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56

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An Empirical Confrontation of an Old Story and a Supergame Implication

Summary: The paper confronts the hypothesis of a positive profitability concentration relationship ("the old story") with a robust prediction of supergame models ("the new story"). In supergames the feasibility of collusion (and to some degree also actual profits) depends on relative profitability of defection versus that of collusion. The determinants for this evaluation - the time discount proper, riskiness of markets, exit probability and lags - can be summarized as "relevant time discount". Cross section empirical evidence (97 sectors, 886 firms) is more in line with the supergame prediction. The evidence depends on the variables chosen to proxy the "relevant time discount". Its value is limited as any evidence for game theoretical models supplied by cross section aggregate data. We followed *Sutton* (1991) to test robust predictions and *Schmalensee* (1989) to investigate the robustness of the results.

JEL: L11, C72

Collusion, Concentration and Profits

An Empirical Confrontation of an Old Story and a Supergame Implication

1. Plan of the paper

The positive relationship between profit margins and concentration is one of the oldest stories in industrial organization. Non cooperative game theory however does not predict a simple relation between profits and concentration, but rather different results depending on the action space, the horizon and interactions of firms.

In supergames we find a set of related parameters which crucially determine the feasibility of collusion: the time discount rate proper, the length of detection and punishment lags, exit probability and uncertainty about the market conditions. We summarize these variables into a wider concept of a "relevant time discount rate", which weights the advantages of defection (in one period) relative to the advantages of continued collusion . The *feasibility* of collusion and the "relevant time discount rate" are predicted to be negatively related. This could lead to an empirically observable (negative) relation between actual profits and proxies for this set of variables. Due to the well known multiplicity of equilibria in supergames there is no one to one relationship between a supergame result and an empirically testable prediction. The proxies determine the feasibility of collusion, something like an "upper bound" to equilibrium profits.

We use cross section data to test first the hypothesis of a positive profitability - concentration relation ("the old story") and secondly that of a negative relation between profits and proxies for the "relevant time discount rate" ("the new story").

The limits of cross section data to test theories is well discussed in the literature, testing implications of game theory with aggregate data adds some more problems. Game theoretical concepts can "often be mapped into empirical categories in a rather loose and informal way" (*Sutton*, 1991, p .6). Many researchers focus analysis therefore on a very specific market ("ultra micro") approach. We follow *Sutton* that it may be worth "to find some (necessarily weak) predictions that are robust in the sense that they hold across a wide class of models" (*Sutton*, 1991, p 7). However we do not claim to test game theoretical models but to confront concentration as determinant of profits with variables hinted at in a specific class of supergames. Even this humble approach heavily relies on the available proxies for the relevant time discount.

The paper is structured as follows. The next section repeats the arguments for a positive profitability-concentration relationship and the limits of cross section studies. In section 3 the conditions for collusion as derived in supergames are presented and summarized into the concept of the "relevant time discount factor" (to prevent confusion remind that game theory formulate the crucial conditions for collusion using discount *factors* i.e. the inverse of discount *rates*). Section 4 describes the data used to test the old profit concentration story and introduces four proxies for the relevant time discount rate. The evidence for 97 three digit industries and a set of 896 firms for Austrian manufacturing is presented in section 5. Section 6 summarizes the results, its limits and prospects. The appendix follows the "Schmalensee postulate" for cross section studies (*Schmalensee*, 1989) to test the robustness of the findings.

2. The original story

The traditional foundation for the positive concentration profitability relationship relies on micro economic theory with collusion presumptions added. The competitive firm earns normal profits only, the monopoly accumulates extra profits[1]), in between these extreme models collusion is easier the fewer firms are in the market and the higher barriers of entry are[2]).

The implied direction of causality in *Bain's* argument was never uncontested. *Demsetz* (1974) argued that efficient firms increase their market shares so that markets may look concentrated as a result of efficiency rather than collusion. The collusion and the efficiency hypothesis can be discriminated empirically[3]), the policy consequences are different. The implied forecast for the concentration-profitability relation is however the same. Among the standard theories[4]) which do not forecast a

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1) This is the essence of the story for the long run equilibrium. If however entry (or exit) is blockaded, competition could give positive and negative profits. Even monopoly could go with negative profits (due to fixed costs or strategic considerations) in the short run. Theoretical predictions are more robust about the price cost margin, than about profits as such.

2) *Bain* (1956), *Stigler* (1964). As Paul A. *Geroski* pointed out in the discussion of this paper Bain's main interest was to determine some critical value for concentration which could be used in antitrust policy.

3) *Schmalensee* (1987), *Harris* (1988). *Weiss* (1989) proposes to use price instead of profit margin as dependent variable, partly with the argument to incorporate *Demsetz'* position.

4) Standard theories mean non game theoretical theories in this context. Of course Bertrand models do not forecast a positive relationship between profits and concentration (at least for homogeneous markets). Cournot models do forecast a positve relationsship with demand elasticity as additional determinant of profit margin.

positive profit concentration relationship we want to mention rent dissipation hypothesis (*Posner*, 1975) and x-inefficiency theory (*Frantz*, 1988).

The empirical evidence on the relation had once been impressive (see *Weiss*, 1974). It became mixed as additional "structural" variables were added, some papers find even negative coefficients if market shares are added[5]). A recent review by *Salinger* (1990) found instable coefficients of concentration over time (in the majority of years they are positive).

Today cross section studies on the profitability concentration relation belong to the most contemptuous research areas. A part of the argument against profitability-concentration studies applies to cross section studies in general (no structural form, direction of causality), another part to the empirical implementations (measurement of concentration, profits, marginal costs, see *Fisher - Mc Gowan* 1983, *Bresnahan*, 1989, *Schmalensee*, 1989).

