Capital utilisation in manufacturing industry

Both officials and commentators concerned with demand management need up-to-date indicators of the pressure of demand on economic resources. Statistics on the supply of and demand for labour have been compiled for many years. The unemployment figures, which are available monthly and promptly, have long been regarded as a measure of the pressure of demand for labour and, more recently, the adult vacancies series has been preferred for the same purpose. The strength of demand for the other main factor of production – capital – has been relatively neglected, however, because of the problems of measurement and consequent paucity of statistics. The Confederation of British Industry publishes the results of a sample survey indicating the proportion of firms working below full capacity, but there is no directly observed measure of how much of the capital stock is in use at any time. In an attempt to remedy this situation, an index of capital utilisation in manufacturing industry has been developed in the Bank.[1] It was referred to in the last issue of the Bank's annual *Report and accounts.*

The first section of this article describes the assumptions made and the general method used in constructing the capital utilisation index; the second section explains the calculation in greater detail; and the third section attempts to relate the index to other measures of the pressure of demand.

Underlying assumptions

Capital utilisation may be defined as the ratio of actual output to the potential output that could be produced from the existing capital stock, given an unlimited supply of labour to operate the plant and machinery. In practice, it is difficult to estimate potential output, and two assumptions have been made.

First, potential output is assumed to be closely related to average output over successive economic cycles, and so a connection is sought between average output and gross capital stock before depreciation. The Wharton School in the United States have usually assumed that output at the peak of each business cycle (if this could be identified unambiguously) always reached the same pressure of demand, and that potential output could be obtained by joining successive peaks.[2] This does not appear to be valid in the United Kingdom because there was almost certainly lower pressure at the end of 1968 than at the end of 1964. The precise form of relationship between potential and average output has therefore been chosen empirically.

The second, and less important assumption is that 100% utilisation is attained at the point of greatest deviation of output above the average; this merely fixes the scale of measurement and does not imply that utilisation of more than 100% is impossible.

1 See ''Capacity utilisation and the determination of fixed investment'' in *The Econometric Study of the United Kingdom*, edited by K. Hilton and D. F. Heathfield, London, 1970, pages 185-202.
2 L. R. Klein and R. Summers ''The Wharton index of capacity utilisation'' in *Studies in Quantitative Economics*, *No. 1* published by the University of Pennsylvania, 1966.

Method of calculation

(a) *Capital stock*

Annual estimates of the gross capital stock at 1963 replacement cost for plant and machinery in manufacturing industry[1] are available in the *National Income and Expenditure* 'Blue Books'. No figures are given for the textile industry because the data are considered to be unreliable.

The published capital stock series is not entirely suitable for the present purpose. The stock figures are derived by the perpetual inventory method *i.e.* each year's stock is obtained from the previous year's by adding gross domestic fixed capital formation (gross investment) and subtracting an estimate of retirements (scrapping). But gross investment is recorded for large capital goods when progress payments are made by the buyer, rather than at the time of completion. As there is considerable variation in the lag between payments and deliveries during the business cycle, the published capital stock series does not provide a good measure of plant available. For retirements, assets are divided into five groups, which are assumed to be scrapped at the end of their fixed lives, these ranging from sixteen to fifty years. This means that periods of high investment in the past can lead to bunching of the retirement series a fixed number of years later. Though average retirements over several years ought to be correctly estimated by this method, it is unlikely that the annual rate of scrapping is as erratic as the published series implies.

An alternative was required to the published gross investment expenditure series, the timing of which would be closer to the deliveries of capital equipment. This was found in a series of selected home produced and imported capital goods used mainly in manufacturing industry, which was compiled from a combination of engineering deliveries and overseas trade figures, both published by the Department of Trade and Industry. Over the period 1957 to 1970 there proved to have been a close relationship between the annual figures of selected deliveries and the expenditure series, which enabled a linear regression to be fitted. This relationship was used to estimate a total deliveries series from selected deliveries, both annually and quarterly.

