The cyclicality of mark-ups and profit margins: Some evidence for manufacturing and services

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Abstract

This paper looks at price cost mark-ups and firm profit margins in UK manufacturing and services. In particular it examines how they behave over the business cycle. It has two main findings. First, the estimated average mark-ups and the profit margin results both suggest that there is imperfect competition in manufacturing and services. Second, mark-ups are pro-cyclical, as are profit margins even after allowing for movements in their standard determinants. This suggests that price pressures may increase during recovery periods and decrease during recessions. One possible explanation for this is Kreps and Scheinkman's argument that the pro-cyclicality of capacity constraints means that firms move between Cournot and Bertrand competition over the cycle. The finding that mark-ups are pro-cyclical also raises doubts about macroeconomic models that assume that demand shocks may affect employment via counter-cyclical mark-ups.

1. Introduction

Movements in profit margins or price cost mark-ups are an important component of changes in prices.[1] For example, Wales (1989) referring to the mid to late 1980s concludes: 'In recent years profit margins have undoubtedly accounted for a significant part of the increase in prices - perhaps as a much as a third'. Given this, the behaviour of mark-ups over the business cycle is of interest to anyone concerned with the behaviour of prices in the short to medium run. It is also of interest because of the potential implications for the real economy. A number of recent macroeconomic models identify counter-cyclical movements in the mark-up as a simple transmission mechanism by which changes in nominal demand can lead to pro-cyclical movements in employment in the absence of nominal rigidities - for example see Blanchard and Fisher (1991).

Theory gives an ambiguous prediction as to how mark-ups behave over the cycle. The models of Bils (1989), Weitzman (1982) and Rotemberg and Saloner (1986) predict that mark-ups are counter-cyclical, whereas the models of Kreps and Scheinkman (1983) and Green and Porter (1984) predict they are pro-cyclical. Thus the issue is an empirical one. Most of the empirical work on mark-ups and the business cycle uses US data, although recent articles by Haskel, Martin and Small (1995) and Machin and Van Reenen (1993) have looked at UK data and found that mark-ups and firm profit margins in the UK are pro-cyclical. However, both articles only look at the manufacturing sector which now accounts for less than 25% of the UK economy. In addition, it is the behaviour of retailers' mark-ups rather than manufacturers' mark-ups which is of immediate relevance to the behaviour of retail prices.

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(1) By profit margins I mean the difference between a good's selling price and its average variable cost, expressed as a proportion of its price. The term mark-up refers to a good's selling price expressed as a proportion of its costs. Economists normally regard the mark-up over marginal cost as the right measure for price setting. However as marginal cost is not normally observable, the mark-up of price over average costs, which is related to one minus the inverse of the profit margin, is often used as a proxy. This involves making a number of restrictive assumptions.

The aim of this paper is to extend the above work by seeing whether mark-ups and firm profit margins in non-manufacturing industries, particularly retailing, are pro or counter-cyclical. It does this in two ways. First, the extension to Robert Hall's method of estimating the mark-up proposed by Haskel *et al* is used to see whether mark-ups in non-manufacturing as well as manufacturing industries are pro or counter-cyclical. Second, Machin and Van Reenen's model of firm profitability is used to see if the pro-cyclicality exhibited by firms' profit margins in retailing and manufacturing reflects changes in the time-varying determinants of profit margins, or whether after controlling for these factors profit margins are still pro-cyclical. An advantage of using these two different approaches and datasets is that it acts as a test on the reliability and robustness of the results.

There are two main results. First, average mark-ups are significantly greater than one in all but a few manufacturing industries, and profit margins are positively associated with both firm market share and industrial concentration, and display a significant degree of persistence. This suggests that significant imperfect competition exists in both UK manufacturing and services. Second, mark-ups are found to be pro-cyclical, and the pro-cyclicality exhibited by firm profit margins is found to only partly reflect movements in the standard determinants of margins. Once the latter are controlled for, profit margins still display a pro-cyclical pattern. This finding suggests that price pressures increase during recovery periods and decrease during recessions. It also raises doubts about macroeconomic models that assume that demand shocks may affect employment via counter-cyclical mark-ups.

The rest of the paper is divided into three sections. The following section looks at the cyclicality of the mark-up. It sets out Hall's approach to estimating the average mark-up and Haskel *et al*'s extension to this, discusses the data and estimation, and presents the results. The second section looks at the cyclicality of firm profit margins. It discusses the data and the behaviour of firm profit margins over the business cycle, sets out Machin and Van Reenen's model of profitability and the estimation technique used, and presents the results. The final section of the paper reviews the main findings and draws some conclusions.

2. The cyclicality of mark-ups

Estimating the mark-up

Haskel *et al* examine the cyclicality of the mark-up using an extension of Hall's approach to estimating the average mark-up, which in turn draws on Solow's (1957) seminal article on estimating productivity growth.(2) Assuming the only inputs are labour, capital and technical progress or total factor productivity (TFP) growth, Hall argues that a good approximation to marginal cost is the ratio of the change in total labour costs plus the change in total capital costs to the change in value-added output adjusted for the increase in output caused by TFP growth:(3)

$$MC = \frac{W \Delta L + r\Delta K}{\Delta Y - \theta Y} \qquad \textbf{(1)}$$

where W is the wage rate, L is labour input, r is the cost of capital, K is capital input, Y is value-added output, θ is TFP growth, and $\Delta X = X_t - X_{t-1}$.

The above equation cannot be used to measure marginal cost directly as it contains a number of unobservables; the cost of capital and TFP growth. However, equation **(1)** can be transformed into an expression which allows the average mark-up to be estimated. Rearranging equation **(1)** into a relationship between the growth rate of output and the growth rates of the inputs gives the following:

$$\frac{\Delta Y}{Y} = \frac{WL}{xY}\frac{\Delta L}{L} + \frac{rK}{xY}\frac{\Delta K}{K} + \theta \qquad \textbf{(2)}$$

where x is marginal cost.

Assuming that there are constant returns to scale - implying that the ratio of the sum of the input payments to output valued at marginal cost is unity - approximating growth rates by changes in logarithms and

(2) Hall develops this approach in a series of articles, Hall (1986), Hall (1988) and Hall (1990)

(3) Hall assumes that the firm's input markets are competitive.

defining the mark-up as the ratio of marginal cost to price allows equation **(2)** to be rewritten as:[4]

$$\Delta(y-k)_t = \mu_t \; V_t^L \Delta(l-k)_t + \theta \qquad \textbf{(3)}$$

where lower case indicates logarithms and $V_t^{\,L}$ is labour's factor share at time *t*.

