

[4] Focus: Why has the stock-output ratio fallen?

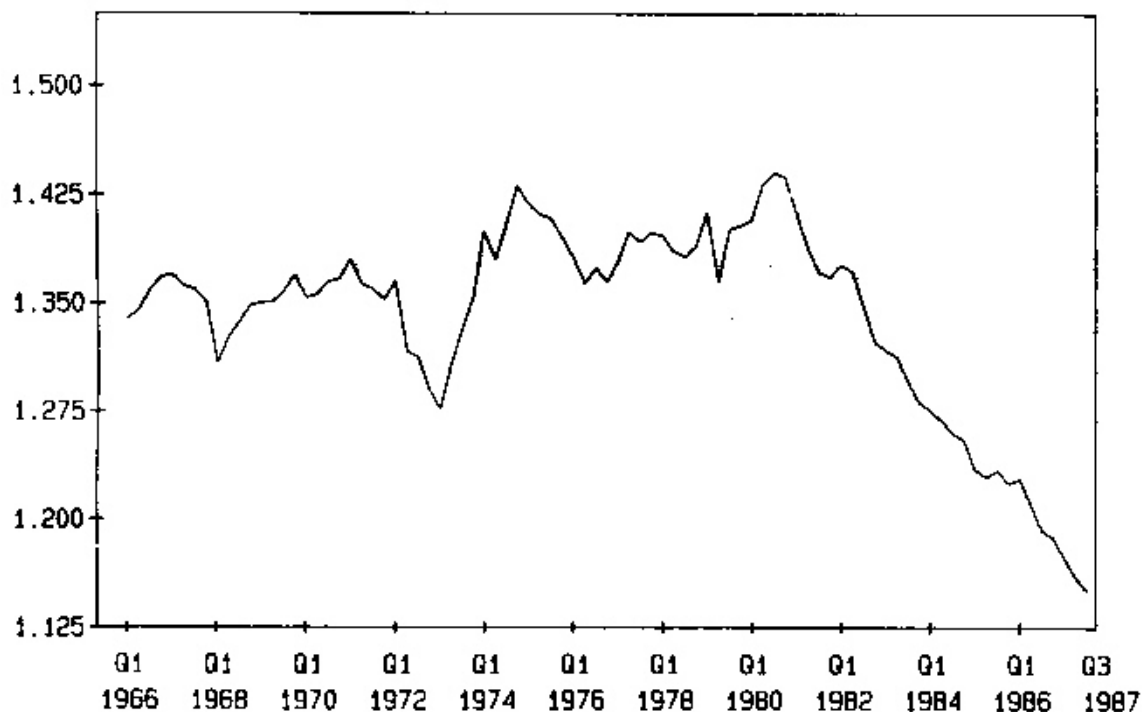
CHRIS HIGSON and SEAN HOLLY

*[From Economic Outlook 1987-1991,
(The London Business School Centre for Economic Forecasting)
Gower Publishing, Volume 12, number 5, February 1998]*

Introduction

The stock-output ratio for the UK economy is shown in Chart 20. From 1965 to 1980 there is a clear anti-cyclical pattern. During the upswing in the cycle there was a tendency for stocks to fall relative to output, while in the downturn this was reversed. Since 1980 there has been a marked change. The stock-output ratio has been in almost continuous decline, with the run-down in coal stocks during the miners' strike accelerating this process.

Chart 20



THE STOCK-OUTPUT RATIO

In this *Focus* we consider a number of explanations for the decline, and use company data in order to test what factors are most important.

We concentrate on the manufacturing sector where much, but by no means all of the decline has been concentrated. The absolute level of stocks in manufacturing declined 14 per cent between the third quarter of 1979 and the third quarter of 1987, while manufacturing output, over the same period, rose by 3 per cent.

