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**Working Paper**

## Mark-ups, industry structure and the business cycle

FE Working Paper, No. 9902

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*Suggested Citation:* Weiss, Christoph R. (1999) : Mark-ups, industry structure and the business cycle, FE Working Paper, No. 9902, Kiel University, Department of Food Economics and Consumption Studies, Kiel

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## **Mark-ups, Industry Structure and the Business Cycle**

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Working paper EWP9902  
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### **Abstract:**

Information on the primal and dual productivity measure is used to estimate industry mark-ups for 4-digit U.S. manufacturing industries. Investigating the relationship between these estimates and various industry characteristics as well as their cyclical movements, we find that mark-ups are significantly higher in concentrated and capital intensive industries with high growth rates and advertising to sales ratios. In contrast to previous research we do not find significant differences in mark-ups over the business cycle. We argue that the procyclicality of margins reported in earlier studies might be caused by the (false) assumption of identical average and marginal costs.

## **Mark-ups, Industry Structure and the Business Cycle**

### **Introduction**

The essence of market power is the firm's ability to rise product prices above marginal costs. While prices can be observed directly, marginal costs cannot. Faced with this difficulty empirical studies typically assume marginal costs and average costs to be identical which allows them to use profit rates (price-average cost margins) as a measure of mark-ups (see Schmalensee, 1989 for a review).

An alternative approach to measuring mark-ups, which avoids assuming marginal and average costs to be identical, has been proposed by Roeger (1995).<sup>1</sup> Information on the primal and dual productivity measures can be used to estimate the mark-up from industry time series data. In the present paper, we follow this approach to investigate the relationship between mark-ups and various industry characteristics as well as consider cyclical movements in mark-ups. We find that mark-ups are significantly higher in concentrated and capital intensive industries with high growth rates and advertising to sales ratios. In contrast to previous research using the same data for a shorter time period (Domowitz, Hubbard, and Petersen, 1986), we do not find significant differences in mark-ups over the business cycle. We argue that the procyclicality of margins reported in earlier studies might be caused by the (false) assumption of identical average and marginal costs.

## Estimation and empirical results

Following Roeger (1995) we compute the difference between the primal and dual measure of total factor productivity which yields an equation from which price-marginal cost margins  $\mathfrak{m}_{i,t}$  (and thus the mark-up) can be determined:  $y_{i,t} = \mathfrak{m}_{i,t}x_{i,t} + e_{i,t}$ ,

$$\text{where } y_{i,t} = g_{q_{i,t}} + g_{p_{i,t}} - a_{l_{i,t}}(g_{w_{i,t}} + g_{l_{i,t}}) - a_{m_{i,t}}(g_{pm_{i,t}} + g_{m_{i,t}}) - (1 - a_{l_{i,t}} - a_{m_{i,t}})(g_{r_{i,t}} + g_{k_{i,t}}),$$

$$x_{i,t} = g_{q_{i,t}} + g_{p_{i,t}} - (g_{r_{i,t}} + g_{k_{i,t}}),$$

and  $g$  refers to the growth rate of a variable,  $q$ ,  $p$ ,  $w$ ,  $l$ ,  $pm$ ,  $m$ ,  $r$ , and  $k$  are output, the output-price-index, wages, labour, price index of materials, materials, factor price of capital and the capital stock respectively. The share of wage payments and materials in revenue is  $a_l$  and  $a_m$ . Subscript  $i$  refers to an industry and  $t$  is time. Assuming  $\mathfrak{m}_{i,t}$  to be constant over time ( $\mathfrak{m}_{i,t} = \mathfrak{m}_i$ ) and estimating the above shown equation for each industry,

$$\text{mark-up}_i = \frac{1}{1 - \hat{\mathfrak{m}}_i}.$$

In order to investigate whether mark-ups are significantly related to various industry characteristics (such as concentration ( $CR$ ), capital-intensity ( $COR$ ), industry growth rates ( $GR$ ), and advertising to sales ratio ( $ASR$ )) and fluctuates over the business cycle, we specify the following linear equation

$$\mathfrak{m}_{i,t} = b_0 + b_1CR_{i,t} + b_2COR_{i,t} + b_3GR_{i,t} + b_4ASR_{i,t} + b_5T + b_6UER_t + b_7CR_{i,t}UER_t + b_8COR_{i,t}UER_t$$

The economy-wide unemployment rate ( $UER_t$ ) is used to represent business cycles. Procyclical fluctuations in mark-ups in particular in concentrated industries (as suggested in Domowitz, Hubbard, and Petersen, 1986) would imply  $b_6, b_7 < 0$ .

