GERRARD & NATIONAL

Monthly Economic Review

No. 21, March 1991

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Gerrard & National Holdings PLC

Gerrard & National Limited   Gerrard & National Securities Limited

33 Lombard Street, London, EC3V 9BQ Tel: 071-623 9981 Tlx: 883589 Fax: 071-623 6173

Commentary on the economic situation

"Recovery" not in prospect with 13% base rate

Several definitions of "recovery"

The word "recovery", like "recession", has several possible meanings. It is used rather carelessly in the public debate, in at least three senses. The first describes a situation, after a recession, when output stops falling and/or starts to rise. Output could nevertheless be growing at a beneath-trend rate and unemployment might still be going up. The second meaning is the stabilisation of output growth at the trend rate, with unemployment also steady. The final meaning is above-trend output growth, which must lead (even if after a lag) to a fall in unemployment.

Above-trend growth the legitimate definition

Of these three meanings, it is only the third which is really legitimate. However, there is little doubt that the newspapers will trumpet "the recovery" when the first signs of stabilising or rising output emerge. This may cause serious misunderstanding. There will be a tendency for commentators to make such statements as "the recovery will prevent further interest-rate cuts" and "the recovery will lead to a return of inflation pressures". These statements may have an effect on markets and even official policy.

It is important to realize that progress on inflation can continue to be made even if output is growing. The key determinants are the level of actual output relative to some concept of "capacity" or "potential" output and the rate at which output is growing. (These points are emphasized in the accompanying research paper on 'Potential output and the natural rate of unemployment in the UK'.) For example, if unemployment is over 2 1/2m., and output is rising at a miserly 1% or so a year, the degree of excess capacity in the economy is high and rising, and inflation will keep on falling.

As in early 1989, 13% base rates will restrain demand

It is also important to realize that no "recovery" - in the proper sense of above-trend output growth - is in prospect with 13% base rate. This may seem a strong and controversial view, but it should not be. The UK economy began to slow down in early 1989 under the impact of base rates of 12% (from 26th August 1988 to 25th November) and 13% (from 25th November to 24th May 1989, when they went to 14%). Real domestic demand grew at an annualised rate of 9% in the second half of 1988; it fell slightly in the middle two quarters of 1989. If people and companies are responding to interest rates in much the same way now as two years ago, it is fantasy to expect a return to above-trend growth in the near future. In fact, they may be more nervous about the economic environment than in early 1989 because of their many recent financial disappointments, notably the fall in house prices. Evidence of increased caution comes from recent statistics on mortgage lending. Despite the cut in base rates to 14% last October, new building society commitments in January 1991 were £2.5b., lower than the £2.9b. recorded in January 1990.

Professor Tim Congdon   6th March, 1991

Summary of paper on

'Potential output and the natural rate of unemployment in the UK'

Purpose of the paper The Government engineered the present recession in order to reduce inflation. But, now that monetary targetting has been abandoned, it has not provided a framework for relating the behaviour of domestic economic variables to its inflation objectives. The purpose of this paper - which uses Keynesian-style concepts such as aggregate demand and output - is to provide such a framework.

Main points

* The key concepts are "potential output" and the "natural rate of unemployment". When actual output is beneath potential output (i.e., there is a "negative output gap"), and unemployment is beneath the natural rate, inflation falls. Potential output grows at a "trend rate".

* To lower inflation two conditions have to be met. First, output has to be reduced to a level beneath potential output, which will probably also be associated with unemployment beneath the natural rate. Secondly, domestic demand has to be kept growing at a rate equal to (or less than that of) the trend rate of output.

* If a negative output gap has been established, and demand and output grow at the trend rate or less, inflation falls continuously.

* Our assessment, based on econometric techniques, is that the natural rate of unemployment is roughly 7% - 7 1/2%, while the trend rate of output growth in the early 1990s will be about 2 1/2% p.a. (In the late 1980s the trend rate of output growth may have briefly approached 3% p.a.).

* Unemployment is now almost at the natural rate and will undoubtedly exceed it by late 1991. We therefore believe that output is now about to fall beneath potential output. Because the current recession will persist for at least a few quarters yet, a negative output gap of 4% - 5% - similar to that in mid-1981 - will have been opened up by early 1992.

* Inflationary pressures will weaken from now on. Indeed, unless above-trend output growth occurs at some point, they will weaken for the foreseeable future.