We consider three explanations. Firstly, the composition of manufactured output has altered. Sectors such as heavy engineering, metals and motor cars have declined in absolute terms while there has been rapid growth in electrical and instrument engineering, chemicals and man-made fibres. If particular industries tend to hold a higher level of stocks relative to output compared with the average for manufacturing as a whole then a relative decline in these industries will lower the stock-output ratio for the manufacturing sector

The second explanation concerns the financial cost of holding inventories. The transition from negative real interest rates common in the 1970s to positive real interest rates in the 1980s has significantly altered the financial cost of holding inventories. The introduction of stock relief in 1975 provided a tax subsidy to stock-building, though this was revised in 1980 and abolished in 1984. (Many firms were 'tax exhausted' and hence unable to take advantage of this subsidy.)

The final explanation, though more difficult to quantify, concerns the *return* on holding inventories. One reason for holding inventories is to insure against running out of components and raw materials. If a company's suppliers are unreliable or affected by unpredictable industrial disputes then more stocks have to be held. Improvements in industrial relations make it possible to hold a lower level of stocks of raw materials and parts (work in progress). There have also been significant developments in the management of inventories, because of greater computerization, and the adoption of better operational procedures for the management of production. 'Just in time' methods are replacing the 'just in case' methods of the 1970s.

Changes in the composition of manufacturing output

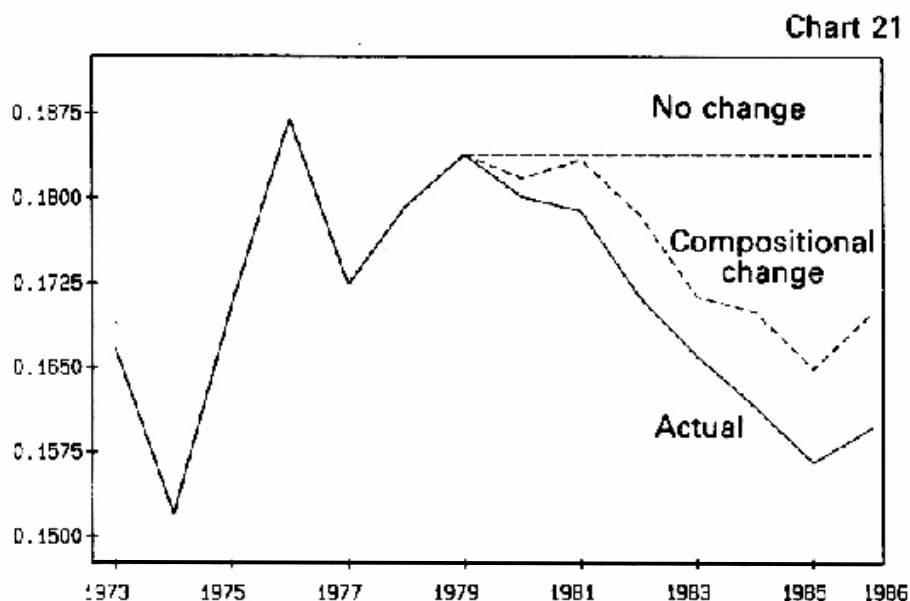
The compositional hypothesis is that there was a relative decline in those sectors which had high stock ratios. Table 15 sheds some light on this. Using company accounts data it decomposes the manufacturing sector into 16 industry groups and calculates the stock ratio for each industry in 1972, 1978 and 1985. The growth in the output of each sector over 1972-78 and 1978-85 is also shown. Both growth and the stock ratio are measured in 1980 prices. If de-stocking occurred because the composition of output changed, there should be a negative association between the stock ratios in 1978 and the 1978-1985 growth rates.

Table 15 illustrates rather dramatically the changes in the composition of UK manufacturing since 1978. Seven of the sixteen industries in Table 15 experienced a decline in real output between 1978 and 1985. But the compositional hypothesis only explains part of the de-stocking at the industry level - of the bottom eight industries in terms of growth, only five were in the top half in terms of their 1978 stock ratio, and stock ratios and growth are mildly inversely correlated. That compositional change is not the whole story can be seen by comparing the second and third columns of Table 15. Apart from the residual classes, 'Other' and 'Industrial Holding Companies', all industries showed a marked fall in their stock-sales ratio over this period.

