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

By Ian Small of the Bank's Structural Economic Analysis Division.

This article[1] reviews how price-cost mark-ups and firm profit margins in UK manufacturing and services behave over the business cycle, to see whether they move pro-cyclically. Movements in mark-ups and margins are important because of their effect on prices: pro-cyclical changes might suggest that price pressures increase during recovery periods and decrease during recessions. The article presents some empirical evidence that suggests that mark-ups and profit margins do both move pro-cyclically.

Introduction

Movements in price-cost mark-ups and profit margins are an important component of changes in prices. So the behaviour of these mark-ups and margins over the business cycle is of interest to anyone concerned with the behaviour of prices in the short to medium run.

The term 'mark-up' refers to a good's selling price expressed as a proportion of its marginal costs; 'profit margins' are the difference between a good's selling price and its average variable cost, expressed as a proportion of its price. Different theoretical models give contradictory predictions about how mark-ups and margins will behave over the cycle. So we turn to empirical evidence. Studies based on US and Canadian data give mixed results.[2] 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 United Kingdom are pro-cyclical. But these articles only look at the manufacturing sector, which now accounts for less than 25% of the UK economy. This article aims to extend the existing work by examining whether mark-ups and profit margins are pro-cyclical not only in manufacturing, but also in non-manufacturing industries, particularly retailing.

The rest of the article is in three sections. The second section looks at the cyclicality of mark-ups, using Haskel *et al*'s extension to Robert Hall's method of estimating mark-ups.[3] The third section looks at the cyclicality of firm profit margins, using Machin and Van Reenen's model of firm profitability, to see if profit margins are still pro-cyclical even after adjusting for other factors that vary with time. Using these two different approaches and datasets acts as a test on the reliability and robustness of the results. The final section of the article reviews the main findings and draws some conclusions. Annex 1 gives further details on the data used, and Annex 2 the regression results.

The cyclicality of mark-ups

To test for the cyclicality of mark-ups, we use Haskel *et al*'s extension to Hall's approach to estimating average mark-ups. Starting from a definition of marginal cost, Hall derives the following relationship between the growth rate of the output/capital ratio and the average mark-up, labour's revenue share, the growth rate of the labour/capital ratio and technical progress:[4]

$$\Delta(y-k)_t = \mu * V_t^L \Delta(l-k)_t + \theta(t) \qquad \textbf{(1)}$$

where y is the log of value-added output, l is the log of labour input, k is the log of capital input, μ is the average mark-up, V_t^L is labour's factor share at time t and $\theta(t)$ is the rate of technical progress.

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).[5] That is:

$$\mu_t = \mu + \mu_1 * cyc_t \qquad \textbf{(2)}$$

The coefficient μ_1 tells us whether mark-ups are pro or counter-cyclical and, in conjunction with the cyclicality variable, how much mark-ups move over the cycle.

To test how the mark-up behaves over the cycle in a range of industries, the following version of equation **(1)** is estimated:

$$\Delta(y-k)_{i,t} = (\mu_i + \mu_1 * cyc_{i,t}) * V_{i,t}^L \Delta(l-k)_{i,t} + \theta(t)_i + u_{i,t} \qquad \textbf{(3)}$$

where i represents industry i.

Equation **(3)** is estimated using annual data for a total of 16 industries: Financial services, Communications, Transport, Hotels and catering, Distribution, Repair and

(1) This article is based on Bank of England *Working Paper* No 72, December 1997.
(2) For the United States, Domowitz, Hubbard and Peterson (1986 and 1988) reported pro-cyclical mark-ups. However, Bils (1987), Rotemberg and Woodford (1991) and Morrison (1990) all found counter-cyclical mark-ups. Interestingly, Morrison (1994) reports pro-cyclical mark-ups for Canada.
(3) See Hall (1986), (1988), (1990).
(4) Details of Hall's approach and Haskel *et al*'s extension to his approach are given in the *Working Paper*.
(5) They also specify the mark-up as a function of market power in the industry.

construction, Metal manufacturing, Other mineral products, Chemicals, Other metal products, Mechanical engineering, Electrical engineering, Motor vehicles, Textiles, Clothing and footwear, and Paper, publishing and printing. Changes in the standard industrial classification restrict the period of estimation to 1968–91.