The econometric work behind this paper was carried out by Giorgio Radaelli of Lombard Street Research Ltd., Gerrard & National's economic consultancy subsidiary. The paper was written by Professor Tim Congdon and Giorgio Radaelli.

Potential output and the natural rate of unemployment in the UK

How far will inflation fall? A Keynesian-style analysis of the inflation problem - part 2

How much of a recession is needed to curb inflation?

Debates on the current UK recession are often accompanied by statements like "a period of beneath-trend growth is necessary in order to curb inflation". But precisely what is meant by "trend", how long does low growth (or falling output) need to last and what is the relationship between the severity of the recession and the reduction in inflation? This paper attempts to shed some light on such questions. It can be seen as the sequel to our *Monthly Economic Review* in September 1989, where we argued that the annual increase in domestic demand had to be cut to under 1% for three years (or to nil for two years) in order to tackle the twin problems of high inflation and a large payments deficit. Our message was that "the slowdown had to be speeded up", with "a long period of high interest rates". When that verdict was given it was regarded as surprising and very disturbing, because it made a nonsense of all the conjectures about a "soft landing". It was assumed that the official aim was to bring underlying inflation back down to about 5%.

Agenda of austerity of September 1989 *Review* now overfulfilled

In practice, demand had not been dampened down sufficiently in late 1989 and early 1990, and inflation was policy-makers' main worry throughout 1990. But the economic situation has now changed radically. As we shall see, the agenda of austerity set out in September 1989 has been more than met in recent months. The justification for its over-fulfilment may be that the inflation target has changed. Perhaps the 5% inflation number which would then have been regarded as reasonable has been superseded by an objective of 2% - 3% required by our membership of the European Monetary System. But an alternative interpretation - that the authorities are about to overshoot in the deflationary direction, just as they overshot in the inflationary direction in 1987 and 1988 - seems equally plausible.

Four important concepts, *i. potential output*

A number of concepts will define the analytical approach. As in September 1989, the first is the idea of "potential output". This is the level of output at which the pressure of demand is in line with the economy's capacity to supply, at which - in consequence - inflation is stable. Associated with potential output are certain levels of unemployment and capacity utilisation.

ii. the natural rate of unemployment

The level of unemployment at which pay settlements (and so inflation) are stable is known among economists as the "natural rate of unemployment". When actual output is equal to potential output, the actual rate of unemployment is likely to be equal or close to the natural rate of unemployment. There is no specific name for the degree of capacity utilisation which keeps the inflation rate stable, but this concept also hovers in the background of the discussion.

iii. trend growth rate The third idea is the rate at which potential output grows over time, which may be called the underlying or "trend" growth rate. If the economy were continuously to grow in line with its trend rate, and if actual output were continuously in line with potential output, inflation would be stable. It should be emphasized - since people are sometimes sloppy in their use of words - that this does not mean that the price level would be stable. To reduce inflation it is necessary to have actual output beneath potential output.

iv. the output gap This introduces our fourth concept, the "output gap". When actual output is above potential output, there is a "positive output gap"; when it is beneath potential output, the output gap is "negative". A positive output gap is accompanied by rising inflation, a negative output gap by falling inflation. A positive output gap is usually the result of a boom, after an extended period with growth above its trend rate; a negative output gap, by contrast, is the sequel to recession.

Conclusions of analysis will be that trend growth now and in the early 1990s will be 2 1/2% p.a., with natural rate of unemployment at 7%-7 1/2% Our conclusions will be that the trend growth rate of the economy today is about 2 1/2% p.a., similar to the figure recorded in the past over the very long run. It is likely to remain at this level in the next few years, while the natural rate of unemployment is between 7 and 7 1/2%. As unemployment now stands at 6.9%, almost enough has already been done to ensure that the underlying inflation rate falls. A recession lasting about a year is proving sufficient to turn the inflationary tide. This contrasts with 1974/75 and 1980/81, when two-year recessions were needed. The difference between the latest experience and its two predecessors stems from the improved supply-side performance over the last decade. Before we consider these conclusions in detail, alternative ways of estimating the natural rate of unemployment and the trend rate of output growth need to be reviewed. The subject is discussed in an appendix, which borrows heavily from an article in the June 1990 *IMF Staff Papers* by C. Adams and D.

