Economics Letters 29 (1989) 353–359
North-Holland

MANUFACTURING MARGINS
Differences Between Small and Large Firms

A.R. THURIK and W.H.M. VAN DER HOEVEN *

Research Institute for Small and Medium-Sized Business, 2701 AA Zoetermeer, The Netherlands

Received 30 September 1988
Accepted 8 January 1989

The influence of labour costs, concentration, capacity utilization, exports and firm size on manufacturing profit margin is studied with a discrimination between small and large firms.

1. Introduction

There is a vast body of empirical literature of the structure–performance relationship in business industries and particularly in manufacturing. The investigation of scale effects in this relationship has been neglected. We want to focus on whether there are systematic scale effects in the price–cost margin in Dutch manufacturing industries. Our approach is the following: first, we study whether there are systematic differences in the explanation of profit mark-ups dependent upon whether small or large businesses are considered; second, we study whether average firm size influences the profit mark-up for small and large businesses, respectively. Moreover, we want to focus on how the structure–performance relationship behaves in the business cycle. Until recently, industry prices were mainly studied in a cross-sectional setting, referring either to a single year or a yearly average in a certain period of time. See reviews in Weiss (1974), Scherer (1980), Semmler (1984), Waterson (1985), and De Wolf (1987). However, a longitudinal dimension is indispensable for a sound investigation of interactions between performance, structure and business cycle. [1]

For our analysis of the influence of firm size and business cycle we shall use a new panel of averaged data covering twelve years (1974–1985), 26 business types and two size classes.

Pricing is studied within the framework of a model which explains the average percentage gross margin, μ, per type of business as a profit mark-up over average percentage costs, κ. μ is defined as the difference of the value of production and the value of purchased raw materials and semi-finished products as a percentage of the value of production. κ is defined as the payroll-costs and remaining non-capital costs as a percentage of the value of production. The profit mark-up is assumed to depend upon average firm size, export rate, a concentration measure and degree of capability utilization.

* The authors acknowledge the indispensable contributions of K. Bakker and S. Vollebregt of the Department for Collecting and Elaborating Data. They thank P. de Wolf, A. Kleijweg and S. Vollebregt for helpful comments.

[1] We know only a few instances where averaged panel data are used to study these interactions: Nooteboom and Thurik (1985), Domowitz, Hubbard and Petersen (1985, 1986a, b), Frantzen (1986), Odagiri and Yamashita (1987), Van der Hoeven and Thurik (1987).

2. The model

For testing our ideas we use the following model:

$$\mu_{it} = \alpha_1 \kappa_{it} + f(X_{it}), \tag{1}$$

where

μ $= (Q - I)/Q$,
Q = value of production = value of sales + Δinventories,
I = value of purchased raw materials and semi-finished products,
κ $= K/Q$,
K = value of payroll costs and remaining non-capital costs,
$f(X_{it})$ = profit mark-up if $\alpha_1 = 1$, where X is a vector of market descriptions,
i, t = indices of business type and year, respectively.

The above-set-up considers average percentage gross margin, μ, as the performance measure. This measure of 'value added' is an indicator of the difference between the selling price and costs of purchased materials indexed by the selling price and is interpreted as a price for manufacturing production. Variation of this measure is explained using a measure of average percentage labour and remaining non-capital costs, κ, and some function of market descriptions, $f(X)$. If μ follows κ directly, hence if $\alpha_1 = 1$, $f(X)$ can be regarded as the profit mark-up over percentage costs or as the ability of firms in a certain industry to obtain prices in excess of percentage labour and remaining non-capital costs. [2] Following Domowitz, Hubbard and Petersen (1986a), we use production (= value of sales + Δinventories) rather than sales. Payroll, material and remaining non-capital costs are the actual expenditures used for production in a certain year. Sales may differ from production because of changes in the inventory level which may contain a considerable cyclical element.

We have no direct measurement of capital costs. This is only a minor drawback, because payroll and remaining non-capital costs (henceforth called labour costs) can be conceived of as a major part of out of pocket costs and these are probably what businessmen perceive when setting profit mark-ups.

