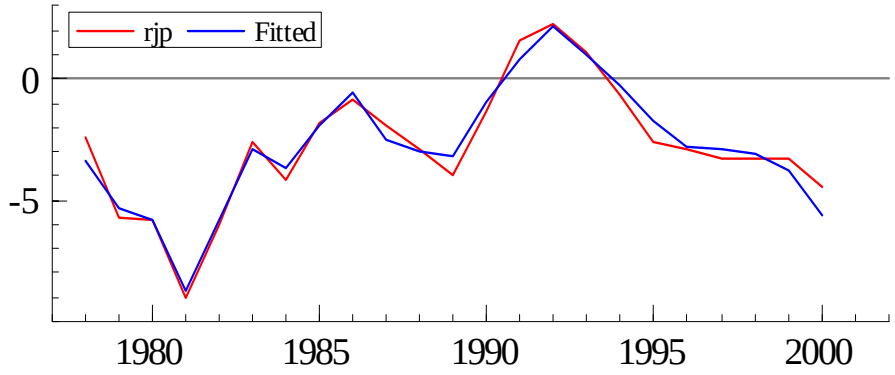
rgr = + 0.2813*infus - 0.05551*infjp + 1.517*infgr - 0.8322*inffr
(SE) (0.34) (0.337) (0.252) (0.161)
- 0.3356*infuk - 0.1166*gus - 0.2131*gjp - 0.1541*ggr
(0.139) (0.17) (0.161) (0.274)
- 0.4911*gfr + 0.1629*guk + 5.319
(0.263) (0.214) (1.04)

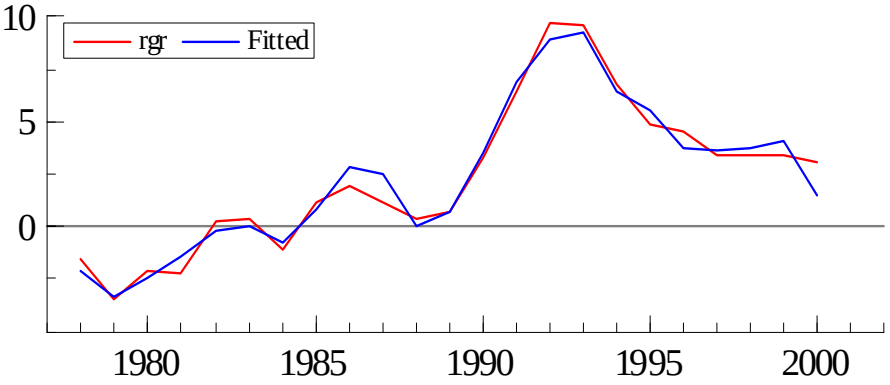
rfr = - 0.8201*infus + 0.1866*infjp + 1.228*infgr - 0.1101*inffr
(SE) (0.261) (0.258) (0.194) (0.123)
- 0.09884*infuk + 0.009484*gus + 0.2115*gjp - 0.06226*ggr
(0.106) (0.131) (0.124) (0.21)
- 0.3603*gfr + 0.2028*guk + 2.111
(0.201) (0.164) (0.796)

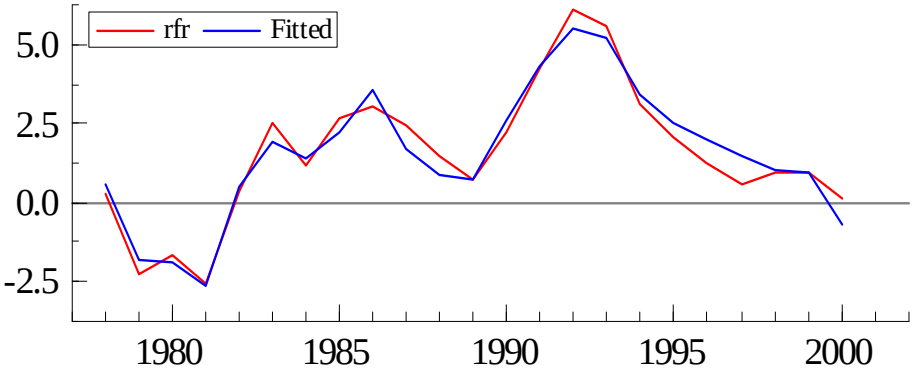
ruk = - 1.394*infus + 0.6449*infjp + 0.8495*infgr - 0.3876*inffr
(SE) (0.405) (0.401) (0.301) (0.192)
+ 0.501*infuk - 0.4017*gus + 0.3004*gjp + 0.4134*ggr - 0.1568*gfr
(0.165) (0.203) (0.192) (0.326) (0.313)
+ 0.2822*guk + 1.89
(0.255) (1.24)

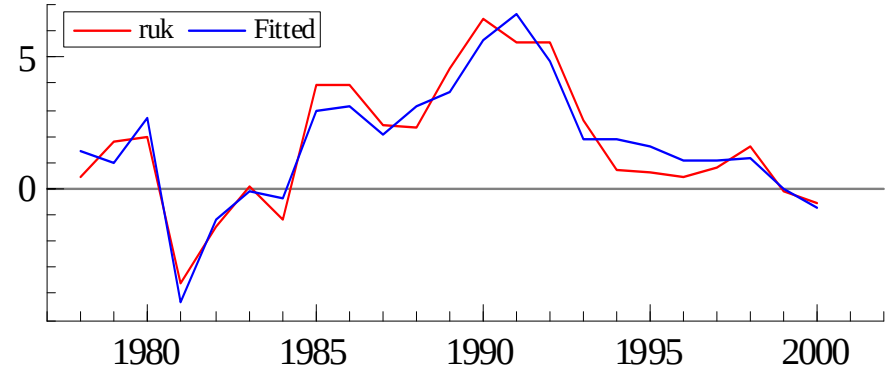
Actual and predicted values of interest Rate for UK and Four Major Industrial Country











Main Points of this Paper

Origin of the interest determination rule in the literature of the natural rate of unemployment hypothesis, dynamic time inconsistency and credibility and policy co-ordination at the national and international level.