Finally, assuming that the mark-up is constant over time ($\mu_t = \mu$) and modelling the rate of TFP growth - for example by including a constant term and a series of shift dummies, to capture any changes in the rate of TFP growth - gives the following equation:

$$\Delta(y-k)_t = \mu \; V_t^L \Delta(l-k)_t + \theta(t) \qquad \textbf{(4)}$$

Equation **(4)** can be used to estimate the average mark-up of price over marginal cost and test whether it is significantly different from unity. If μ is not significantly different from unity then this implies that price equals marginal cost, and the joint assumption of perfect competition and constant returns to scale cannot be rejected. But, if μ is significantly greater than unity, then given the assumption of constant returns to scale this implies that price exceeds marginal cost and μ can be interpreted as an estimate of the average mark-up. [5]

Haskel *et al* extended Hall's approach to allow for the possible cyclicality of the mark-up by specifying the mark-up as a function of a cyclical variable (cyc_t).[6] That is:

$$\mu_t = \mu + \mu_1 \; cyc_t \qquad \textbf{(5)}$$

Using this specification of the mark-up, equation **(4)** becomes the following:

$$\Delta(y-k)_t = (\mu + \mu_1 \; cyc_t) \; V_t^L \Delta(l-k)_t + \theta(t) \qquad \textbf{(6)}$$

The coefficient μ_1 tells us whether mark-ups are pro-cyclical or counter-cyclical, and in conjunction with the cyclical variables the extent to which the mark-up moves over the cycle.

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(4) Although equation **(3)** looks like an extension of Solow's approach to estimating TFP growth, it has been derived from a definition of marginal cost so it is not the first difference of a production function.
(5) μ may also exceed unity because there are increasing returns to scale as well as imperfect competition.
(6) They also specify the mark-up as a function of market power in the industry.

Data and estimation

A major difficulty involved in estimating the mark-up for non-manufacturing industries is the limited amount of disaggregated data available for these industries.[(7)] Data is only readily available at the one-digit level for non-manufacturing industries, as opposed to the two-digit level for manufacturing industries. Therefore, it is only possible to estimate mark-ups for quite broadly defined non-manufacturing industries. In total, annual data has been collected for six one-digit non-manufacturing industries - Financial Services, Communications, Transport, Hotels and Catering, Distribution and Repair and Construction - and ten two-digit manufacturing industries - Metal Manufacturing, Other Mineral Products, Chemicals, Other Metal Products, Mechanical Engineering, Electrical Engineering, Motor Vehicles, Textiles, Clothing and Footwear and Paper, Publishing and Printing. The main sources of these data are the Blue Book and the Employment Gazette. The former provided data on real and nominal value-added output, the nominal wage bill and the real capital stock, and the latter provided data on employment and hours worked.[(8)] Changes in the standard industrial classification restrict the period of estimation to data from 1968-91.

To see how imperfect competition varies within UK industry, the average mark-up for each of the sixteen industries is estimated using the following version of equation **(4)**:

$$\Delta(y-k)_{i,t} = \mu_i \; V^L_{i,t} \Delta(l-k)_{i,t} + \theta(t)_i + u_{i,t} \qquad \textbf{(7)}$$

where *i* represents industry *i*.

Although Hall models TFP growth using a constant, it is debatable whether this is satisfactory in the case of UK industries given the evidence of substantial changes in the rate of TFP growth over the period, for example see Layard and Nickell (1989). Therefore, the approach of Bean and Symons (1989) is used, and two shift dummies are included (one for 1974-80 and one for 1981-91) in equation **(7)** to

(7) This lack of data for non-manufacturing is why most articles restrict themselves to just looking at manufacturing industries.

(8) See the Data appendix for further details.

allow for changes in TFP growth. In the initial regressions, however, many of the shift dummies, particularly those for the 1980s, were found to be insignificant and were dropped from the equations.[9]

To see how the mark-up behaves over the cycle, the following version of equation **(6)** is estimated:

$$\Delta(y-k)_{i,t} = (\mu_i + \mu_1 \; cyc_{i,t}) \; V^L_{i,t}\Delta(l-k)_{i,t} + \theta(t)_i + u_{i,t} \qquad \textbf{(8)}$$

As it is unclear what the most appropriate cyclical indicator is, five different cyclical variables are used. These are the current and lagged values of the CSO coincident indicator, the current value of the CSO lagged indicator and the current and lagged values of the proportion of firms in the CBI Industrial Trends survey reporting that their level of output is not below capacity and reporting that their output is constrained by capacity. As there are no industry-specific cyclical variables available for non-manufacturing industries, the same aggregate cyclical variables is used for all industries.[10] The rate of TFP growth and changes in it are modelled as before.

The individual industry equations are estimated as a system. This allows the estimated coefficients to vary across the industries while taking account of the possibility that the residuals of the individual industry equations are correlated, for example due to common macro shocks. As the industry equations are estimated as a system a Wald test is used to see whether the estimated mark-ups are all significantly different from one, and hence whether the null hypothesis of perfect competition and constant returns to scale is accepted or rejected, and to see whether the mark-ups are the same in all industries. The labour factor share weighted growth rate of the labour-capital ratio is potentially endogenous in equations **(7)** and **(8)**, so the system is estimated using three-stage least squares. The instruments used are the lagged change in the industry's labour-capital ratio, the change in the labour-capital ratio of the whole economy and the growth rates of output in the whole economy and in the OECD.

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(9) This suggests that in most industries the pattern of TFP growth during the period was of a slowdown in the mid to late 1970s, followed by a recovery in the 1980s to rates similar to those enjoyed in the late 1960s/early 1970s.
(10) An attempt was made to construct industry cyclicality variables by taking the difference between actual output and trend output as estimated by a regression of industry output on a quintic in time, but this produced very imprecise estimates.

Results

The first column of Table A contains the estimates of the average mark-up from equation **(7)**. These estimates show that with just three exceptions all the industries have average mark-ups greater than one. The three exceptions are Textiles, Other Metal Products and Chemicals. The negative mark-ups in Other Metal Products and to a lesser degree Textiles are not unsurprising as these are both industries which have made heavy losses at some point over the period.[(11)] The negative mark-up in Chemicals is, however, puzzling.

The rest of the estimates in column (1) suggest that there are significant differences in the level of imperfect competition within UK industry. In particular, Paper, Printing and Publishing, Communications, Construction and Mechanical Engineering all have relatively high average mark-ups, while Other Mineral Products, Metal Manufacturing and Motor Vehicles all have relatively low average mark-ups. Overall the estimates show that the average mark-up tends to be higher in service industries than in manufacturing industries, which could reflect the greater tradeability of manufacturing.