Table 15
Sector stock ratios and relative growth

| Manufacturing Sector | Stock Ratio | | | Real Growth | |
|--------------------------|-----------------------------|------|------|-------------|-------|
| | (inventories as % of sales) | | | % | |
| | 1972 | 1978 | 1985 | 78/72 | 85/78 |
| Building Materials | 16.3 | 18.8 | 17.1 | 26.2 | 42.7 |
| Metals | 23.2 | 27.7 | 18.3 | 13.5 | -14.9 |
| Chemicals & Plastics | 20.5 | 20.6 | 16.5 | 25.4 | 19.7 |
| Mech. Eng. (Heavy) | 21.3 | 27.2 | 25.8 | 24.7 | 0.5 |
| Mech. Eng. (Light) | 24.5 | 26.4 | 21.6 | 11.7 | -18.3 |
| Electricals (Industrial) | 19.5 | 22.7 | 19.2 | 7.7 | 4.4 |
| Electricals (Domestic) | 19.3 | 22.5 | 14.3 | 13.3 | 42.2 |
| Motors | 22.3 | 24.8 | 21.9 | 17.8 | -13.5 |
| Food & Tobacco | 15.9 | 16.0 | 12.0 | 20.4 | -4.5 |
| Brewers | 23.8 | 23.1 | 16.2 | 17.6 | 11.0 |
| Pharmaceuticals | 20.5 | 23.3 | 18.3 | 26.3 | 30.7 |
| Publishing & Printing | 28.4 | 28.5 | 22.3 | -2.3 | -9.4 |
| Packaging & Paper | 10.9 | 12.7 | 10.0 | 0.4 | 7.2 |
| Textiles | 17.4 | 18.0 | 14.7 | 22.2 | -14.3 |
| Ind. Holding Co.s | 20.0 | 17.9 | 18.6 | 13.6 | 18.2 |
| Other Manufacturing | 17.1 | 17.2 | 18.1 | 25.9 | -10.5 |

One way of determining what contribution the change in the composition of manufacturing output has made to the decline in the stock-output ratio is shown in Chart 21.



The chart shows the actual stock-sales ratio for manufacturing, using company accounts data. Suppose that we assume that after 1978 each company in our sample kept the same proportion of each year's aggregate sales as it had in 1978, but that it retained the *actual* stock ratio after 1978. This is shown in Chart 21 as the middle line, and represents an estimate of what the stock ratio would have been had there been no change in the composition of manufacturing output after 1978. The chart also shows a horizontal line from 1978 which represents a constant 1978 stock ratio. The distance between the horizontal line and the observed stock ratio is what we want to explain. The distance between the horizontal line and the middle line is what is accounted for by other factors at the company level while the change in the composition of the manufacturing sector accounts for the rest. It appears that the change can account for about one third of the decline in the stock ratio. In 1983, for example, it accounts for 38 per cent while in 1984 it is 30 per cent.

The financial cost of holding inventories

In the absence of taxes the financial cost of holding inventories is simply the real, risk-adjusted interest rate. So at the margin the company has to trade off the expected marginal benefits of more inventories against the expected financial costs.

When there are taxes on companies, calculating the cost of holding inventories is more complex. Interest payments are tax deductible; between 1975 and 1984 there was stock relief, which was tax relief on the increase in the value

of stocks. However, a number of companies were tax exhausted and paid no mainstream corporation taxes. This means that we must calculate for each company the *effective* tax rate, where the upper limit on this is the actual statutory corporation tax rate, and the lower limit is zero for a company which is permanently tax exhausted.

The effective tax rate is, therefore, the expected present value of the marginal tax payment. Under the UK tax system a company also faces another form of tax exhaustion if it is unable to impute all of the advance corporation tax it pays on dividends against its mainstream corporation tax.