For the profit mark-up the following specification is used:

$$f(X_{it}) = \alpha_0 + \alpha_2 C4_{it} + \alpha_3 CU_{it} + \alpha_4 EX_{it} + \alpha_5 1/Q_{it}, \tag{2}$$

where

$C4$ = four firm concentration ratio,
CU = degree of capacity utilization,
EX = value of exports as a percentage of value of production,
Q = average value of production per firm (adequately deflated),
i, t = indices of business type and year, respectively.

Several points deserve elaboration: straightforward oligopoly models reveal that price cost margins are influenced by the level of industry concentration. See Waterson (1985) and Zeelenberg

[2] A similar specification was introduced by Nooteboom (1985) for studying retail margins. Our model is more flexible than the set-up of Domowitz, Hubbard and Petersen (1986a) where $\mu - \kappa = f(X)$ is used or Odagiri and Yamashita (1987), where $Q/(K + I) = f(X)$ is used. In our study an explicit test on $\alpha_1 = 1$ is taken into account. Comparable explicit tests on the influence of costs can be found in Ripley and Segal (1973) and Zeelenberg (1986), where (the change rates of) price index numbers are on the left of the equation instead of a 'value added' measure.

(1986), for instance. Also there is a huge body of empirical evidence for this influence. See Weiss (1974) or De Wolf (1987). For the investigation of price cost margins it is customary to use the four firm concentration ratio (percentage of total employment of the largest four firms). Observed positive correlations between margins and concentration measures are used as intellectual support for antitrust policy.

A Wharton index is computed for capacity utilization (CU) for small and large firms separately. [3] It is assumed that there is a positive relation between capacity utilization and price cost margins, because, first CU is an indicator of the stage of the business cycle and, second, a high capacity utilization can be associated with low percentage capital costs. [4]

The relation between export rate and profitability is discussed extensively in Pagoulatos and Sorensen (1976). They claim that the opportunity of price differentiation across markets induces a positive relation between export rate and profitability. See De Wolf (1987) for more references and other opinions. Export rates are important for a small open economy: average (weighted) export rate in all industries considered is 53% in 1974 and 55% in 1985, while for the small firms these numbers are 15% and 21%, and for the large firms 58% and 60%, respectively.

It is not straightforward to make an assumption about the relation between average scale and profitability. Our specification using the inverse of average scale is adopted from Nooteboom (1985) who assumes that a higher average sales size requires a lower percentage of sales to achieve a given fixed reward for entrepreneurial labour and risk, α_5. For small retail firms α_5 is consistently estimated to be in the neighbourhood of the legal yearly minimum wage of employees. For manufacturing firms which are considerably larger than retail firms, the yearly minimum wage will play no significant role, but the idea of a fixed reward for entrepreneurial risk is appealing. However, average scale could also have influences which might lead to $\alpha_5 < 0$: a higher average scale may point at higher entry barriers or at a higher capital intensity.

Clearly, some influences are missing which usually occur in empirical studies. We mention demand elasticity of the industries products (always difficult to quantify in cross-sectional analyses), barriers to entry, capital intensity, rate of competing imports (probably important in a small open economy like the Netherlands) and to a lesser extent influences like degree of vertical integration, buyer concentration, R & D expenses, advertising expenses, degree of regulation, degree of unionisation, etc.

3. Data

The 26 business types (third digit level) are drawn from the following eight industries (second digit level): extraction and preparation of metalliferous ores and production and preliminary processing of metals, manufacture of metal articles, mechanical engineering, manufacture of office machinery (except data processing), electrical engineering, manufacture of motor vehicles and of motor vehicle parts and accessories, and manufacture of other means of transport.

[3] Average value of production minus costs of purchased materials and semi-finished products per firm (adequately deflated) was plotted for the period 1974–1985. The straight lines through the peaks of this series of average value added per firm were assumed to correspond to full capacity cases. The ratio between average value added and the corresponding value of the straight line is called the degree of capacity utilization.

[4] Alternative propositions such as prices adjust in proportion to excess demand (traditional price-auction theory) or price levels depend upon the growth rate of demand [Nooteboom and Thurik (1985)] or of production [Domowitz, Hubbard, Petersen (1986b) and Odagiri and Yamashita (1987)] are not discussed or tested here. Nor shall we discuss interrelations between concentration and the influence of demand, such as, for instance, the administered price hypothesis saying that the more concentrated an industry is, the less prices react to demand changes. See Shinjo (1977), for instance.