As it is unclear what the most appropriate cyclical indicator is, five different cyclical variables were used in the tests: the current and lagged values of the ONS coincident indicator; the current value of the ONS lagged indicator;[1] and the current and lagged values of the proportions of firms in the CBI Industrial Trends Survey reporting either (i) that their level of output is not below capacity, or (ii) that their output is constrained by capacity. No industry-specific cyclical variables are available for non-manufacturing industries, so the same aggregate cyclical variables were used for all industries.[2] The individual industry equations are estimated as a system. This lets the estimated coefficients vary across the industries, while allowing for the possibility that the residuals of the individual industry equations are correlated, for example because of common macro shocks. Following Bean and Symons (1989), the rate of growth due to technical progress is modelled by a constant and two shift dummies (one for 1974–80 and one for 1981–91) to allow for possible changes in the rate.

Table A contains estimates of equation **(3)** 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. In each case, the estimated coefficient is positive and significant, which implies that mark-ups are pro-cyclical, though the estimate in column 2 is only significant at the 10% level.

Table A
Cyclicality results from equation (3)

Standard errors in brackets

Cyclical variable	(1)	(2)	(3)	(4)	(5)
Lagged ONS coincident indicator	0.0822 (0.0097)				
Current ONS coincident indicator		0.0225 (0.0134)			
ONS lagged indicator			0.0579 (0.0092)		
Lagged per cent of firms reporting output below capacity (a)				1.716 (0.4917)	
Lagged per cent of firms reporting capacity shortage (a)					1.979 (0.8820)

(a) From CBI Industrial Trends Survey.

The cyclicality of firm profit margins

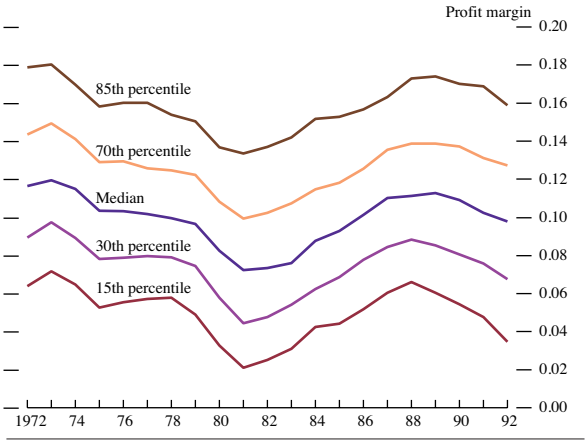
To check the robustness of the previous section's findings, this section looks at the behaviour of firm profit margins over the cycle, to see whether any pro-cyclicality only reflects movements in the standard determinants of margins, or whether, even after controlling for these, margins are still pro-cyclical.

Firm profit margins

The data used here are from Datastream, and cover 761 quoted firms in the period 1972–92. The sample is restricted to companies operating in either manufacturing or retailing, and for which at least eight consecutive years of data are available. These 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.[3] It shows that all the percentiles of the distribution display 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, though not as sharply as in the previous recession.

Chart 1
Distribution of profit margins



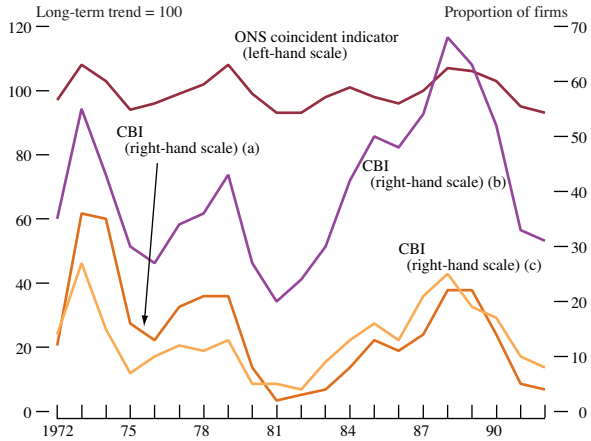
Comparing the pattern of profit margins with the various aggregate cyclical indicators plotted in Chart 2 shows that there appears to be some pro-cyclicality in firm profit margins during the period. This is confirmed by pooling the data and regressing firm profit margins $(\Pi/S)_i$ on the various cyclicality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

To see if there are substantial differences in the cyclical nature of profit margins between different sectors, the data on firm profit margins in each sector are pooled and

(1) The ONS discontinued publishing cyclical indicators in February 1997.
(2) An attempt was made to construct industry-specific cyclicality variables by taking the difference between actual output and trend output as estimated by a regression of industry output on a quintic polynomial in time, but this produced very imprecise estimates.
(3) 'Trading profits' are profits inclusive of interest payments and depreciation.

regressed on the various aggregate cyclicality variables (see top panel of Table B). This shows that firm profit margins are pro-cyclical in all the sectors. It also suggests 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 2
Cyclical indicators



(a) Proportion of firms facing skilled labour shortages, question 14b.
(b) Proportion of firms not below capacity, question 4.
(c) Proportion of firms facing capacity shortages, question 14d.