The prominence of the central bank independence and rule based monetary policy in 1990s.

A simple model for interest determination and found its analytical solution using the second order difference technique.

Estimation of the model using quarterly series on treasury bills rate, growth rate of output and inflation rates for the UK and annual time series for UK and four major economies.

An evidence for such a interest rule and the interest changes to have significant impacts on output, unemployment and inflation in our estimation.

The simultaneous equation technique better than the single equation technique.

References-1

Alesina A, L. H. Summers (1993) Central Bank Independence and Macroeconomic Performance: Some Comparative Evidence Journal of Money, Credit and Banking, Vol. 25, No. 2. May, pp. 151-162.

Altig D E, C.T. Carlstrom and K.L. Lansing (1995) Computable General Equilibrium Models and Monetary Policy Advice, Journal of Money Credit and Banking, vol. 27, no. 4, Nov., pp. 1472-1493.

Barro R.J. and D. B. Gordon (1983) Rules, Discretion and Reputation in a Model of Monetary Policy, Journal of Monetary Economics, 12: 101-121, North-Holland.

Barro R.J. and D. B. Gordon (1983) A Positive Theory of Monetary Policy in a Natural Rate Model, Journal of Political Economy, vol.91 no. 4, pp. 589-610.

Benigno, Pierpaolo (2002) A Simple Approach to International Monetary Policy Coordination; Journal of International Economics, June 2002, v. 57, iss. 1, pp. 177-96

Bernanke B. S. and F.S. Mishkin (1997) Inflation Targeting: A New Fremework for Monetary Policy, Journal of Economic Perspectives, vol. II, no.2, Spring, pp. 97-116.

Bhattarai K (2003) An Analysis of Interest Rate Determination in the UK and Four Major Industrial Economies, Research Memorandum no. 42, Business School, University of Hull, UK.

Canzoneri M. B. and J A Gray (1985) "Monetary Policy Games and the Consequences of Non-Cooperative Behaviour", International Economic Review, 26:3: 547-567.

Corsetti, G.; P.Pesenti; (2001) Welfare and Macroeconomic Interdependence; Quarterly Journal of Economics, May, v. 116, iss. 2, pp. 421-45

Cukierman A.(1994) Policy Forum: The Banking System and Monetary Control
Central Bank Independence and Monetary Control The Economic Journal, Vol. 104, No. 427. November, pp. 1437-1448

Driffil J. (1988) Macroeconomic Policy Games with Incomplete Information: A Survey, European Economic Review, 32 (2-3) 513-41.

Doornik J.A and D.F. Hendry (2003) Econometric Modelling Using PCGive Volumes I, II and II, Timberlake Consultant Ltd, London.

Eichenbaum (1997) Some Thoughts on Practical Stabilisation Policy, American Economic Review, 87:2:236-239.

Eijffinger SCW and J.D. Haan (2000) European Monetary and Fiscal Policy, Oxford University Press.

Friedman, M (1968) The Role of Monetary Policy, American Economic Review, vol. LVIII, March , 58:1:1-17.

Goodhart C. (1989) The Conduct of Monetary Policy, Economic Journal, 99, June, pp. 293-346

References-2

Julius DeAnne (1998) Inflation and growth in a service economy, Bank of England Quarterly Bulletine, November, pp. 338-346.

Kydland, F. E. and E.C. Prescott (1977) Rules Rather than Discretion: The Inconsistency of Optimal Plans, JPE vol. 85, no. 3, pp. 473-491.

Lockwood, Ben; Miller, Marcus; Zhang, Lei (`998) Designing Monetary Policy When Unemployment Persists Economica, August, v. 65, iss. 259, pp. 327-45

W. D. Nordhaus (1995) Policy Games: Co-ordination and Independence in Monetary and Fiscal Policeis, *Brookings Papers on Economic Activity* 2:1994: 139-216.

Miller M and M. Salmon (1985) Dynamic Games and the Time Inconsistency of Optimal Policy in Open Economies The Economic Journal, Vol. 95, Supplement: Conference Papers. pp. 124-137.

MPC Bank of England (www.bankofengland.co.uk) The Transmission Mechanism of Monetary Policy.

Nelson E. (2000) UK monetary policy 1972-97: a guide using Taylor Rules, Bank of England Working Paper no. 120.

Phillips A W. (1958) The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861-1957.

Phelps E. S. (1968) Money wage dynamics and labour market equilibrium, Journal of Political Economy, 76 , 678-711.

Phelps E. S. and J.B. Taylor (1977) Stabilisation Powers of Monetary Policy under Rational Expectations, Journal of Political Economy, vol.85 no. 1, pp. 163-190.

Sargent, T. J. and N. Wallace (1975) "Rational" Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule, JPE, pp. 41-254.

Taylor J B (1972) Staggered Wage Setting in a Macro Model, American Economic Review, 62, pages 1-18.

Taylor J (1993) Discretion versus policy rules in practice, Carnegie Rochester Conference Series on Public Policy 29 Amsterdam.

Tobin, J (1969), A general Equilibrium Approach to Monetary Theory, JMCB, pp. 15-29, 1969.

Vickers J (1999), Inflation Targeting in the UK, Bank of England Quarterly Bulletin, pp. 368-375.