A subdivision is made into small versus large firms for all business types. Small firms are defined to have between 10 and 50 employees and large firms employ over 50 people. Data from very small firms employing less than 10 people are not available. Our data cover the population of firms employing more than 10 people. [5]

For four business types a discrimination between small and large firms is not possible because there are either very small or very few large firms; two of these business types are assigned to the small firms group and two to the large firms group. Data over twelve years (1974–1985) are available; so we have $12 \times (2 \times 22 + 4) = 576$ datapoints.

The data stem mainly from the Production and Price Statistics published by the Central Bureau of Statistics in Voorburg, The Netherlands. These and other data have been intensively elaborated by the Research Institute for Small and Medium-sized Business in Zoetermeer, The Netherlands. An impression of the main variables is given in Thurik and Van der Hoeven (1988).

4. Evidence

As a first exercise we run the following cross-section regression. Eq. (2) is substituted into (1), but instead of using panel data, unweighted averages over time are used for all variables: e.g., $\mu_i = \Sigma_{t=1}^{T}\mu_{it}/T$ for $T = 12$ instead of μ_{it}. Time specific effects are eliminated to a certain extent and we can concentrate on differences between small and large manufacturing in this cross-sectional setting. All 'percentage' variables are divided by 100. From the OLS regression results in table 1 we see that

- Small firms are more inclined to follow costs in determining gross margin (α_1 does not differ significantly from 1, at a 5% significance level) than large firms (α_1 is significantly below 1). Large firms leave the target strategy of 'full-cost' pricing and feel more at liberty to set prices according to market situations, whereas small firms use a genuine mark-up procedure;
- The degree of concentration has a positive influence as expected, but not significant at a 5% level;
- Capacity utilization has a positive influence on gross margin for both small and large firms;
- Export rate has a positive influence on gross margin only for large firms;
- The volume of average production of the large firms is taken for the influence of scale in both the small and the large firms regression. The value of small firms average production lacks variation. Furthermore, it is plausible that characteristics of the high end of the size distribution particularly influence pricing behaviour of all firms within a business type. We conclude that the small firms mark-up is low if the average large firms size is high. For instance, for small firms the contribution to the percentage profit mark-up is 1% if the average large firm production value is 10 million Dutch guilders of 1975 and 0.5% if average large firm production value is 20 million Dutch guilders of 1975. For large firms this contribution is nine times higher.

In the last column of table 1 the grouped regression results using averages per business type are reported ($n = 26$), so that a comparison to other studies can be made where no partitioning into small and large businesses is available.

[5] Only a small part of total employment per industry is not covered: for instance, in 1984 a share of 17.5% is employed in the very small firms in the manufacture of metal articles and 6.9% in mechanical engineering (including the manufacture of office machines).

Table 1
Cross section regression resulting using averaged data and eq. (1) after substitution of (2). [a]

		Independent regression		Grouped regression
		Small firms	Large firms	Averages per business type
Intercept	α_0	−0.03(0.05)	−0.06(0.06)	−0.10(0.60)
Costs	α_1	1.09(0.06)	0.79(0.10)	0.94(0.09)
Concentr.	α_2	0.05(0.03)	0.05(0.04)	0.07(0.03)
Cap. util.	α_3	0.19(0.11)	0.33(0.14)	0.33(0.15)
Exp. rate	α_4	−0.02(0.06)	0.11(0.04)	0.08(0.04)
1/scale	α_5	0.10(0.05)	0.89(0.29)	0.31(0.08)
ρ^2		0.96	0.89	0.94
n		24	24	26

[a] Standard errors are given between brackets and ρ^2 represents in the square of the correlation coefficient between the vectors of the observed and the estimated μ.

As a second exercise the following specification is used:

$$\mu_{it} = \beta_0 + \beta_1\kappa_i + \beta_2 C4_i + \beta_3 CU_i + \beta_4 EX_i + \beta_5 1/Q_i + \gamma_1\tilde{\kappa}_{it} + \gamma_2\tilde{C4}_{it} + \gamma_3\tilde{CU}_{it} + \gamma_4\tilde{EX}_{it} + \gamma_5\tilde{1}/Q_{it}, \quad (3)$$

where

$\kappa_i = \sum_{t=1}^{T}\kappa_{it}/T$, etc. (unweighted averages over time),
$\tilde{\kappa}_{it} = \kappa_{it} - \kappa_i$, etc. (deviation from unweighted averages over time).