Employment patterns in the 1970s and 1980s

Chart shows % annual change in working population (i.e. workforce plus unemployed) and workforce. Note the sharp contrast between the early and late 1980s.
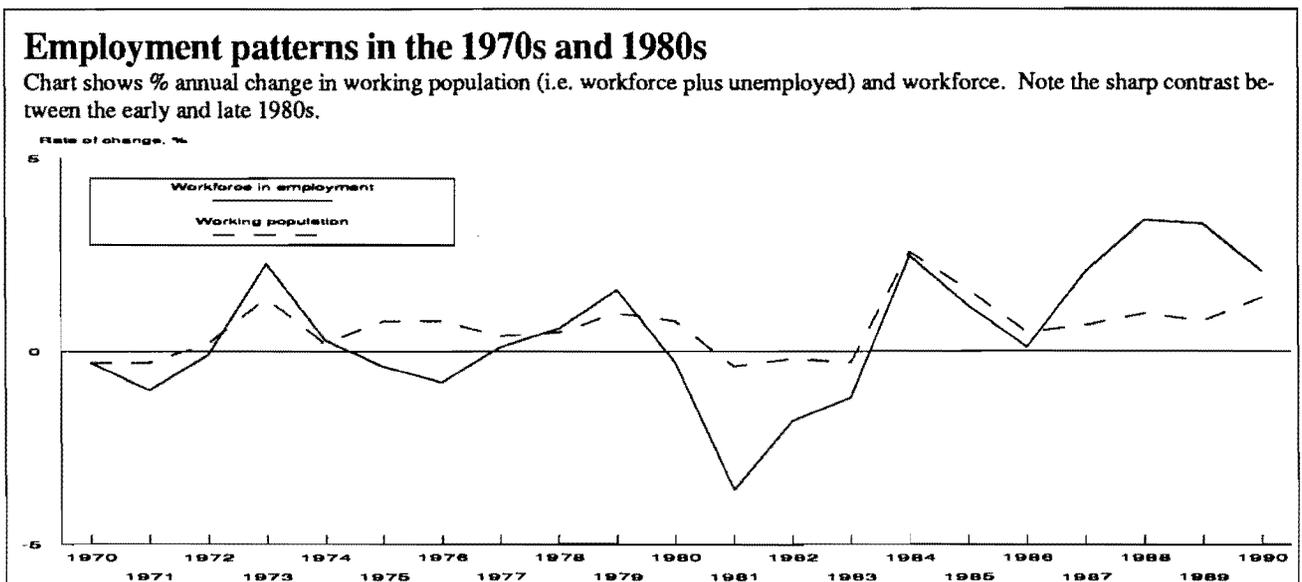
T. Coe on 'A systems approach to estimating the natural rate of unemployment and potential output for the USA'. As explained in the appendix, there are no less than five techniques for estimating potential output and the natural rate. The first two approaches are applicable to both potential output and the natural rate of unemployment, the third and fourth address the natural rate of unemployment only. The fifth approach, which is the one we used, considers potential output and the natural rate jointly, via a two-stage strategy.

A description of our analytical approach

The first step is to estimate a "production function" relating real gross domestic product to the main inputs, which are taken to be fixed capital, labour and energy. Output depends on not only the quantity of these inputs, but also the technology with which they are applied. The precise measurement of improvements in "technology" would be extremely difficult. Our procedure is to attribute to technology all the production gains which cannot be explained by the production inputs. In effect, "technology" gains are an unexplained residual. Once the production function has been estimated in this way, we use a technical relationship known to economists as Okun's Law to compute the associated natural rate of unemployment. Okun's Law is a relationship linking the difference between actual and natural rates of unemployment to the gap between actual and potential output. (See the appendix for a fuller explanation.) Our estimation work covered the period from 1970: Q1 to 1990: Q2. Before we summarize the results on trend output growth and the natural rate, some comments on the behaviour of production inputs may be helpful.