A smooth retirements series was derived by assuming that the true level of retirements in any year is a fixed proportion of the recorded capital stock at the end of the previous year (a common assumption in economics). This proportion was estimated so as to give the same level of retirements over several years as the official series. Quarterly estimates were obtained by interpolation. The smoothed retirements were then deducted from the investment deliveries series to obtain quarterly changes in capital stock at 1963 prices. Successive addition of these changes to the level of capital stock at the end of 1956 provided an adjusted quarterly series for the gross capital stock. The figure for the end of the period coincides almost exactly with that in the 'Blue Book'. This is because the methods of estimation used for both deliveries and retirements ensured that the sum of the differences between the original and adjusted figures was zero. The capital stock series is kept up to date during the year as further deliveries figures

[1] Defined in *National Accounts Statistics: Sources and Methods* published by the Central Statistical Office 1968, page 304.

become available; and each October, after publication of a new 'Blue Book' containing revised estimates of the capital stock, the method described above is used to produce a new adjusted stock series. Thus the figures in this article have been based on official estimates up to the end of 1970 and projections made for 1971.

(b) *Output*
A seasonally adjusted quarterly index of manufacturing output (excluding textiles) has been constructed from the monthly industrial production figures produced by the Central Statistical Office. In March each year these are revised for the previous calendar year.

(c) *Capital utilisation index*
To eliminate cyclical effects so far as possible from the output series, a seventeen-quarter moving average was used, reflecting the normal length of domestic economic cycles since the Second World War. The next stage was to try to connect average output and capital stock (see starting assumptions). Chart A shows that a simple linear relationship fits very well, implying a constant "incremental capital/output ratio". The growth of capital stock is close to a steady time-trend, but average output is distinctly more closely related to the capital stock than to a time-trend. The maximum positive deviation of actual output from the fitted straight line (relating average output and capital stock) took place in the fourth quarter of 1964, and this was taken as the nearest approach to full capacity working by manufacturing industry in the period. It was then assumed that a line drawn through this point and parallel to the average output/capital line represented potential output (see Chart B). A quarterly series of potential output could be calculated by using the relationship with capital stock represented by this parallel line, and a capital utilisation index constructed from the ratio of seasonally adjusted actual to potential output. The index from 1955 to the third quarter of 1971 appears in the table below and is illustrated by Charts C and D.

Capital utilisation index
(1964 IV = 100)

	I	II	III	IV
1955	96·9	98·0	98·0	99·3
1956	97·0	94·5	93·7	93·2
1957	94·0	93·8	94·4	92·5
1958	92·6	90·8	89·8	89·3
1959	90·1	92·5	93·4	96·9
1960	98·7	98·3	97·8	97·0
1961	96·6	95·9	95·1	92·7
1962	90·9	93·3	93·2	90·6
1963	89·2	92·1	94·7	96·5
1964	98·0	97·5	98·0	100·0
1965	99·0	98·6	97·6	98·4
1966	98·6	97·2	97·2	93·3
1967	93·2	93·1	92·8	93·3
1968	93·9	94·5	95·5	95·8
1969	94·5	95·6	95·2	94·5
1970	94·0	91·8	92·6	93·1
1971	90·2[a]	91·1	90·6	

a Depressed by Ford strike.