The full richness of the entire panel of 576 data points is exploited partitioning the slope coefficients α of table 1 into the 'between group' coefficients, β, and the 'within group' coefficients, γ. Coefficients are estimated using an additive i.i.d. disturbance term. [6] Regression results are given in table 2.

Comparing table 1 and table 2 we see that, obviously, coefficients α and β do not differ apart from the intercepts. Interpreting the 'within group' coefficients, γ, as the reflexion of short-term temporal effects, we see that

- Changes in percentage labour costs are not immediately accounted for in setting percentage gross margin [7] ($\gamma_1 < \beta_1$ for both small and large firms);
- Concentration growth appears to decrease percentage gross margin ($\gamma_1 < 0$ for both small and large firms, but not significantly);
- Capacity utilization changes do affect percentage gross margin changes ($\gamma_3 > 0$ for both small and large firms), but the 'within group' effect is smaller than the 'between group' effect ($\gamma_3 < \beta_3$ for both small and large firms);

[6] The alternative assumption of a disturbance term consisting of independent temporal, contemporaneous and remaining components gives identical estimates for β, whereas the estimates for γ differ from OLS estimates depending upon the degree of temporal variance. Clearly, this is due to the separate specification of temporal and contemporaneous effects in (3).

[7] Cf., Nooteboom, Kleijweg and Thurik (1988) where a 'normal costs' variable is used and a comparable result is obtained.

Table 2
Regression results using panel data and eq. (3). [a]

	Index of coefficient	Small firms		Large firms	
		β	γ	β	γ
Intercept	0	−0.04(0.02)		−0.08(0.02)	
Costs	1	1.09(0.03)	0.83(0.05)	0.79(0.04)	0.60(0.06)
Concentr.	2	0.05(0.01)	−0.09(0.06)	0.05(0.01)	−0.13(0.07)
Cap. util.	3	0.19(0.05)	0.05(0.02)	0.34(0.05)	0.11(0.03)
Exp. rate	4	−0.02(0.02)	0.06(0.03)	0.11(0.01)	0.02(0.04)
1/scale	5	0.10(0.02)	−0.17(0.13)	0.88(0.10)	0.50(0.33)
ρ^2		0.90		0.83	
n		288		288	

[a] See note to table 1.

- The 'within group' coefficients of export rate, γ_4, and scale, γ_5, do not differ significantly from zero for both size classes.

5. Summary and conclusion

In this article we use Dutch panel data to systematically describe the relative importance of certain factors influencing the level of average percentage gross margin, μ, which is interpreted as a price for manufacturing production.

Our main conclusions are

- The use of a model explaining μ as profit mark-up on average percentage labour costs, κ, works well in the case of small firms. In the case of large firms μ is explained taking a mark-up over approximately 80% of κ. Consequently, price corrected productivity differences have a direct effect on μ in the sense that this effect is somewhat dampened for large firms. Moreover, price corrected productivity movements are not immediately accounted for. Again large firms appear to react slower than small firms;
- For both small and large firms the profit mark-up can be explained using measures for concentration, capacity utilization, export rate and average size of large firms. The degree of capacity utilization is used as a proxy for business cycle effects. There is a positive relation between the height of the mark-up and capacity utilization. This effect is stronger for large firms than for small firms. Moreover, the short term effect is weaker than the long term effect;
- Both the four-firm concentration measure and the average size of large firms appear to effect the profit mark-up of both small and large firms. The size of both effects differs between small and large firms. A larger scale, in the sense of a larger average production volume, yields a lower profit mark-up. Scale may be a proxy for entry barriers, monopolistic power (next to a concentration measure), capital intensity, regional dispersion, etc. These assumptions, however, would lead to a positive relation between scale and mark-up, which is not what we observe. Alternatively, entrepreneurs may aim at some fixed minimal recompensation for their efforts and risk and this recompensation is inversily related to production value, Q, in an equation where essential variables are expressed as percentages of Q. See Nooteboom (1985). This explanation may be valid for large firms, but not for the small ones, because average large firms scale occurs in the profit mark-up of the latter group. Some competitive element will play a role here: the larger the average

scale of large firms, the lower the small firms mark-up. However, the four-firm concentration measure has a positive effect on the small firms mark-up;