The Wald test rejects the restriction that the average mark-ups are equal to one in all the industries, (χ^2=39.43, p=0.00), and the restriction that the average mark-ups are the same in all industries, (χ^2=39.43, p=0.00). In addition, the Wald test rejects the restrictions that the average mark-ups are equal to one, or all the same in those industries where the estimated mark-up is greater than one, (χ^2=65.21, p=0.00 and χ^2=29.29, p=0.00, respectively). The restrictions that the average mark-ups are equal to one or all the same in those industries where on the basis of just an individual t-test the estimated mark-ups are not significantly different from one, are also rejected, (χ^2=32.71, p=0.00 and χ^2=17.60, p=0.00, respectively). [(12)]

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(11) These negative mark-ups could also reflect decreasing returns to scale.

(12) The only industries where the estimated mark-up is significantly different from unity on the basis of just an individual *t*-test are Mechanical Engineering, Construction and Communications.

Table A
Average mark-ups

Industries	(1) Average mark-up	(2) Average mark-up
Metal Manufacturing	1.247 (0.233)	1.382
Other Mineral Products	1.147 (0.202)	1.499
Chemicals	0.790 (0.313)	0.858
Other Metal Products	0.983 (0.200)	1.042
Mechanical Engineering	1.535 (0.171)	1.621
Electrical Engineering	1.395 (0.255)	1.606
Motor Vehicles	1.141 (0.136)	1.164
Textiles	0.862 (0.159)	1.198
Clothing and Footwear	1.345 (0.412)	1.286
Paper, Printing and Publishing	1.950 (0.611)	2.945
Construction	1.564 (0.249)	1.696
Distribution and Repairs	1.382 (0.329)	1.552
Hotels and Catering	1.447 (0.342)	1.485
Transport	1.459 (0.292)	1.517
Communications	1.826 (0.401)	1.850
Financial Services	1.282 (0.260)	1.540

Notes: Standard errors in parentheses below estimates; Sample period 1969-91; Column (1) contains the estimates of the average mark-up from equation (10); Column (2) contains the estimates of the mark-up implied by the coefficients from the restricted versions of equation (11).

For manufacturing industries these results are broadly similar to what Martins, Scarpetta and Pilat (1996) and Haskel *et al* report. Both studies find that in most manufacturing industries the average mark-up is significantly greater than unity, and conclude that there is imperfect competition in UK manufacturing. The main difference with these studies is the size of the point estimates. In general the estimates of the average mark-up reported by Martins *et al* are lower than those in column (1), while the estimates reported by Haskel *et al* are higher. The difference with Martins *et al*'s estimates is because they estimate the mark-up of gross output over marginal costs including material costs (μ^g), while column (1) contains estimates of the mark-up of value-added output over the cost of marginal labour and capital (μ). The relationship between the two is $\mu^g = \mu / (1 + (\mu - 1)\alpha^m)$, where α^m is materials' share of gross output. Given α^m is less than one, the gross output mark-up is less than the value-added mark-up. The difference with Haskel *et al*'s estimates reflects the difference estimation procedure used - Haskel *et al* stack the individual equations to form a single equation - and the different instrument sets used - Haskel *et al* use industry-specific CBI cyclicality variables as instruments.

Table B
Cyclicality results

Cyclical variable	(1)	(2)	(3)	(4)	(5)
Lagged CSO coincident indicator	0.0822 (0.0097)				
Current CSO coincident indicator		0.0225 (0.0134)			
CSO lagged indicator			0.0579 (0.0092)		
Lagged % below capacity				1.716 (0.4917)	
Lagged % facing capacity shortages					1.979 (0.8820)

Notes: Standard errors in parentheses below estimates. These estimates are from estimating equation **(11)** with the restriction that the coefficients on the cyclical variable are the same in all industries.

Table B contains estimates of equation **(8)** using various cyclicality variables and imposing the restriction that the coefficient on the cyclicality variable is the same in all industries; this restriction is accepted in each column. Column (1) uses the lagged CSO coincidence indicator as the cyclicality variable. The estimated coefficient is positive and significant which implies that mark-ups are pro-cyclical. This finding is confirmed by the other cyclicality variables. The estimated coefficients are all positive and significant, although the estimate in column (2) is only significant at the 10% level. The estimates in Table B imply that mark-ups move quite substantially over the business cycle. For example, the estimates using the current value of CSO coincident indicator imply that the mark-up in Construction varied between 1.137 and 2.370. Over the whole period the average mark-ups implied by the estimates of equation **(8)** are broadly similar to those obtained from equation **(7)**. Column (2) of Table A contains the average mark-up for each industry implied by the estimates in column (2) of Table B. The correlation between the two columns in Table A is 0.864.

The finding that mark-ups in UK manufacturing and non-manufacturing are pro-cyclical is similar to that reported by Haskel *et al*. Using lagged cyclicality variables they find that mark-ups in manufacturing industries are pro-cyclical. The main difference with Haskel *et al*'s results is that the average mark-ups implied by their estimates are higher than those in column (2) of Table A. The finding is also similar to what Domowitz, Hubbard and Petersen (1986 and 1988) found for US manufacturing using the same type of approach, and Morrison (1994) found for Canadian manufacturing using a different approach. However, it contrasts with the results of Bils (1987), Rotemberg and Woodford (1991) and Morrison (1990), who all, using different approaches, find that the mark-up in US manufacturing is counter-cyclical.

3. The cyclicality of firm profit margins

The previous section used an extension of Hall's approach to examine the cyclicality of the mark-up. The robustness of Hall's approach has, however, been questioned. For example, Roeger (1995) argues that it is overly sensitive to the choice of instrument set:(13) the difference between the estimates in section 2 and Haskel *et al*'s estimates lends some support to this argument. Therefore to check the robustness of the previous section's findings, this section looks at the behaviour of firm profit margins over the cycle to see whether their pro-cyclicality just reflects movements in the standard determinants of margins, or whether, even after controlling for these, margins are still pro-cyclical.(14)

Firm profit margins

This section uses company accounts data drawn from Datastream. The data consists of 761 quoted firms and covers the period 1972-92. The sample is restricted to those companies operating in either manufacturing or retailing, and for which at least eight consecutive years of data are available. This sample selection criteria generated 12,524 firm-year observations, 78% of the maximum number of observations available for a panel with these dimensions. The firms tend to be large, which means that while the sample is not representative of the population of all firms, it is an appropriate sample for estimating oligopolistic models of profitability.

Chart 1 plots the distribution of firm profit margins, defined as the ratio of trading profits (Π) to sales (S), in the sample during the period 1972-92.(15) It shows that the whole distribution displays a similar pattern during the period. During the mid 1970s profit margins fell slightly and then stabilised before falling sharply during the recession at the beginning of the 1980s. After 1981 profit margins started to recover and continued to rise throughout the rest of the 1980s until the start of the recent recession when they again fell, although not as sharply as in the previous recession.