Table B
Regression results: pro-cyclicality of profit margins, 1972–92(a)

Standard errors in brackets

Panel A: aggregated results

	(1)	(2)	(3)	(4)
Constant	-0.0611 (0.0121)	0.1509 (0.0029)	0.0868 (0.0011)	0.0872 (0.0013)
ONS coincident indicator	0.1667 (0.0122)			
Firms reporting output below capacity (b)		0.0758 (0.0046)		
Firms reporting output constrained by skilled labour shortages (b)			0.1212 (0.0061)	
Firms reporting output constrained by capacity (b)				0.1852 (0.0095)
R^2	0.0142	0.0208	0.0307	0.0296
N	12524	12524	12524	12524

Panel B: individual sectors

	Metals and chemicals	Engineering	Other manufacturing	Retailing
ONS coincident indicator	0.1745 (0.0342)	0.1649 (0.0197)	0.1653 (0.0195)	0.1657 (0.0333)
Firms reporting output below capacity (b)	0.1156 (0.0131)	0.0649 (0.0076)	0.0696 (0.0074)	0.0876 (0.0128)
Firms reporting output constrained by skilled labour shortages (b)	0.1163 (0.0171)	0.1215 (0.0099)	0.1258 (0.0098)	0.1055 (0.0165)
Firms reporting output constrained by capacity (b)	0.2454 (0.0265)	0.1621 (0.0155)	0.1828 (0.0152)	0.1955 (0.0259)
N	1723	4815	4829	1157

(a) Dependent variable in both panels is $(\Pi/S)_{i,t}$.
(b) From CBI Quarterly Industrial Trends Survey.

Modelling profitability

In the light of the evidence just presented, which suggests that profit margins are pro-cyclical, we now test whether this finding is robust when movements in the factors that determine profit margins are taken into account. The model used is that of Machin and Van Reenen, for which the starting-point, as with many models of profitability, is 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) that 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_i). That is:

$$(\Pi/S)_i = MS_i(1+\lambda_i) / \varepsilon_i \qquad \textbf{(4)}$$

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:

$$\lambda_i = \alpha_{1,i}((1-MS_i) / MS_i) + \alpha_{2,i}(1/MS_i) \qquad \textbf{(5)}$$

The coefficients $\alpha_{1,i}$ and $\alpha_{2,i}$ capture how much 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).(1) The cyclicality variable is included to allow for the possibility that even after controlling for the structural time-varying determinants of profit margins, margins still vary over the cycle, for example as the nature of competition varies. So firm conjectures are modelled by the following expression:

$$\begin{aligned}\lambda_i = {} & (\delta_{1,1}(\Pi/S)_{i,t} + \delta_{1,2}SC_{j,t} + \delta_{1,3}CYC_t)((1-MS_i)/MS_i) \\ & + (\delta_{2,1}(\Pi/S)_{i,t} + \delta_{2,2}SC_{j,t} + \delta_{2,3}CYC_t)(1-MS_i)\end{aligned} \qquad \textbf{(6)}$$

Substituting this expression for λ_i in equation **(4)** and rearranging it gives the following general model of profit determination:

$$\begin{aligned}(\Pi/S)_{i,t} = {} & \gamma_i + \beta_1 (\Pi/S)_{i,t-1} + \beta_2 MS_{i,t} + \beta_3 SC_{j,t} + \beta_4 CYC_t \\ & + \beta_5 MS_{i,t} * (\Pi/S)_{i,t-1} + \beta_6 MS_{i,t} * SC_{j,t} \\ & + \beta_7 MS_{i,t} * CYC_t + u_{i,t}\end{aligned} \qquad \textbf{(7)}$$

where γ_i controls for any unobservable firm-specific effects that do not vary with time, for example management ability.(2)

Equation **(7)** is estimated using the panel of firm data from the first part of this section.(3) Firm market share is