Growth rates of key inputs in last 20 years, *i. capital stock*

The rate of growth of the capital stock has varied considerably in the 20-year period. According to statistics prepared by the Central Statistical Office, the capital stock in constant 1985 prices grew on average by 2.8% p.a. over the whole period. But there was a definite contrast between the 1970s and 1980s. Between 1970:Q1 and 1980:Q1 the capital stock increased on average by 3.2% p.a., whereas between 1980:Q1 and 1990:Q1 the figure was 2.3% p.a. The contrast is largely due to the drop in the share of investment in GDP in the recession of the early 1980s, perhaps combined with accelerated obsolescence. (These remarks do, of course, beg the question of how the CSO prepares its numbers.)

ii. labour force

The growth of the employed labour force was more stable between the two decades, although with marked fluctuations from year to year which reflected the business cycle. Between 1970:Q1 and 1980:Q1 the workforce in employment went up by 0.2% p.a., while between 1980:Q1 and 1989:Q2 it rose by 0.4% p.a. However, these figures are rather misleading, for two reasons. First, they neglect a much larger increase in the total labour force (i.e., employed and unemployed). According to the Department of Employment, between 1970:Q1 and 1980:Q1 the workforce rose by 0.5% p.a., between 1980:Q1 and 1989:Q2 by 0.6% p.a. Secondly, the 1980s are divided very sharply between the early 1980s, when the employed workforce collapsed, and the mid- and late

1980s, when it rose at an exceptionally fast rate. Between 1979:Q3 and 1983:Q1 the employed workforce fell from 25.5m. to 23.4m., or at an annual rate of 2.5%; on the other hand, between 1983:Q1 and 1990:Q3, it increased from 23.4m. to 27.4m., or at an annual rate of 2.0%.

iii. energy

Energy consumption, which was growing quickly before the first oil price shock in 1973, fell in the late 1970s and early 1980s. But it started rising again after 1985. The "energy intensity" of GDP (i.e., the ratio between energy consumption and GDP) fell by 16.2% between 1980 and 1988.

In short, the growth of the capital input was slower in the 1980s than in the 1970s, while the growth of the labour input was more or less the same in the two decades. The energy input changed little over the period, with considerable economy in its use between 1975 and 1985.

Acceleration in trend growth rate between the 1970s and 1980s

Our estimates of actual and potential GDP growth are given in the table on p.6. According to these figures, the underlying annual growth rate averaged 1.6% in the 1970s, but rose to 2.3% in the 1980s. Indeed, the final figures in 1989 and 1990 are in the 2 3/4% - 3% area. So an acceleration in the underlying growth rate did occur between the 1970s and 1980s and, in this sense, there was some sort of "Thatcher miracle".

Actual and potential growth in the 1970s and 1980s

	Contributions to potential growth from:			Growth rate of potential GDP	Growth rate of actual GDP
	Extra inputs	"Technology" residual			
1971	1.5	0.2		1.7	1.7
1972	1.5	0.2		1.7	-2.7
1973	1.4	0.2		1.6	7.3
1974	1.4	0.2		1.6	-1.5
1975	1.4	0.2		1.6	-0.8
1976	1.4	0.2		1.6	2.6
1977	1.5	0.2		1.7	2.5
1978	1.5	0.2		1.7	3.0
1979	1.5	0.2		1.7	2.8
1980	1.2	0.6		1.8	-2.1
1981	1.3	0.6		1.9	-1.1
1982	1.3	0.6		1.9	1.8
1983	1.3	0.7		2.0	3.8
1984	1.4	0.7		2.1	1.9
1985	1.6	0.7		2.3	3.8
1986	1.6	0.8		2.4	3.6
1987	1.7	0.8		2.5	4.3
1988	1.8	0.9		2.7	4.3
1989	1.9	0.9		2.8	1.9
1990 H1	1.9	1.0		2.9	2.6

The growth rate of potential GDP is the sum of contributions from extra inputs and "technology"; actual GDP is measured by the average measure of GDP.

Sources:*Economic Trends* and estimates by Lombard Street Research Ltd.

Faster output growth *not* due to faster increase in inputs

But it is important to pin down more precisely what this miracle was. It is clear from our discussion of the growth of the inputs into the production process that in the 1980s one of them, capital, increased more slowly than in the 1970s, while the quantity of another, energy, actually fell in absolute terms. With employment growth roughly the same in both decades, the faster growth in potential output in the later decade must be attributable to the remaining influence - a higher rate of "technology" improvement. In fact, our estimate is that in the 1970s the improvement of "technology" contributed about 1/4% p.a. to the growth rate of potential GDP, whereas in the 1980s it contributed about 1/2% to 1% p.a. to the growth rate of potential GDP. Moreover, the contribution of "technology" gradually rose over time, reaching a peak towards the end of the period.