Table 16
Tax exhaustion in UK manufacturing

| | % of companies mainstream | Tax-exhausted ACT |
|-------------|------------------------------|----------------------|
| 1973 | 7 | 8 |
| 1974 | 21 | 47 |
| 1975 | 21 | 50 |
| 1976 | 29 | 60 |
| 1977 | 24 | 58 |
| 1978 | 24 | 60 |
| 1979 | 35 | 72 |
| 1980 | 43 | 73 |
| 1981 | 45 | 71 |
| 1982 | 42 | 69 |
| 1983 | 41 | 66 |
| 1984 | 33 | 56 |
| 1985 | 23 | 47 |
| 1986 | 18 | 39 |
| 1987 (est.) | 14 | 26 |

In Table 16 we show an estimate (using company data) of the proportion of *industrial and commercial companies* which were tax exhausted with respect to both mainstream and advance corporation tax between 1973 and 1987. Tax exhaustion became widespread in the 1970s because of a combination of low profits and generous tax allowances on investment in plant and machinery and inventories. It reached a peak in 1980, when 50 per cent of industrial and commercial companies were not paying taxes, and over 70 per cent had unrelieved advance corporation tax. Consequently the marginal value of tax allowances, and therefore the value of stock relief, was considerably lower for a number of firms.

Table 17
Post-tax real financial cost of inventories

| | Non tax-paying (a) | Temporary non- tax paying | Full tax-paying (b) | Tax subsidy (b-a) |
|------|-----------------------|------------------------------|------------------------|----------------------|
| 1973 | 8.0 | 5.60 | 3.84 | 4.16 |
| 1974 | -1.3 | -0.91 | -5.16 | 5.96 |
| 1975 | 0.8 | -3.92 | -5.16 | 5.96 |
| 1976 | 1.0 | -3.43 | -4.62 | 5.62 |
| 1977 | 5.7 | -0.51 | -2.84 | 8.54 |
| 1978 | 7.2 | 1.86 | -0.44 | 7.64 |
| 1979 | 7.5 | 0.91 | -1.78 | 9.28 |
| 1980 | 13.4 | 4.18 | -0.06 | 13.46 |
| 1981 | 15.0 | 8.53 | 3.63 | 11.37 |
| 1982 | 16.4 | 9.82 | 4.87 | 11.53 |
| 1983 | 13.7 | 7.98 | 4.07 | 9.63 |
| 1984 | 11.7 | 6.54 | 3.90 | 7.80 |
| 1985 | 18.1 | 12.67 | 10.86 | 7.24 |
| 1986 | 19.9 | 13.93 | 12.94 | 6.97 |

In Table 17 estimates of the after-tax financial cost of holding inventories are shown. Column 1 shows the cost for a company which does not pay taxes, through tax exhaustion, and does not expect to pay taxes. This cost is the same as the cost of holding inventories when there are no corporation taxes. The second column shows the cost of holding inventories for a company which is temporarily non-taxpaying and has an effective tax rate of, say, 30 per cent, and the third column shows the cost for a company which pays taxes at the statutory corporation tax rate.

There is a large gap between the effective marginal tax rate for a company which is tax exhausted and one which is not. As the last column in Table 17 shows, the tax subsidy to tax-paying companies peaked at 13 per cent in 1980, compared to the completely tax exhausted company. In 1975 a combination of a tax subsidy and rapid inflation made the financial cost of holding inventories negative (-5 per cent). In 1980 the cost was zero and by 1985 it had risen to 11 per cent. Nevertheless, the broad picture remains unchanged. All companies in the 1980s faced a large increase in the financial cost of holding inventories - whatever their tax-paying position - compared with the 1970s.

Some empirical evidence

The sample we have comprises 447 companies in the manufacturing sector over the period 1973-1986. The results of regressing stocks on gross output, the

nominal interest rate, the rate of inflation and the effective tax rate are shown in Table 18. Note that the effective tax rates in Table 17 are for aggregated companies. In our sample, each firm has its own effective tax rate, and this varies over time depending on its taxpaying position.