- The influence of the four-firm concentration measure on average profit mark-up is less for small firms than for large ones. The leading top four firms may have higher profit margins than the remaining firms. In concentrated industries, by definition, the leading firms receive a higher weight in the computation of the overall average profit mark-up. This prevents the correct measurement of the influence of concentration on the profit margin of the entire industry including non-leading firms; see Miller (1988). The average profit mark-up of small firms clearly does not contain the profit mark-ups of the leading top four firms. Nevertheless, concentration appears to have a positive influence on their profit mark-up.

We conclude that there are striking and significant differences in the pricing behaviour between small and large manufacturing firms. As far as we know this is the first study where scale effects play a central role in the explanation of pricing in manufacturing and where temporal and contemporaneous effects are simultaneously specified. In follow-up studies we shall report on a wider range of industries and/or variables like the effects of competing imports, diversification and capital costs, alternative estimation procedures, etc.

References

De Wolf, P., 1987, Industry concentration and the effects on profitability and prices (in Dutch: Marktconcentratie en de gevolgen voor winstgevendheid en prijzen) (Eburon, Delft).

Domowitz, I., R.G. Hubbard and B.C. Petersen, 1985, Industry margins and the business cycle, Economics Letters 19, 73–77.

Domowitz, I., R.G. Hubbard and B.C. Petersen, 1986a, The intertemporal stability of the concentration-margins relationship, Journal of Industrial Economics 35, no. 1, 13–34.

Domowitz, I., R.G. Hubbard and B.C. Petersen, 1986b, Business cycles and the relationship between concentration and price–cost margins, Rand Journal of Economics 17, no. 1, 1–17.

Frantzen, D.J., 1986, The cyclical behaviour of manufacturing prices in a small open economy, Journal of Industrial Economics 34, no. 4, 389–408.

Miller, E.M., 1988, Profit margins and concentration, Atlantic Economic Journal 16, no. 1, 96.

Nooteboom, B., 1985, A mark-up model of retail margins, Applied Economics 17, 647–667.

Nooteboom, B. and A.R. Thurik, 1985, Retail margins during recession and growth, Economics Letters 17, 281–284.

Nooteboom, B., A.J.M. Kleijweg and A.R. Thurik, 1988, Normal costs and demand effects in price setting: A study of retailing, European Economic Review 32, 999–1011.

Odagiri, H. and T. Yamashita, 1987, Price mark-ups, market structure and business fluctuations in Japanese manufacturing industries, Journal of Industrial Economics 35, no. 3, 317–331.

Pagoulatos, E. and R. Sorensen, 1976, Foreign trade, concentration and profitability in open economies, European Economic Review 8, 255–267.

Ripley, F.C. and L. Segal, 1973, Price determination in 395 manufacturing industries, The Review of Economics and Statistics 55, no. 3, 263–271.

Scherer, F.M., 1980, Industrial market structure and economic performance (Rand McNally, Chicago, IL).

Semmler, W., 1984, Competition, monopoly and differential profit rates (Columbia University Press, New York).

Shinjo, K., 1977, Business pricing policies and inflation: The Japanese case, The Review of Economics and Statistics 59, no. 4, 447–455.

Thurik, A.R. and W.H.M. van der Hoeven, 1988, Pricing in Dutch manufacturing, Research paper no. 8803 (Research Institute for Small and Medium-Sized Business, Zoetermeer).

Van der Hoeven, W.H.M. and A.R. Thurik, 1987, Pricing in the hotel and catering sector, De Economist 135, no. 2, 201–218.

Waterson, H., 1985, Economic theory of the industry (Cambridge University Press, Cambridge).

Weiss, L.W., 1974, The concentration–profits relationship and antitrust, in: Goldschmid, Mann and Westen, eds., Industrial concentration: The new earning (Little, Brown and Co., Boston, MA).

Zeelenberg, C., 1986, Industrial price formation (Elsevier Science Publishers, Amsterdam).