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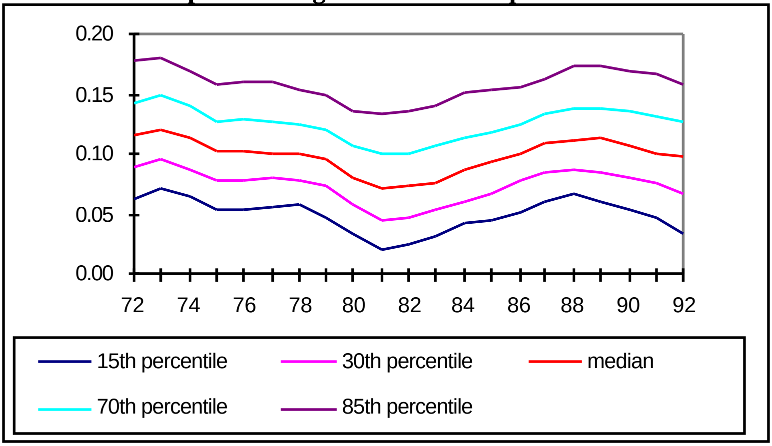
(13) Roeger proposes an extension of Hall's approach which avoids the use of instrumental variables, but his approach does not readily lend itself to examining the cyclicality of the mark-up.
(14) See S. Hall (1997) for an attempt to measure margins at the level of the manufacturing sector as a whole.
(15) Trading profits are profits inclusive of interest payments and depreciation.

Chart 1
Distribution of profit margins - whole sample



Comparing the pattern of profit margins with the various aggregate cyclical indicators plotted in Chart 2 shows that there appears to be an element of pro-cyclicality in the behaviour of firm profit margins during the period. This is confirmed by pooling the data and regressing firm profit margins $(\Pi / S)_i$ on the various cyclicality indicators - see Table C. The estimated coefficients on the cyclicality indicators all suggest that firm profit margins are pro-cyclical.

Chart 2
Cyclical indicators

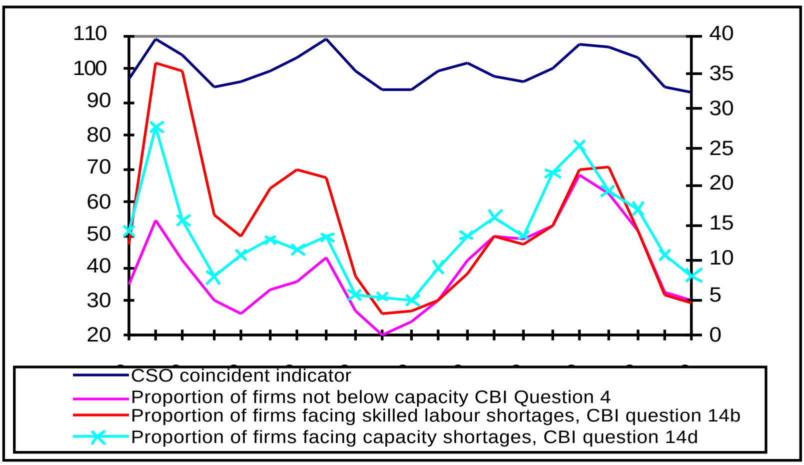


Table C
Whole sample

	(1)	(2)	(3)	(4)
C	-0.0611 (0.0121)	0.1509 (0.0029)	0.0868 (0.0011)	0.0872 (0.0013)
CSO coincident indicator	0.1667 (0.0122)			
CBI Q4		0.0758 (0.0046)		
CBI Q14b			0.1212 (0.0061)	
CBI Q14d				0.1852 (0.0095)
R^2	0.0142	0.0208	0.0307	0.0296
N	12524	12524	12524	12524

Notes: Dependent variable $(\Pi / S)_{i,t}$. Period of estimation 1972-92. Standard errors in brackets.

To see if there are substantial differences in the cyclical nature of profit margins between different sectors, the distribution of profit margins in each one-digit manufacturing sector and in retailing are plotted - see Charts 3, 4, 5 and 6. In addition, the data on firm profit margins in each of these sectors is pooled and regressed on the various aggregate cyclicality variables - see Table D. These exercises both show that the pro-cyclicality of firm profit margins is a feature common to all these sectors. They also suggest that there are only relatively minor differences in the behaviour of firm profit margins over the business cycle in the various sectors of manufacturing and in retailing.

Chart 3
Metals and chemicals

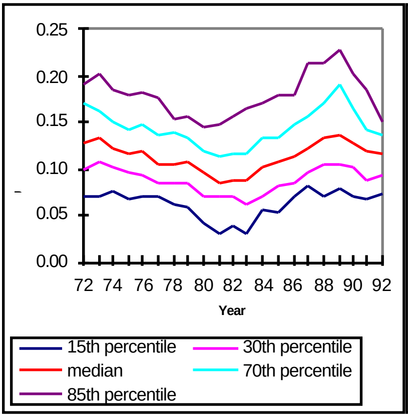


Chart 4
Engineering

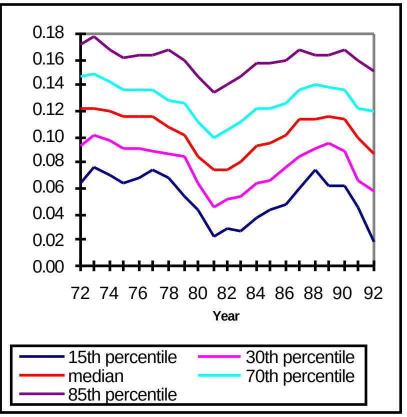


Chart 5
Other manufacturing

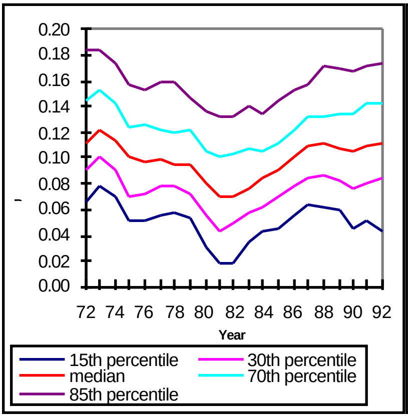


Chart 6
Retailing

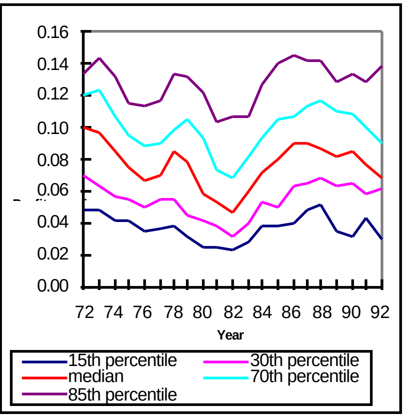


Table D
Individual sectors

	Metals and chemicals	Engineering	Other manufacturing	Retailing
CSO coincident indicator	0.1745 (0.0342)	0.1649 (0.0197)	0.1653 (0.0195)	0.1657 (0.0333)
CBI Q4	0.1156 (0.0131)	0.0649 (0.0076)	0.0696 (0.0074)	0.0876 (0.0128)
CBI Q14b	0.1163 (0.0171)	0.1215 (0.0099)	0.1258 (0.0098)	0.1055 (0.0165)
CBI Q14d	0.2454 (0.0265)	0.1621 (0.0155)	0.1828 (0.0152)	0.1955 (0.0259)
N	1723	4815	4829	1157