Chart A
Manufacturing industry (excluding textiles)
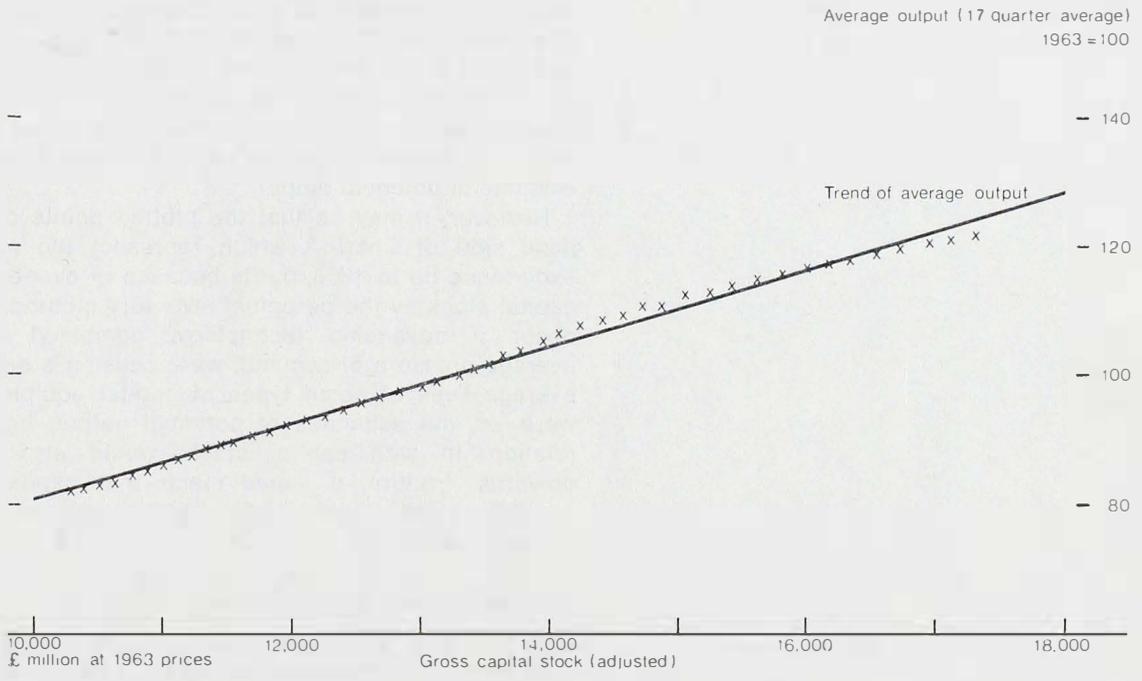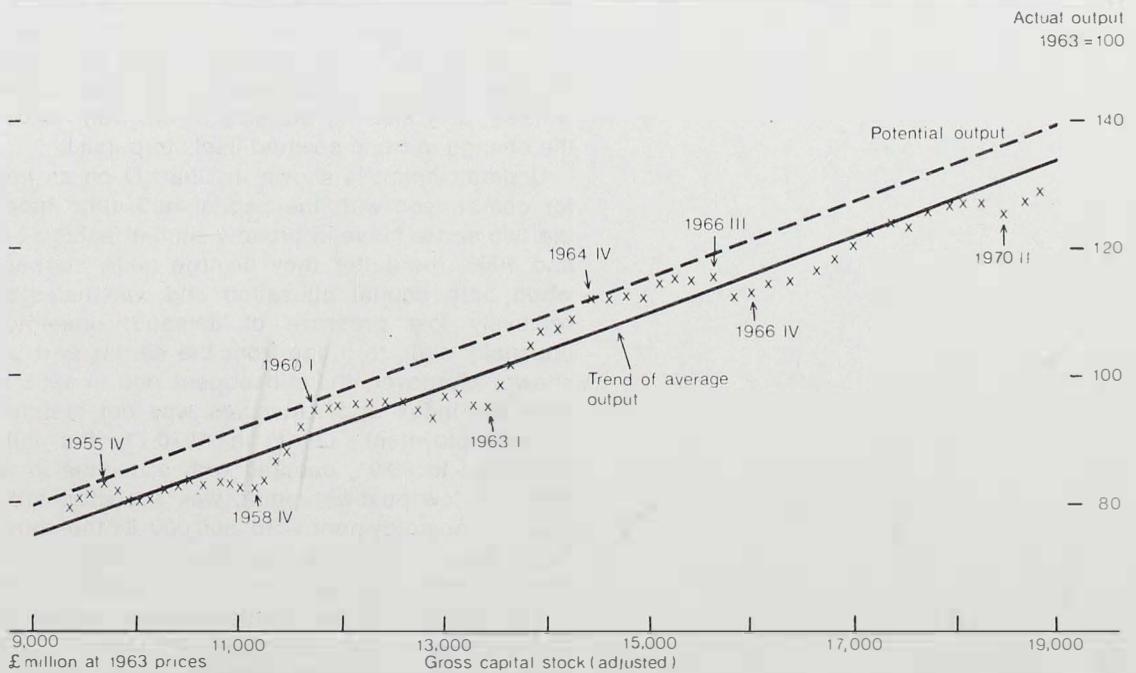### Average output and gross capital stock (1957-68)

Average output (17 quarter average)
1963 = 100

— 140

Trend of average output

— 120

— 100

— 80

10,000   12,000   14,000   16.000   18.000
£ million at 1963 prices   Gross capital stock (adjusted)

Chart B
Manufacturing industry (excluding textiles)
Actual output and gross capital stock

Actual output
1963 = 100

Potential output   — 140

1966 III
1964 IV   1970 II   — 120

1966 IV

1960 I   Trend of average
output   — 100

1955 IV   1963 I

1958 IV   — 80

9,000   11,000   13.000   15.000   17,000   19,000
£ million at 1963 prices   Gross capital stock (adjusted)

By drawing the potential output line parallel to that for average output against capital stock, it has been assumed that the average margin of spare capacity is constant, even though capital stock increases. There is no evidence of increasing amplitude of the cycles which would contradict this assumption. It is certainly true that in the most recent economic cycle the pressure of demand has been lower than average, but in the preceding cycle it was higher than average, and it may be concluded from Chart B that this period of low pressure has not yet biased downwards the estimate of potential output.