The rise in industry prices was used as an estimate of the inflation rate, and all companies were assumed to share the same cost of capital, indexed in the regression model by the treasury bill rate. Data on inventories and sales from company accounts were converted to 1980 prices using CSO industry (2-digit) quarterly price indices for materials and outputs respectively. The tax subsidy on inventories is based on estimates from Higson (1987) derived using company accounts data and a model of the UK corporation tax system. Because of the difficulties of estimating effective tax rates for companies whose accounts data contain a large overseas component, the sample was restricted to the 447 mainly domestic companies with not less than 60 per cent of their activities in the UK.

Company accounts data is not available on the benefits to holding inventories. However in order to capture non-financial factors that might be significant in explaining the stock ratio the model was estimated using group dummies, with companies clustered into ten groups on the basis of their average stock ratios.

Certain other elements were included in the regression analysis. If there are adjustment costs to changing inventories the model will be augmented by lagged functions of the independent variables. Hence one year backward- and forward-looking changes in output were included as independent variables. Secondly, because the effective tax rate is positively correlated with profitability there is a danger that it will proxy profit-ability-related attributes of the firm. To allow for this, a profitability variable was introduced, measured as earnings before interest and tax divided by gross assets.

Table 18 provides some suggestive regression results. A logarithmic specification was used and variables were combined into change form only when this did not restrict the underlying coefficients. Regressions were run on pooled data, for the period 1974-1985. The results show:

1. There is strong evidence of lagged adjustment of inventories to the previous year's sales, and a smaller anticipation of future output. Both these backward- and forward-expectations were strongly significant, and robust to all specifications of the model.
2. The tax subsidy has the predicted positive effect on the stock ratio.
3. Profitability was significant.
4. The results on the other components of financial cost, the nominal interest rate, and the rate of stock inflation, are mixed. There is a strong negative relationship between the stock ratio and the lagged interest rate. Though significant, the coefficients on stock inflation are generally small, perverse and unstable.

Table 18
Regression results
 (pooled sample, 1974-85)

| Dependent variable: $\ln(I/O)_t$ | | |
|----------------------------------|-------------|-------------|
| Independent variables | coefficient | t-statistic |
| $\Delta \ln I/O_{t-1}$ | +6.25 | (98.5) |
| $\Delta \ln O_t$ | -.644 | (61.9) |
| $\ln O_{t+1}$ | +.098 | (9.3) |
| $\ln O_t$ | +.002 | (1.6) |
| $\ln Ts_t$ | +.023 | (14.0) |
| $\ln r_{t-1}$ | -.313 | (9.3) |
| $\ln r_t$ | +.074 | (2.3) |
| $\ln i_{t-1}$ | +.007 | (2.4) |
| $\ln i_t$ | -.009 | (3.0) |
| $\ln P_t$ | -.007 | (2.7) |

I_t is inventories, O_t is gross sales, Ts_t is the tax subsidy, r_t is the rate of interest, i_t the price index for stocks, and p_t is profitability.

Conclusions

We have shown that something like a third of the fall in the stock-output ratio since 1979 can be attributed to a change in the composition of manufacturing output away from industries which have high stock-output ratios to industries which have lower ratios. We have identified two other factors. First, the financial cost of holding inventories and, particularly prior to 1980, tax incentives have played an important role in decisions about what level of stocks to hold. Secondly, a change in the climate under which companies operate and improvements in operational methods have allowed companies to produce a given level of output with lower levels of stocks, both in the form of raw materials and parts and finished goods.

With increases in company profitability, the outstanding mountain of tax deductions is being eroded and the tax subsidy on inventories is moving towards zero, increasing further the financial cost of inventory holding. Against this background the rate of improvement of production techniques and computerized control is unlikely to slacken. The prospects are that stock-output ratios will continue to decline.

Reference

Higson, C.J. The effective rate of Corporation Tax for UK companies, LBS Working Paper, 1987.