Notes - as for Table C

Modelling profitability

The starting point for Machin and Van Reenen's model of profitability is, as with many models of profitability, the model of oligopoly developed by Cowling and Waterson (1976). This expresses the mark-up of price over marginal cost for a profit-maximising firm, measured here by the profit margin, as a function of the firm's market share (MS_i), a conjectural term (λ_i) which captures what the firm expects the output responses of other firms to be to a change in its output, and the elasticity of demand in the firm's industry (ε_j). That is:

$$(\Pi / S)_i = MS_i(1 + \lambda_i) / \varepsilon_j \quad \textbf{(9)}$$

To turn this expression into an estimable equation the unobservable conjectural term needs to be modelled. Machin and Van Reenen use the following relatively general formulation which expresses firm conjectures as a function of two terms:

$$\lambda_i = \alpha_{1,i}((1 - MS_i) / MS_i) + \alpha_{2,i}(1 / MS_i) \quad \textbf{(10)}$$

The first term is that suggested by Clarke and Davies (1982) and incorporates perfect collusion and Cournot behaviour as special cases; if $\alpha_{1,i} = 1$ then there is perfect collusion as the firm expects that other firms will react to a change in its output by trying to maintain their market share, while if $\alpha_{1,i} = 0$ then there is Cournot behaviour as the firm believes that other firms will not react. However, as the first term means that the magnitude of λ_i declines with market share, which implies that larger firms always have smaller conjectures, Machin and Van Reenen include the second term to allow the firm's conjecture to be determined by own market share.

The coefficients $\alpha_{1,i}$ and $\alpha_{2,i}$ capture the extent to which each firm reacts to the actions of its competitors. These coefficients are assumed to be functions of sales concentration in the firm's principal operating industry ($SC_{j,t}$), past profitability and an aggregate cyclicality variable (CYC_t).(16) The cyclicality variable is included to allow for the possibility that even after controlling for the time varying determinants of profit margins, margins still vary over the cycle, for example because the nature of competition varies over the cycle. Thus firm conjectures are modelled by the following expression:

$$\lambda_i = (\delta_{1,1}(\Pi / S)_{i,t} + \delta_{1,2}SC_{j,t} + \delta_{1,3}CYC_t)((1 - MS_i)/MS_i) + (\delta_{2,1}(\Pi / S)_{i,t} + \delta_{2,2}SC_{j,t} + \delta_{2,3}CYC_t))(1/MS_i) \quad \textbf{(11)}$$

Substituting this expression for λ_i in equation (**9**) and rearranging it gives the following general model of profit determination:

$$(\Pi / S)_{i,t} = \gamma_i + \beta_1(\Pi / S)_{i,t-1} + \beta_2 MS_{i,t} + \beta_3 SC_{j,t} + \beta_4 CYC_t + \beta_5 MS_{i,t}\ (\Pi / S)_{i,t-1} + \beta_5 MS_{i,t} * SC_{j,t} + \beta_7 MS_{i,t} * CYC_t + u_{i,t} \quad \textbf{(12)}$$

where γ_i is a firm-specific fixed effect which controls for any unobservable firm-specific effects that are time invariant, for example management ability.(17)

Equation **(12)** is estimated using the panel of firm data from the first part of this section. Firm market share is measured by each firm's share of sales in its two-digit industry, while sales concentration is measured by the sales weighted average of three-digit sales concentration in the

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(16) The assumptions that these coefficients are the same for all firms in an industry and increasing functions of industry sales concentration are standard in studies that use Cowling and Waterson's model. Lagged profitability is included to allow for the possibility that there are lags in adjustment and because current conjectures may depend upon past performance.

(17) The coefficient on the interaction between firm market share and the cyclicality variable was always small and insignificant, so this term was dropped from the estimated equation.

firm's two-digit industry.[18] Both industry sales and sales concentration are matched to individual firms on the basis of the firm's principal operating industry in terms of sales. A number of cyclicality variables are used to model the cyclicality term, including the current values of the CSO coincident indicator and the current proportion of firms in the CBI survey reporting that their current level of output is not below capacity and reporting that their output is currently constrained by a lack of skilled labour and a lack of capacity.

With regard to the estimation procedure the firm-specific fixed effects are eliminated from equation **(12)** by using the standard method of taking first differences. As this means the lagged dependent variable is now endogenous and because all the current firm level explanatory variables can reasonably be regarded as endogenous, the equation is estimated by instrumental variables. This is done by using the Generalised Method of Moments procedure proposed by Arellano and Bond (1988 and 1991).[19] This procedure uses variables dated (t-2) or earlier as valid instruments and calls upon more instruments as the period of estimation advances. The actual instruments used are all the moment restrictions dated between t-3 and t-4 on the lagged dependent variable, firm market share, the firm's investment-sales ratio and dividend payments.[20] The validity of the instrument set is checked by a Sargan test and a test for second-order serial correlation. [21]

Results

Table E contains the results from estimating equation **(12)** with the different cyclicality variables. The estimated coefficients on the non-cyclicality variables are very similar in terms of sign and size in all of the columns and with a few exceptions are all significant at the 5% level.[22] As anticipated by the traditional view in industrial economics

(18) See the data appendix for further details.

(19) This is a more efficient estimation procedure than the three-stage least squares procedure used in section two. Unfortunately Arellano and Bond's DPD package which contains this estimator does not lend itself to the estimation of systems of equations.

(20) If the interactions are included in the regression the same moment restrictions on them are also used as instruments.

(21) In a first differenced model the Sargan test is only valid if there is no second-order serial correlation.