Better usage of inputs (i.e., "technology") should take the credit

As explained earlier, "technology" in this context is a bit of a rag-bag. In essence, it is that part of economic growth which cannot be explained by increases in the quantity and quality of inputs. It therefore reflects all those forces responsible for gains in economic efficiency, not just "technological progress" as such. More robust management techniques in basic industries like steel, cars and coal, which were undoubtedly a feature of the early 1980s, would be as relevant as genuine technological progress in these industries.

It would be tempting to attribute the faster rate of "technology" improvement we have identified to the "Thatcher reforms" and so to say that they were worth about 1/2%-a-year to the growth rate. Nevertheless, merely to identify faster "technology" improvement is not to prove that the improvement is exclusively the result of particular government policies. The improvement may have been due to something else, such as an autonomous increase in management efficiency altogether unconnected with government policy. To some extent, readers must make up their own minds. The figure of 1/2% p.a. "extra" may not sound much. But, over a decade, it would mean another 5% on GDP or (in today's prices) about £25b. - £30b. a year. The capitalised value of £25b. - £30b. a year in perpetuity is an enormous figure.

Natural rate of unemployment also fell, making possible fuller employment of labour force

What, then, of the natural rate of unemployment? As discussed above, the natural rate is calculated by applying Okun's Law to our estimates of potential output. According to Okun's Law, changes in employment in the course of the business cycle should be associated with somewhat larger changes in output. This is corroborated by our econometrics, which suggests that a 1% change in employment is accompanied by a 1.7% change in output. Our work also indicates that the natural rate of unemployment was 7.2% in 1990:Q2. This is markedly less than figures of 10% or more experienced in the early 1980s. The drop in the natural rate of unemployment may reflect a number of labour market reforms in the last decade, notably changes in industrial relations law (e.g., the end of the closed shop), the tightening of eligibility criteria for unemployment

benefit, reductions in the ratio of benefits for the unemployed relative to incomes in work and changes in housing policy.

We have here a second reason for the increased growth rate of potential output in the 1980s. Not only did the rate of growth in the effectiveness of inputs (i.e., our "technology") increase compared to the 1970s, but also it became possible to employ the labour force more fully without inflationary effects. Indeed, with a 1% change in employment being associated with 1.7% more output, the 3% reduction in the natural rate of unemployment also meant a roughly 5% addition to potential output.

**Figure-work not precise, but suggests rough orders of magnitude**

To summarize, the growth rate of potential output rose from 1 1/2% - 1 3/4% p.a. in the 1970s to 2 1/4% - 2 1/2% p.a. in the 1980s and to perhaps even higher than that for two or three years in the late 1980s. Higher growth rates of inputs were not responsible for this gain. If anything, with the capital stock hit by low investment in the early years of the Thatcher government, the growth rate of inputs was lower in the 1980s than in the 1970s. Instead the approximate 1% increase in the growth rate was due to two factors of roughly equal importance, better use of the existing inputs and a decline in the natural rate of unemployment. We are not insisting on the precise accuracy of our figure-work, but it is suggestive and gives an indication of rough orders of magnitude.

Early 1990s will probably see less benefit from "technology" improvements

What of the future? The faster growth of the "technology" residual may have owed much to once-for-all gains in businesses (steel, cars and the like) which were badly under-managed before the Thatcher government. If so, it may be unreasonable to expect this influence to be so positive in coming years. Moreover, the improvement in labour market efficiency, and the consequent fall in the natural rate of unemployment, must have largely reflected reforms which cannot be repeated. It seems unlikely that another 3% fall in the natural rate of unemployment lies ahead in the next few years. A reasonable conjecture