Substituting the expression for  $m_{i,t}$  into the above shown equation gives our estimation equation:

$$y_{i,t} = b_0 x_{i,t} + b_1 x_{i,t} CR_{i,t} + b_2 x_{i,t} COR_{i,t} + b_3 x_{i,t} GR_{i,t} + b_4 x_{i,t} ASR_{i,t} \\ + b_5 x_{i,t} T + b_6 x_{i,t} UER_t + b_7 x_{i,t} CR_{i,t} UER_t + b_8 x_{i,t} COR_{i,t} UER_t + e_{i,t}$$

with  $e_{i,t} = u_i + v_t + w_{i,t}$ .

Table 1 summarises the results of the random-effects estimation for 299 US-manufacturing industries for the period 1961 to 1989. A detailed description of the data is available from the author upon request.

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Table 1

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Model (1) corresponds to Roeger's basic model, assuming mark-ups to be constant over time and identical in all industries. The parameter estimate  $\hat{m}$  implies a mark-up of 1.96, which is within the range of estimates reported in Roeger for two-digit industries. Extending this basic model however indicates, that mark-ups are significantly related to industry characteristics (see models (2) and (3)) and are not constant over time (model (3)). According to model (3) a 1 standard deviation increase in concentration rises industry mark-ups by 7.21%. A 1 standard deviation increase in capital-output ratios, growth rates, and advertising to sales ratios rises mark-ups by 1.66%, 2.28%, and 6.68%, respectively. Table 1 also suggests a significant and positive trend but rejects the proposition of a strong cyclical fluctuation in mark-ups. Mark-ups seem to be acyclical in both, concentrated and competitive industries, as indicated by the insignificant parameter estimate of  $x_{i,t} CR_{i,t} UER_t$ .

The difference between our results and earlier findings (such as Domowitz, Hubbard, and Petersen, 1986) might be due to the assumed identity between marginal and average costs in these studies.<sup>2</sup> Increasing marginal costs and positive fixed costs imply that marginal costs will rise more sharply with output than will average costs. Using average costs as a proxy for marginal costs will thus overestimate mark-ups in periods of high demand and underestimate mark-ups in a recession. This bias will be larger in concentrated industries since entry of new firms in a competitive environment will prohibit firms to deviate from that level of output which minimises average costs (where marginal and average costs are in fact identical). Price-average cost margins might thus fluctuate procyclically - and in particular in concentrated industries - even if mark-ups and price-marginal cost margins are acyclical.

## **References**

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- Roeger, W. (1995) Can Imperfect Competition Explain the Difference between Primal and Dual Productivity Measures? Estimates for U.S. Manufacturing, *Journal of Political Economy*, **103**, 316-330.
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Table 1: Results of the random-effects model for U.S. manufacturing 1961 to 1989.

Independent Variables	Param. (t-value) estimate (1)	Param. (t-value) estimate (2)	Param. (t-value) estimate (3)
Intercept	0.015 (3.79)	0.013 (3.87)	0.013 (3.42)
$x_{i,t}$	0.488 (144.03)	0.355 (58.43)	0.272 (11.45)
$x_{i,t}CR_{i,t}$		0.178 (16.03)	0.182 (4.19)
$x_{i,t}COR_{i,t}$		0.006 (0.90)	0.076 (2.45)
$x_{i,t}GR_{i,t}$		0.076 (24.62)	0.065 (20.42)
$x_{i,t}ASR_{i,t}$		0.958 (12.04)	1.007 (12.69)
$x_{i,t}T/100$			0.579 (10.97)
$x_{i,t}UER_t$			-0.079 (-0.20)
$x_{i,t}CR_{i,t}UER_t$			-0.003 (-0.47)
$x_{i,t}COR_{i,t}UER_t$			-0.869 (-1.62)
$R^2$	0.623	0.694	0.693
Hausman-Test	90.33	123.20	182.14
$LMT (DF)$	14,733 (2)	8,170 (2)	8,141 (2)

Remarks:  $LMT$  refers to the Lagrange Multiplier Test against a model without any group and period effects,  $DF$  is the degrees of freedom. The number of observations in each model is 8,671.