(22) The exceptions are firm market share in columns (1), (2) and (4).

both firm market share and industry sales concentration have a positive effect on firm profit margins. However the interaction between firm market share and industry sales concentration has a negative effect. Therefore, although increases in a firm's market share or in sales concentration leads to higher profit margins, this effect is offset to an extent if a firm has a large market share and operates in a highly concentrated industry. The latter suggests that there is a degree of competitive behaviour between firms in oligopolistic industries. Past profitability has a substantial effect upon current profit margins suggesting there is a large degree of persistence in firm profitability. This result is in line with the findings of the persistence of profitability literature, for example see Mueller (1990). Finally looking at the coefficients on the cyclical variables shows that even after controlling for quite a wide range of determinants of profit margins, margins are still pro-cyclical.

Table E

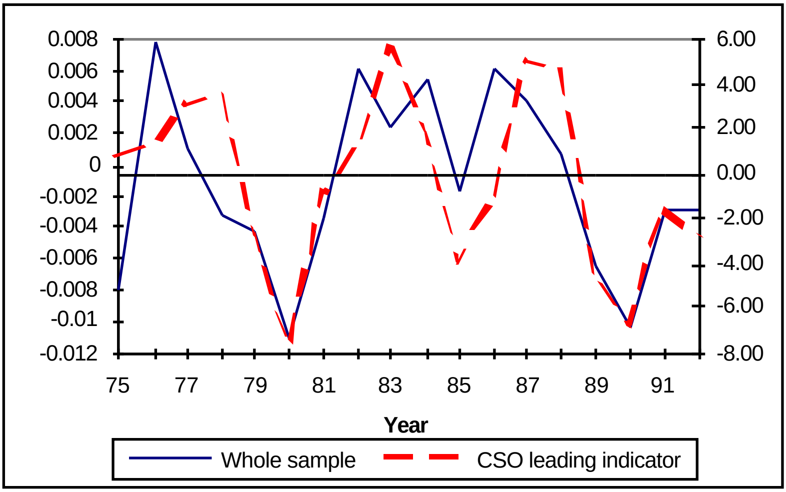
	(1)	(2)	(3)	(4)	(5)
C					-0.0079 (0.0017)
$(\Pi/S)_{i,t-1}$	0.5381 (0.0299)	0.4998 (0.0518)	0.4283 (0.0605)	0.4975 (0.0507)	0.5056 (0.0782)
$MS_{i,t}$	0.3965 (0.2129)	0.2726 (0.2080)	0.6087 (0.3024)	0.2966 (0.2128)	0.6682 (0.3254)
$SC_{j,t}$	0.1027 (0.0165)	0.1237 (0.0210)	0.0863 (0.0208)	0.1105 (0.0206)	0.0364 (0.0224)
$MS_{i,t} * SC_{j,t}$	-0.6651 (0.3646)	-0.6354 (0.2831)	-1.0657 (0.4461)	-0.6828 (0.2969)	-1.0872 (0.4851)
CSO coincident indicator	0.0586 (0.0078)				
CBI $Q4_t$		0.0430 (0.0047)			
CBI $Q14b_t$			0.0637 (0.0082)		
CBI $Q14d_t$				0.1081 (0.0101)	
1976 dummy					0.0157 (0.0028)
1977 dummy					0.0089 (0.0022)
1978 dummy					0.0046 (0.0020)
1979 dummy					0.0036 (0.0025)
1980 dummy					-0.0032 (0.0023)
1981 dummy					0.0045 (0.0024)

1982 dummy					0.0142 (0.0024)
1983 dummy					0.0104 (0.0030)
1984 dummy					0.0135 (0.0034)
1985 dummy					0.0063 (0.0027)
1986 dummy					0.0142 (0.0025)
1987 dummy					0.0121 (0.0027)
1988 dummy					0.0087 (0.0027)
1989 dummy					0.0016 (0.0028)
1990 dummy					-0.0024 (0.0030)
1991 dummy					0.0051 (0.0036)
1992 dummy					0.0050 (0.0030)
Test statistics					
Serial correlation [N(0,1)]	-1.508	-0.880	-1.227	-0.740	-0.858
Sargan test χ^2 (df)	312.00 (168)	289.44 (168)	286.84 (168)	274.08 (162)	177.26 (168)
Wald test for time dummies χ^2 (df)					327.43 (18)
Sample size	10241	10241	10241	10241	10241
Number of firms	761	761	761	761	761

Notes: The dependent variable is $(\Pi / S)_{i,t}$. Estimation is in first differences. Standard errors in brackets. Those reported are robust one-step estimates. The instrument set consists of all the moment restrictions dated between (*t*-3) and (*t*-4) on the lagged dependent variable, firm market share, the firm's investment -sales ratio and firm dividend payments. The serial correlation test is N(0,1) test for second-order serial correlation and the Sargan test is a χ^2 test of the over identifying restrictions.

The drawback with the results in the first four columns of Table E is that each regression fails the Sargan test. Therefore in column (5) the cyclicality variable is dropped and replaced by a full set of time dummies. This is a more general way of modelling the cyclicality effect as the time dummies will capture any unobserved time-specific effects that are common to all firms. This solves the mis-specification problem in the first four columns; the regression in column (5) passes the Sargan test. In addition, the main non-cyclicality findings from the first four columns still hold; the estimated coefficients on the non-cyclicality variables in column (5) are similar to those in columns (1)-(4).

Chart 7
Whole sample



Examination of the estimated coefficients on the time dummies in column (5) shows that the size of the coefficients falls in the late 1970s and early 1980s, then recovers in the mid-1980s before falling again in the late 1980s and early 1990s, see Chart 7. Comparing this pattern with the CSO leading indicator shows that after controlling movements in the standard determinants of profit margins, margins are pro-cyclical. In terms of the effect on profitability the estimates imply that profit margins were 0.8 percentage points higher in 1976 than in 1975 and 1 percentage point lower in 1990.(23) Given the mean profit margin for the whole period is 10% these effects on profitability are not inconsequential.

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(23) The effect in 1975 is the coefficient on the constant. After 1975 the effect in each year is the sum of the coefficient on the constant plus the coefficient on the time dummy.