Gross and net investment in the 1980s

Chart shows gross and net domestic fixed capital formation in the 1980s. As the difference between them (i.e., capital consumption) is relatively stable, increases in GDPCF are accompanies by proportionately much larger increase in NDFCF. (All figures in constant 1985 prices.)
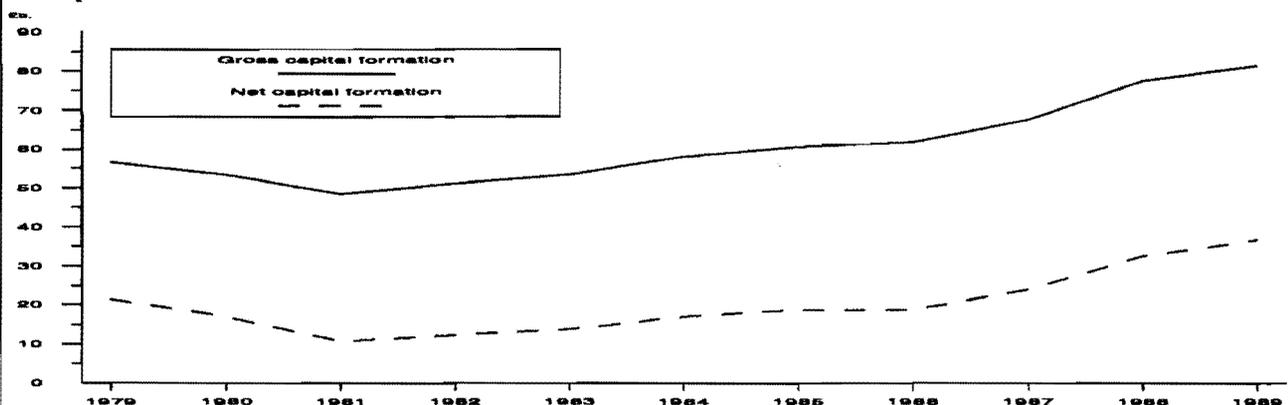
is that the increase in the efficiency of input usage ("technology") and any continuing fall in the natural rate of unemployment will contribute 1/2% to the underlying annual growth rate in the early 1990s, less than the 1% we have guestimated for the 1980s.

but more from faster growth of inputs

However, the prospective growth rate of output is also affected by the growth rate of inputs. Labour force growth in the early 1990s will not be particularly supportive. According to figures prepared by the International Labour Office and the OECD, and published in the January 1990 *Employment Gazette*, the total labour force will expand in the four years to 1995 by 0.2% p.a., which is slightly less than the rates of growth of the employed workforce recorded in the 1970s and 1980s. The only help could come from a faster increase in the capital stock. Unlike the early 1980s, investment as a proportion of national output is now at historically rather high levels.

Sharp rise in *net* investment in late 1980s

An important and often neglected point needs to be made about investment. Capital consumption (i.e., depreciation and obsolescence) represents a high proportion of gross fixed capital formation. For example, the CSO has estimated that it amounted to £41.9b. in 1985 in prices of that year. With gross GDFC of £60.4b., net investment was only £18.5b. But capital consumption is a fairly stable ratio of the existing capital stock and does not change much when the level of investment increases. *It follows that any rise in gross investment is accompanied by a much larger proportionate rise in net investment.* Thus, the CSO gives figures for gross GDFC (in constant 1985 prices) of £48.3b. in 1981 and £81.0b. in 1989, but for net GDFC of £10.7b. in 1981 and £36.4b. in 1989. The growth rate of the capital stock is, of course, determined by the *net* investment figure. On this basis, the growth rate of the capital stock almost quadrupled between 1981 and 1989. Faster growth of the capital stock is therefore likely to be a feature of the economy in the early 1990s. According to our estimates, the contribution of growth in the capital stock to overall GDP growth was lower than might be expected at only 1/4% to 1/2% a year in the 1980s. But, in view of the faster growth of the capital stock now being reported, the contribution may be rather higher in the early 1990s at, say, 1/2% to 1% p.a.

2 1/2% trend growth rate suggested for early 1990s

Our assessment is that the trend growth rate of potential output in the early 1990s will be about 2 1/2% p.a., made up of contributions of 3/4% - 1% from growth of the labour force and its skills, 1/2% - 1% from growth of the capital stock, 1/2% from "technology" improvement, and something extra from a possible continuing fall in the natural rate of unemployment and better use of energy inputs. An optimistic prognosis for inflation now follows easily. Actual unemployment is now almost equal to the natural rate of unemployment, implying that actual output is also roughly equal to potential output. It is certain

Actual output now roughly equal to potential output

that in the next few quarters output will fall further beneath the trend figure. GDP will undoubtedly decline in the first quarter, which was hit by the uncertainties of the Gulf War and bad weather, as well as by the recession itself.

Recent CBI surveys and information on construction orders argue that it will probably also go down in the second quarter. Moreover, influences such as real broad money growth and the corporate sector financial deficit, which usually lead economic activity by six months to a year, imply that the second half of 1991 will also be poor.