However, it may be that the plotted points on the right-hand side of Chart A which represent the more recent experience up to 1968, partly because of over-estimation of capital stock by the perpetual inventory method. This could occur if advancing technology, combined with lower average pressure of demand, were causing a decline in the average lives of some types of capital equipment. If this were so, the estimates of potential output, based on the relationship with capital stock, would also be biased upwards. In turn, it would mean that capital utilisation could be a little higher in the last two or three years than has been estimated.

Comparison with other indicators

Charts C and D compare the index of capital utilisation with two other measures frequently used as indicators of the pressure of demand on productive resources: first, unfilled adult vacancies and second, unemployment (wholly unemployed in Great Britain, excluding school-leavers), both series having been seasonally adjusted.

Vacancies and the index of capital utilisation seem to be closely related over the whole period 1955-71; but while they coincide at the cyclical troughs, there is a tendency for the index to reach cyclical peaks up to one year ahead of vacancies (see Chart C). This would appear to be plausible if employers respond initially to a relative decline in demand by changing the amount of overtime or short time worked, only altering the size of the work force later when the change in trend seemed likely to persist.

Unemployment is shown in Chart D on an inverted scale for comparison with the capital utilisation index. Although the two series move in broadly similar fashion between 1955 and 1966, thereafter they diverge quite markedly. In 1967, when both capital utilisation and vacancies suggested a relatively low pressure of demand, unemployment was unusually high, to judge from the earlier part of the period shown. Moreover, the subsequent rise in 1968 recorded by both the index and vacancies was not matched by a fall in unemployment. Later, in 1970-71, the fall in capital utilisation to 90-91, coupled with a decline in vacancies to a record low post-war point, was accompanied by a sharp rise in unemployment – to 800,000 in the third quarter of 1971. But in 1963, the last time capital utilisation was so low, the peak level of unemployment was less than 600,000.

The results of the Confederation of British Industry's four-monthly survey also give a very similar picture to that provided by the capital utilisation index. The cyclical peaks

CORRECTION

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The first sentence of the second paragraph should read:

However, it may be that the plotted points on the right-hand side of Chart A, which represent the more recent experience up to 1968, are curving away below the trend of average output partly because of over-estimation of capital stock by the perpetual inventory method.
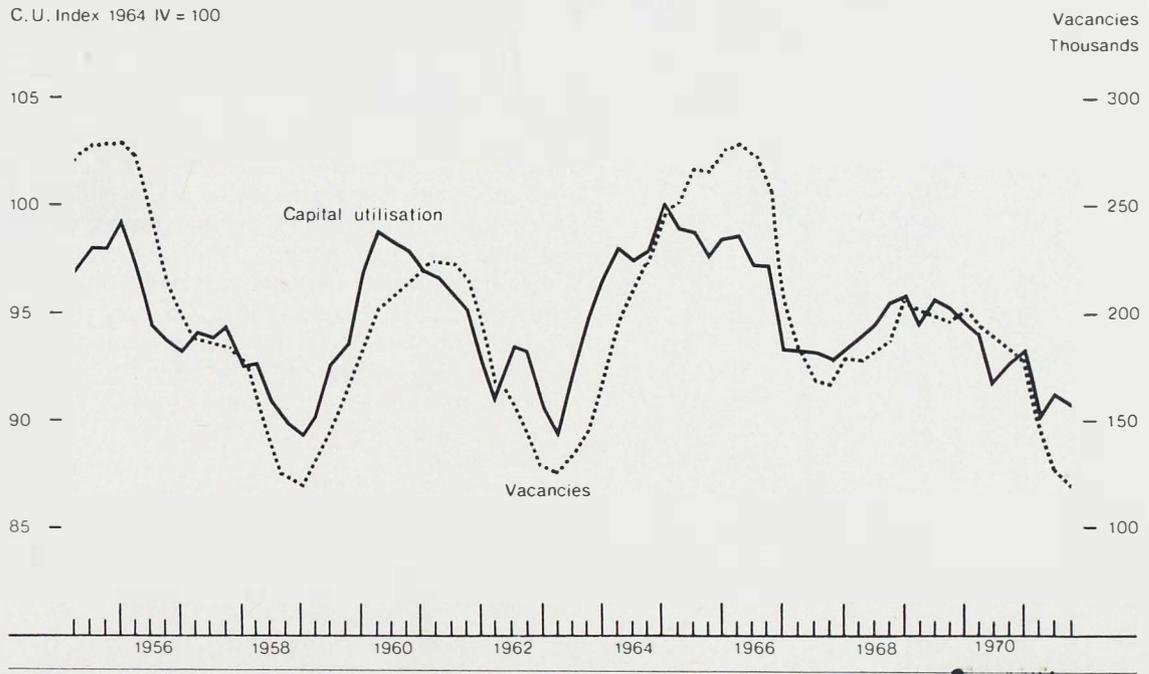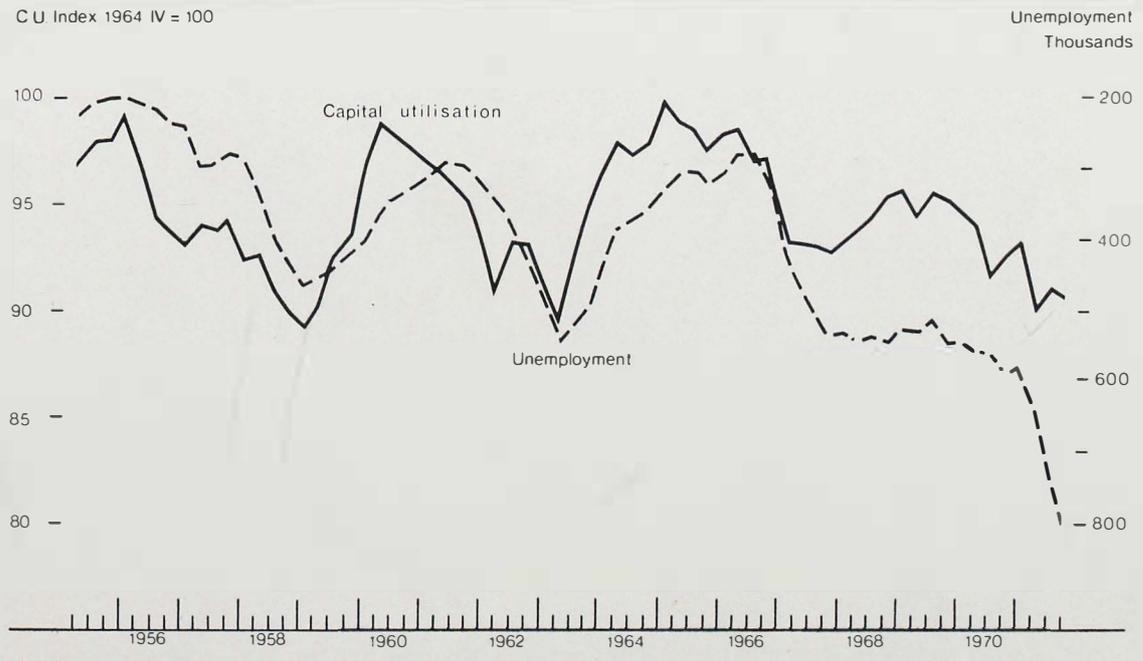
Chart C

Capital utilisation and vacancies

C.U. Index 1964 IV = 100

Vacancies
Thousands

Chart D

Capital utilisation and unemployment

C U Index 1964 IV = 100

Unemployment
Thousands

and troughs coincide quite closely, even though the survey, because it is carried out three times a year, does not generally refer to exactly the same period as the index. For the period 1967 to 1969, the survey suggests a somewhat sharper upturn, more akin to 1963-64, than does the index; but for 1970-71, the survey is becoming more in line with the other indicators.

Clearly, the concept of any absolute measure of capital utilisation is a nebulous one. The capital utilisation index does, however, appear to throw some light on the changes over time in the pressure of demand on economic resources. In broad terms, changes in it agree with other measures which are generally indicators of derived demand as distinct from demand for goods. The index may, therefore, provide a useful supplement to the understanding of the problems of demand management. It is hoped to make it available regularly in future issues of the *Bulletin*.