Table F

	Metals and chemicals	Engineering	Other manufacturing	Retailing
C	-0.0090 (0.0041)	-0.0024 (0.0024)	-0.0133 (0.0031)	-0.0125 (0.0028)
$(\Pi/S)_{i,t-1}$	0.4882 (0.1079)	0.4096 (0.1104)	0.4890 (0.0684)	0.2484 (0.1905)
$MS_{i,t}$	-0.0982 (0.2526)	0.4756 (0.3071)	0.3667 (0.2231)	-0.0937 (0.2308)
$SC_{j,t}$	-0.0148 (0.0949)	0.0402 (0.0360)	0.0721 (0.0349)	0.0896 (0.1442)
$MS_{i,t}*SC_{j,t}$	-0.05381 (0.6146)	-0.8879 (0.4003)	-0.5877 (0.3277)	0.6277 (0.5189)
1976 dummy	0.02420 (0.0075)	0.0059 (0.0036)	0.0245 (0.0052)	0.0074 (0.0057)
1977 dummy	-0.0021 (0.0057)	0.0036 (0.0030)	0.0177 (0.0039)	0.0151 (0.0035)
1978 dummy	0.0070 (0.0055)	-0.0029 (0.0030)	0.0092 (0.0033)	0.0160 (0.0038)
1979 dummy	-0.0002 (0.0086)	-0.0029 (0.0034)	0.0117 (0.0038)	0.0065 (0.0042)
1980 dummy	0.0000 (0.0055)	-0.0058 (0.0041)	-0.0016 (0.0038)	0.0007 (0.0038)
1981 dummy	0.0011 (0.0072)	-0.0051 (0.0038)	0.0102 (0.0040)	0.0073 (0.0037)
1982 dummy	0.0123 (0.0055)	0.0114 (0.0041)	0.0190 (0.0040)	0.0077 (0.0049)
1983 dummy	0.0092 (0.0061)	0.0042 (0.0040)	0.0168 (0.0059)	0.0155 (0.0077)
1984 dummy	0.0222 (0.0062)	0.0066 (0.0038)	0.0191 (0.0071)	0.0183 (0.0055)
1985 dummy	0.0044 (0.0059)	0.0005 (0.0039)	0.0135 (0.0043)	0.0122 (0.0052)
1986 dummy	0.0169 (0.0049)	0.0091 (0.0045)	0.0191 (0.0037)	0.0099 (0.0048)
1987 dummy	0.0170 (0.0061)	0.0082 (0.0047)	0.0145 (0.0038)	0.0150 (0.0053)
1988 dummy	0.0118 (0.0065)	0.0039 (0.0042)	0.0148 (0.0040)	0.0090 (0.0046)
1989 dummy	0.0129 (0.0054)	-0.0001 (0.0038)	0.0026 (0.0051)	-0.0007 (0.0051)
1990 dummy	-0.0108 (0.0079)	-0.0057 (0.0044)	0.0018 (0.0049)	0.0115 (0.0077)

1991 dummy	0.0029 (0.0049)	-0.0098 (0.0045)	0.0225 (0.0075)	0.0095 (0.0043)
1992 dummy	0.0129 (0.0053)	-0.0034 (0.0053)	0.0122 (0.0045)	-0.0044 (0.0071)
Test statistics				
Serial correlation [N(0,1)]	-1.349	-1.459	0.464	-1.300
Sargan test χ^2 (df)	101.24 (162)	172.74 (162)	188.18 (162)	42.00 (162)
Wald test for time dummies χ^2 (df)	134.11 (18)	123.69 (18)	217.60 (18)	106.50 (18)
Sample size	1414	3930	3962	935
Number of firms	103	295	289	74

Notes - as for Table E.

Table F presents estimates for the three sectors of manufacturing and for retailing. Although the estimates for the Metals and Chemicals and the Retailing sectors are poor, this reflects the relatively small number of firms in these two sectors, the estimates for the Engineering and Other Manufacturing sectors broadly support the findings for the whole sample. In particular, comparing the coefficients on the time dummies with the CSO leading indicator shows that profit margins are pro-cyclical in each of the sectors - see Charts 8, 9, 10 and 11.

Chart 8
Other manufacturing

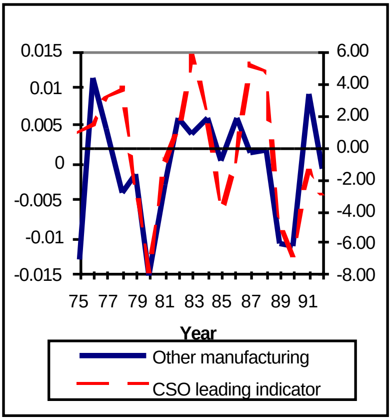


Chart 9
Engineering

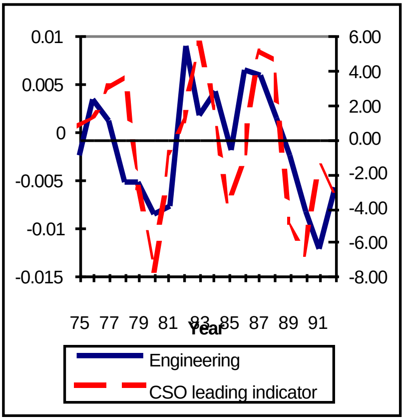


Chart 10
Metals and chemicals

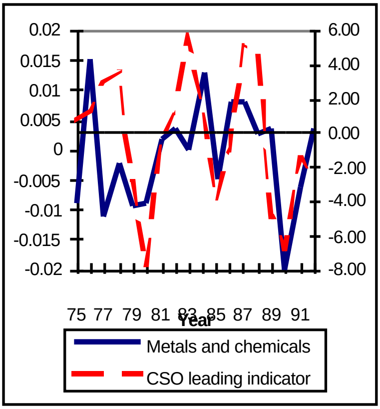
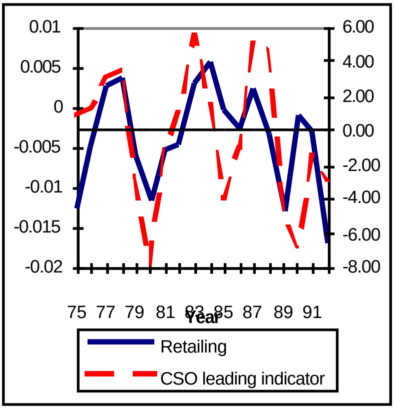


Chart 11
Retailing



The results reported here are rather different to Machin and Van Reenen's findings. In terms of the cyclicality of profit margins, while Machin and Van Reenen conclude that margins are pro-cyclical after controlling for various time-varying determinants of profit margins, the results here suggest that margins actually lead the cycle slightly. This difference may partly reflect the different periods of estimation; Machin and Van Reenen's sample only covers one cycle while the sample used in this work covers two cycles. In terms of the non-cyclical determinants of profit margins the main difference is that Machin and Van Reenen find that firm market share only has a small effect upon profit margins, while the results here suggest that it has a more substantial effect.

4. Conclusion

This paper has looked at price cost mark-ups and firm profit margins in UK manufacturing and services. It has two main findings. The first is that imperfect competition exists in both manufacturing and services. Estimated average mark-ups are significantly greater than unity in all but a few manufacturing industries, while profit margins are positively associated with both firm market share and industrial concentration, and display a large degree of persistence. The second finding is that mark-ups in manufacturing and services are pro-cyclical. The profit margins results support this, showing that the pro-cyclicality exhibited by profit margins only partly reflects movements in the standard determinants of margins, and once these are allowed for, margins still display a pro-cyclical pattern.