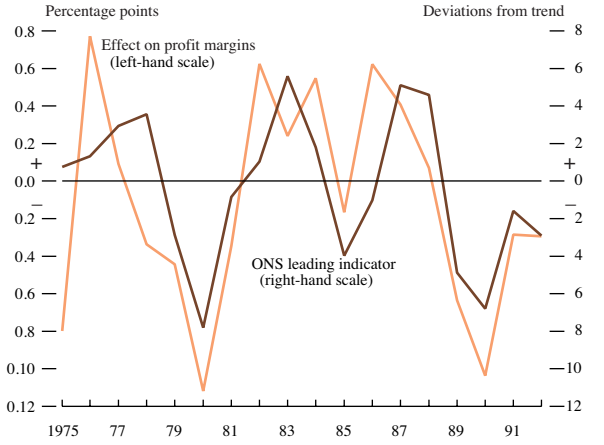
(1) The assumptions that these coefficients are the same for all firms in an industry and increasing functions of industry sales concentration are standard in studies that use Cowling and Waterson's model. Lagged profitability is included to allow for the possibility that there are lags in adjustment, and because current conjectures may depend upon past performance.
(2) The firm-specific fixed effects are eliminated from equation **(7)** using the standard method of taking first differences. The equation is estimated by instrumental variables, using the Generalised Method of Moments procedure proposed by Arellano and Bond (1988 and 1991). 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. If the interactions are included in the regression, the same moment restrictions on them are also used as instruments. The validity of the instrument set is checked by a Sargan test and a test for second-order serial correlation. In a first-differenced model, the Sargan test is only valid if there is no second-order serial correlation.
(3) 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.

measured by each firm's share of sales in its industry, and sales concentration is measured by the weighted average of sales concentration in the firm's industry.(1) Industry sales and sales concentration are matched to individual firms on the basis of the firm's main operating industry in terms of sales. As in the tests for cyclicality of mark-ups, a number of variables are used to model the cyclicality term, including the current values of the ONS coincident indicator and the proportions of firms in the CBI survey reporting either that their current level of output is not below capacity, or that their output is currently constrained by a lack of skilled labour or a lack of capacity.

The results, reported in full in Annex 2, show that the estimated coefficients on the non-cyclicality variables are very similar in terms of sign and size, and with a few exceptions are all significant at the 5% level.(2) Firm market share and industry sales concentration both have a positive effect on firm profit margins. But the interaction between firm market share and industry sales concentration has a negative effect. So though increases in a firm's market share or in sales concentration lead to higher profit margins, this effect is dampened to some 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 that there is a large degree of persistence in firm profitability. This result is in line with the findings of the persistence of profitability literature (see, for example, Mueller (1990)).

Finally, comparing the pattern of the coefficients on the cyclical variables with the ONS leading indicator shows that even after controlling for quite a wide range of determinants of profit margins, margins are still pro-cyclical: 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 3). In terms of the effect on profitability, the estimates imply that profit margins were 0.8 percentage points higher in 1976 (the peak in the sample period) than they would otherwise have been, and 1 percentage point lower in 1990 (the trough in the sample period).(3) Given that the mean profit margin for the whole period is 10%, these effects on profitability are not inconsequential.

Chart 3
Pro-cyclicality of profit margins



Conclusion

This article has examined price-cost mark-ups and profit margins in UK manufacturing and services, extending existing findings that both are pro-cyclical in the manufacturing sector. It has presented evidence that both are pro-cyclical in services as well as in manufacturing. This suggests that price pressures may move in line with the business cycle, increasing during the recovery period and decreasing during recessions.

(1) See Annex 1 for further details.
(2) The exceptions are firm market share in columns (1), (2) and (4).
(3) 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.

Annex 1
Details on data and sources

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: Table 3.3, 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

Percentage of firms reporting that their level of output is below capacity: Question 4, CBI Quarterly Industrial Trends Survey.
Percentage of firms reporting that their output is constrained by capacity: Question 14d, CBI Quarterly Industrial Trends Survey.
Percentage of firms reporting that their output is constrained by skilled labour shortages: Question 14b, CBI Quarterly Industrial Trends Survey.
ONS coincident indicator: Economic Trends.
ONS 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.

Annex 2
Cyclicality of profit margins, regression results

	(1)	(2)	(3)	(4)	(5) (a)
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)
ONS 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)	
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

(a) Time dummies relating to column 5:

1976	0.0157 (0.0028)	1982	0.0142 (0.0024)	1988	0.0087 (0.0027)
1977	0.0089 (0.0022)	1983	0.0104 (0.0030)	1989	0.0016 (0.0028)
1978	0.0046 (0.0020)	1984	0.0135 (0.0034)	1990	-0.0024 (0.0030)
1979	0.0036 (0.0025)	1985	0.0063 (0.0027)	1991	0.0051 (0.0036)
1980	-0.0032 (0.0023)	1986	0.0142 (0.0025)	1992	0.0050 (0.0030)
1981	0.0045 (0.0024)	1987	0.0121 (0.0027)		

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 the table 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).

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