By early 1992 a large negative output gap will have been opened up, implying sustained fall in inflation

If national output is 2% lower in the first quarter of 1992 than today (which seems about right), a negative output gap of 4 1/2% will have emerged by then. This negative output gap arises from the combination of continued trend growth with the fall in output. As the chart on p.10 shows, the last time that the negative output gap was as high as this was in the early 1980s, when it was followed by several years of falling inflation. The better inflation trends now are, of course, starting from a much lower inflation level.

Here we come to the most positive message of our analysis. The improvement in inflation will persist as long as actual output is beneath potential output. There are good reasons - on this Keynesian-style analysis - for expecting inflation in late 1992 and 1993 to be 3% or less. It should be strongly emphasized that a return to a trend rate of growth in 1992 and 1993 would not jeopardize further falls in inflation. Only if actual output rose to equal potential output (i.e., after a period of above-trend growth) would inflation stabilize. A rising inflation rate is some years away and would be possible only if, at some point in, say, 1994 or 1995, actual output again exceeded potential output.

But monetary trends must be consistent with this

Two qualifications have to be made. The Keynesian-style analysis in this *Review*, which turns on departures of unemployment from its "natural" rate and output from its "potential" level, makes no reference to the monetary influences on inflation. But the behaviour of credit and broad money growth must be consistent with its argument. Fortunately, at present there is no great problem. As emphasized in recent *Monthly Economic Reviews*, credit expansion is being restrained by high interest rates and monetary growth is falling sharply.

The output gap

Chart shows % gap between actual and potential output. Potential output is represented by the straight line through zero. A positive output gap implies rising inflation; a negative output gap implies falling inflation. By early 1992 the negative output gap should be similar to the *minus* 4%-5% recorded in 1981 and 1982.
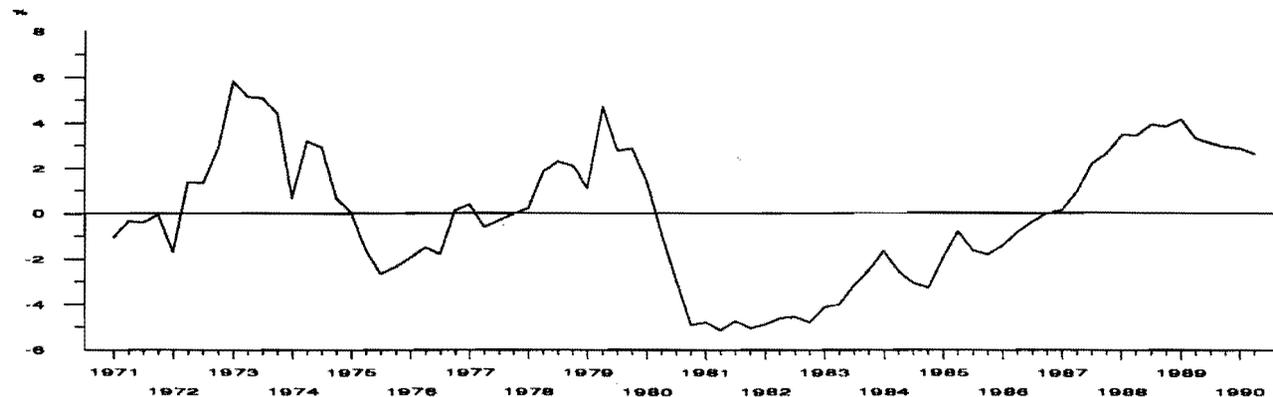
and there are particular dangers of monetary relaxation because of policy-makers' habits

Secondly, British policy-makers have an appalling track-record in failing to distinguish between trend and cycle, and so of mismanaging interest rates and the business cycle. An important consequence of our argument is that above-trend output growth can be reconciled with falling inflation for several quarters in the upturn phase of the business cycle. This was the happy experience of the Heath-Barber government in 1972, the Callaghan-Healey government in 1978 and the Thatcher-Lawson government in 1986 and 1987, as well as of the many stop-go cycles of the 1950s and 1960s. The combination of rapidly rising output and falling inflation may seem counter-intuitive, but the explanation is quite simple. It is due to starting from a cyclically favourable situation with substantial spare capacity (i.e., actual output beneath potential). However, countless Prime Ministers and Chancellors of the Exchequer have decided - when they are in this benign "go" phase of the cycle - that they have put the British economy on a permanently higher trend growth path and achieved "miracles".