The finding that mark-ups and margins are pro-cyclical suggest that price pressures move in line with the cycle, increasing during the recovery period and decreasing during recessions. This could be because the pro-cyclicality of capacity constraints means that firms move between Cournot and Bertrand competition over the cycle. The finding also raises some doubts about macroeconomic models which suggest that counter-cyclical mark-ups are the transmission mechanism via which pro-cyclical changes in demand lead to pro-cyclical changes in employment.

References

Arellano, M and Bond, S (1988), 'Dynamic Panel Data Estimation Using DPD: A Guide for Users', *IFS Working Paper* No.88/15.

Arellano, M and Bond, S (1991), 'Some Tests of Specification for Panel Data', *Review of Economic Studies*, Vol.58, pages 277-98.

Bean, C and Symons, J (1989), 'Ten Years of Mrs T', *NBER Macroeconomics Annual*, 4, pages 13-61.

Bils, M (1987), 'The Cyclical Behaviour of Price and Marginal Cost', *American Economic Review*, vol. 77, pages 838-55.

Bils, M (1989), 'Pricing in a Customer Market', *Quarterly Journal of Economics*, vol. 104, pages 699-718.

Blanchard, O and Fisher, S (1991), 'Lectures on Macroeconomics', *MIT Press*, Cambridge MA.

Clarke, R and Davies, S (1982), 'Market Structure and Price cost Margins', *Economica*, vol.49, pages 227-87.

Cowling, K and Waterson, M (1976), 'Price cost Margins and Market Structure', *Economica*, vol. 43, pages 267-74.

Domowitz, I, Hubbard, G and Petersen, B (1986), 'Business cycles and the Relationship Between Concentration and Price cost Margins', *Rand Journal of Economics*, vol. 17, pages 1-17.

Domowitz, I, Hubbard, G and Petersen, B (1988), 'Market Structure and Cyclical Fluctuations in US Manufacturing', *Review of Economics and Statistics*, vol. 67, pages 55-66.

Green, E and Porter, R (1984), 'Noncooperative Collusion Under Imperfect Price Information', *Econometrica*, vol. 52, pages 87-100.

Hall, R (1986), 'Market Structure and Macroeconomic Fluctuations', *Brookings Papers on Economic Activity*, vol. 2, pages 285-322.

Hall, R (1988), 'The Relationship Between Price and Marginal Cost in US Industry', *Journal of Political Economy*, vol. 96, pages 921-47.

Hall, R (1990), 'Invariance Properties of Solow's Productivity Residual' in P. Diamond ed. *Growth/Productivity/Unemployment*, MIT Press, Cambridge, Mass.

Hall, S (1997), 'The Construction of Manufacturing Margins', *Bank of England Working Paper,* forthcoming.

Haskel, J, Martin, C and Small, I (1995), 'Price, Marginal Cost and the Business Cycle', *Oxford Bulletin of Economics and Statistics*, vol.57, pages 25-39.

Kreps, D and Scheinkman, J (1983), 'Quantity Pre-Commitment and Bertrand Competition Yield Cournot Outcomes', *Rand Journal of Economics*, vol. 14, pages 326-37.

Layard, R and Nickell, S (1989), 'The Thatcher Miracle?', *American Economic Review*, vol. 79, pages 215-19.

Machin, S and Van Reenen, J (1993), 'Profit Margins and the Business Cycle: Evidence From Manufacturing Firms', *Journal of Industrial Economics,* vol. XLI, pages 29-50.

Martins, J O, Scarpetta, S and Pilat, D (1996), 'Mark-Up Ratios in Manufacturing Industries', *OECD Working Paper*, no. 162.

Morrison, C (1990), 'Market Power, Economic Profitability and Productivity Growth Measurement: An Integrated Structural Approach', *NBER Working Paper*, no. 3355.

Morrison, C (1994), 'The Cyclical Nature of Mark-Ups in Canadian Manufacturing: A Production Theory Approach' *Journal of Applied Econometrics*, vol. 9, pages 269-82.

Mueller, D (Ed), (1990), *'The Dynamics of Company Profits: An International Comparison'*, Cambridge University Press.

Roeger, W (1995), 'Can Imperfect Competition Explain the Difference Between Primal and Dual Productivity Measures? Estimates for US Manufacturing', *Journal of Political Economy*, vol.103, no.2, pages 316-30.

Rotemberg, J and Saloner, G (1986), 'A Supergame Theoretic Model of Price Wars During Booms', *American Economic Review*, vol. 76, pages 390-407.

Rotemberg, J and Woodford, M (1991), 'Mark-Ups and the Business Cycle', *NBER Macroeconomics Annual*, 6.

Solow, R (1957), 'Technical Change and the Aggregate Production Function', *Review of Economics and Statistics,* Vol. 39, pages 312-20.

Wales, R (1989), 'Trends in Profit Margins', *Bank of England Quarterly Bulletin*, May, pages 227-34.

Weitzman, V (1982), 'Increasing Returns and the Foundations of Unemployment Theory', *Economic Journal*, vol. 92, pages 787-804.

Data appendix

Mark-ups data

Real value-added output: GDP at constant factor cost, Table B.4, Blue Book.

Nominal value-added: Table B.3, Blue Book.

Nominal total wages: Table3.3, Blue Book.

Real gross capital stock: Table A3.8, Blue Book.

Total employment: Table A.2, Employment Gazette.

Actual hours worked: Table E.4 Employment Gazette.

Capacity variables

% of firms reporting their level of output is below capacity: Question 4 in the CBI Quarterly Industrial Trends Survey.

% of firms reporting their output is constrained by capacity: Question 14d in the CBI Quarterly Industrial Trends Survey.

% of firms reporting their output is constrained by skilled labour shortages: Question 14b in the CBI quarterly Industrial Trends Survey.

CSO coincident indicator: Economic Trends.

CSO lagged indicator: Economic Trends.

Company data

The structure of the panel is as follows: 12 firms have only 8 observations, 25 have 9, 49 have 10, 55 have 11, 48 have 12, 49 have 13, 41 have 14, 40 have 15, 36 have 16, 30 have 17, 43 have 18, 57 have 19, 18 have 20 and 258 firms are observed continuously for the whole 21-year period.

Trading profits: Datastream item 135.

Total sales: Datastream item 104.

Profit margins industry data.

Two-digit industry sales: Manufacturing, Table A, Census of Production, Retailing, Business Monitor.

Sales concentration: Manufacturing, sales weighted average of three-digit sales concentration in each two-digit industry, Table A3 Census of Production. Retailing, Table A3 Retailing Business Monitor SDA25.