## Appendix: (NOT TO BE PUBLISHED)

### (a) The data

The Census of Manufacturers (CM) and the Annual Survey of Manufacturers (ASM) are the primary sources of information for the panel data base. Census data assign individual establishments (plants), as opposed to whole companies, to their primary SIC industry. The full data set contains information on 450 4-digit manufacturing industries (according to the 1972 classification) over the period from 1958 to 1989. Additional information has been taken from the U.S. Statistics of Income (SI).

Table A1.: Definition and descriptive statistics of variables used.

<i>Variables</i>	<i>Definition</i>	<i>Mean</i>	<i>Standard Deviation</i>
<i>ASR</i>	The advertising to sales ratio for 1977 is available at the three-digit level and is defined as advertising expenditures (SI) divided by the value of shipments (ASM). The data are the same used by Domowitz, Hubbard and Petersen (1986), where the process of matching the data on the 4-digit level is described in more detail.	0.016	0.029
<i>COR</i>	Capital Output Ratio, defined as the stock of capital (PCS) divided by the value of shipment which is adjusted for inventory changes, (ASM).	0.371	0.334
<i>CR4</i>	We use the Weiss-Pascoe adjusted four-firm concentration ratio for 1972 and 1977. The CM reports (non-adjusted) concentration ratios also for 1958, 1963, 1967, and 1982, the elements of these series have been adjusted by the difference between Weiss and Pascoe's estimate and the Census' counterpart for 1972. Concentration ratios in non-census years are estimated as weighted averages of the concentration ratios in the immediately preceding and succeeding censuses. Estimates for the 1983 to 1989 period are obtained by extrapolating from the 1977 and 1982 observations. Concentration ratios have been adjusted by the import-to-sales ratio (ASM).	0.424	0.201
<i>GR</i>	Growth rate of the real value of shipment adjusted for inventory changes (ASM).	0.073	0.151



<i>PCM</i>	Following Domowitz, Hubbard, and Petersen (1986) we construct the price-cost margin as ( <i>value of sales</i> + <i>Dinventories</i> - <i>payroll</i> - <i>cost of materials</i> ) / ( <i>value of sales</i> + <i>Dinventories</i> ).	0.276	0.093
<i>UER</i>	Aggregate unemployment rate.	0.061	0.016
$y_{i,t}$	Defined in the text.	0.008	0.118
$x_{i,t}$	Defined in the text.	-0.014	0.275

(b) Re-estimate of Price-average cost model.

**Table A2:** Industry characteristics and price-average cost margins for U.S. manufacturing 1961 to 1989.

Independent Variables	Param. (t-value) estimate (1)	Param. (t-value) estimate (2)	Param. (t-value) estimate (3)
Intercept	0.225 (63.74)	0.137 (16.84)	
$CR_{i,t}$	0.084 (10.61)	0.129 (7.51)	0.127 (11.07)
$COR_{i,t}$	0.005 (1.95)	0.099 (8.95)	0.077 (13.18)
$GR_{i,t}$	0.105 (33.47)	0.119 (21.11)	0.098 (33.24)
$ASR_{i,t}$	0.411 (9.74)	1.127 (38.92)	0.374 (9.05)
$T/100$		0.232 (18.42)	0.188 (26.34)
$UER_t$		0.462 (3.43)	0.487 (7.08)
$CR_{i,t}UER_t$		-0.597 (-2.19)	-0.706 (-5.07)
$COR_{i,t}UER_t$		-1.276 (-6.47)	-1.407 (-13.68)
Fixed period effects	Yes	No	No
Fixed group effects	Yes	No	Yes
$R^2$ (adj.)	0.816	0.290	0.819
<i>Log.Likelihood</i>	15,783	9,764	15,842
<i>LRT (DF)</i>	12,485 (327)		12,156 (298)

Remarks: *LRT* refers to the Likelihood Ratio Test against a model without any group and period effects, *DF* is the degrees of freedom. The number of observations in each model is 8,671.

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1       Roeger's approach extends earlier work by Hall (1988), who uses the definition of marginal costs (as an increase in input costs arising from a change in output) to estimate the mark-up. Hall's approach, however, requires the use of instruments in the econometric model that are exogenous under all views of macroeconomic fluctuations. These instruments typically are hard to find.

2       Results from re-estimating Domowitz, Hubbard, and Petersen's model (using price-average cost margins) for the longer 1961 to 1989 time period are available upon request, the differences to Domowitz, Hubbard, and Petersen's 1987 results are negligible.