But the other side of the cyclical coin is the combination of rising inflation and beneath-trend output growth (or falling output) after the boom, when the economy has to adjust because output is above the potential level. (Think of the economy's miserable state in 1974 and 1975, again in 1980 and 1981, and more recently.) There would be a true British economic "miracle" if policy-makers for once resist the temptation of easier credit and monetary stimulus in late 1992 and 1993, when inflation is at much lower levels.

Appendix on methods of estimating potential output and the natural rate of unemployment

The five approaches to estimating potential output and the natural rate of unemployment are as follows:

(1) Smoothing methods. The most common procedure for estimating potential output and the NRU is to fit a trend (either linear or by moving averages) to actual output and unemployment. The major advantage of this procedure is its computational simplicity. However, this is offset by significant drawbacks. First, if the trend is linear the growth rate of potential output will be constant through time, thus obscuring any qualitative changes in the supply side of the economy. On the other hand, if the trend is non-linear, the decision about when and how it is allowed to change is inevitably arbitrary. Finally, such methods do not shed light on the structural determinants of potential output and the NRU, and so give no insights as to what type of policies would improve the supply side.

(2) Full model simulations. This method involves solving large, economy-wide econometric models for the rates of output growth and unemployment which are consistent with stable inflation. The advantage of this methodology is that the NRU and potential output estimates thus obtained are fully consistent, both mutually and with respect to other relevant macro-variables. However, two costs weigh against those benefits. First, the econometric techniques (of optimal control) required by such approach are extremely complex and computer-intensive. Second, the bigger the model, the higher the probability of wrong representations of how the economy works (misspecification errors) being disseminated here and there. This would bias the estimates of potential output and the NRU.

(3) Estimation of wage equations (Phillips curves). This is perhaps the most common method. An equation is estimated in which wage growth is determined by unemployment, productivity growth, and inflation expectations (this being but one of the many possible specifications). Long-run average values are then imposed on all the variables in the equation, apart from unemployment, and a unit elasticity is imposed on inflation expectations (i.e., there is no money illusion in the long run). Solving the estimated equation for unemployment thus yields the NRU estimate. The NRU is the rate of unemployment consistent with real wages growing in line with trend labour productivity. (This growth pattern for real wages is consistent with constant income shares.) The small scale of the model and its simplicity are the attractions of this approach. However, one is left uncertain about which of the many possible Phillips curve's specifications to adopt. Moreover, one crucial variable required by the model, i.e. expected inflation, is not easily measured.

(4) Unemployment rate equations. This approach requires an equation in which unemployment depends on both cyclical variables (expressed in terms of deviation from trend) and structural variables such as the level of unemployment benefits, union powerg and training skills. Once the parameters of the equation are estimated, the terms on cyclical variables are suppressed (thus imposing long-run equilibrium) and the model is solved for unemployment. The latter is thus the NRU, a function of structural (ie non cyclical), supply-side, variables only. Again, the advantage of this approach lies in simply requiring a single-equation model. However, some of its structural variables are institutional in nature, hence not easy to quantify. Second, this approach does not incorporate information on wage developments. Third, computation of the cyclical segment of the equation usually requires a proxy for potential output.

(5) A two-equation model. Our chosen approach relies on a two- equation model. The first equation is a production function relating real GDP to the factors of production: fixed capital, labour, and energy. Output is therefore approached from a supply- side viewpoint, with GDP being a function of the production inputs and technology. The latter is partly accounted for by the presence of fixed capital and, partly, by a time trend. In other words, we assume that any systematic movement in GDP not explained by the three production factors is attributable to multi-factor productivity, with the latter growing smoothly thanks to technical progress. Once the production function is estimated, potential GDP can be calculated as the level of output attainable when the factors of production are at their trend or long-run levels, i.e. abstracting from short-term fluctuations.

Having estimated potential output, we then use Okun's Law to compute the associated NRU. This "law" is a relationship linking the difference between actual and natural rates of unemployment with the gap between actual and potential output.

Further details of the estimation procedure and the estimates themselves is available from Mr. Giorgio Radaelli of Lombard Street Research Ltd., c/o Gerrard & National.