3. Supergames and the relevant time discount

Supergames[6]) is the class of non cooperative games in which an identical static game is infinitely repeated. Its relevance is sometimes questioned since "anything" can happen (there is a muliplicity of equilibria). We believe however that there is some structure in the supergames which may lead to an empirically testable prediction.

The crucial role for the feasibility of collusion is played by the discount rate. It determines the weight of the presence (in which defection is considered) versus that of the future (in which punishment would follow). At first this seems to be a rather trivial result. But many adaptions of this model to real world circumstances can be derived just by upblowing or downsizing the discount factor proper by some transformation (or some variable) and thus shifting the border line between feasibility and non feasibility of collusion.

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5) An insignificant - and sometimes even negative - coefficient is found for concentration on profits especially if market share and concentration rates are used. See *Ravenskraft* (1983), *Martin* (1983). See *Neumann - Boebel* (1985) for a model (Cournot plus fringe) where a negative concentration rate may be theoretically justified, or *Adelman - Stangle* (1985) for a critique of single equations including market shares and concentration. Negative coefficients are also found in studies on banking profits and concentration, see *Gilbert* (1984).

6) For an overview see Shapiro, 1989 or Tirole, 1989.

In the starting model n firms are engaged in a price game of infinite horizon. The discount *factor* is δ, the inverse of the discount rate. Larger δ can be interpreted as patience. We start with collusion (at the monopoly price). If one firm defects cooperation is halted and price is set at marginal costs forever.

The profits of collusion is the future profit stream V_c, this is monopoly profit divided by the number of firms and adequately discounted. The profits from defection V_d is the one period monopoly profit π^m and then zero profits forever. Equation (1) compares the profits under defection versus collusion and equation (2) gives the condition for the sustainability of collusion.

(1) $V_d = \pi^m < (1 + \delta + \delta^2 + ..)\, \pi^m/n = \pi^m/[n(1-\delta)] = V_c$

(2) $\delta > (n-1)/n$

Collusion will happen when the discount factor is larger than (n-1)/n. In case of 100 firms δ has to be higher than .99 to facilitate collusion, for n = 3 only higher than 2/3. This makes collusion more probably the smaller the number of firms and (under certain assumptions) for less concentration[7]).

Incorporating detection lags or a period between detection and punishment is just an easy modification. If detection or start of punishment takes two periods the defector enjoys monopoly profits for two periods, see LHS of equation (3). The critical value facilitating collusion is the square root of that in the starting model, so collusion becomes harder to sustain (equation (4)). This could be see as a first step of transforming a proper discount factor into a wider concept. More generally the sustainability of collusion decreases with the number of periods elapsing between defection and punishment.

(3) $\pi^m (1 + \delta) < (1 + \delta + \delta^2 ..)\, \pi^m/n = (1-\delta)\pi^m / [n(1-\delta)]$

(4) $\delta > \sqrt{(n-1)/n}$

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7) Remind that any discount factor depends on a proper time discount and the length $\delta = e^{-rt}$, where r is the instanteneous rate of interest and t is real time between periods. Which discount factor is considered as realistic of course depends on the time period considered. If the time period is a week even .99 could be realistic, if the relevant time period is a year this is totally implausible.

If the riskiness of the markets imply that the horizon of the game is uncertain (exit is possible), the relevant benchmark to sustain collusion is the discount factor proper multiplied by the probability not to survive σ. Again collusion becomes harder to achieve, see equation (5)[8]).

(5) $\delta^{rel} = \delta^{prop} . \sigma$ σ = probability of exit

Green - Porter (1984) present a model of quantitiy competition and *Tirole* (1989) its modification for price competition. Firms do not observe their rivals' prices but infer them from own demand. Low own demand may be due to weak market condition or to defection of the partner. The discount factor needed to sustain collusion increases with the degree of uncertainty. For a given probability α of no demand and (1-α) for demand, the discount factor necessary for collusion increases in α. For $\alpha = 1/4$ and for two firms, it is 2/3 (compare this to $\delta > 1/2$ in the starting model for n = 2). For certain demand or its perfect predictability we return to the condition in equation (2).

All these factors like time discount proper, length of detection and punishment lag, demand uncertainty, exit probability can be summarized into a concept of the "relevant time discount factor", δ^{rel}. The smaller this time discount factor the less the probability of collusion.

Let us formalize this set of main determinants[9]) of the feasibility of collusion and its components in equation (6).

(6) $\delta^{rel} = f(\delta^{prop}, \tau, \alpha, \sigma)$

The determinants of this "relevant time discount factor" are empirically closely related. Time discount factor proper is defined as $\delta = e^{-rt}$, where r is the instanteneous rate of interest and t is real time between periods and depends on the length of the period. And if detection takes time it is somewhat arbitrary either to define a longer period (thus increasing δ^{prop}) or to say detection takes two periods ($\tau = 2$). Another constituant element of the discount factor is risk and the amount of "risk adjustment"

8) *Rotemberg - Saloner* (1986) show that it is hard to sustain collusion facing demand fluctuations, especially in phase of high demand. The advantage of defection may be that high in booms, that the patience needed for collusion may not be attained. *Staiger - Wolak* (1992) investigated the relationship between collusion, business conditions, uncertain demand and capacity constraints recently. Other models show that the price stickyness facilitates collusion, since in "any Markov perfect equilibrium, profits are bounded away from the competitive profits" (*Tirole*, 1989, p 256).

9) We disregard the importance of the number of firms since the "old story" put so much emphasis on this point and concentrate on the "innovations" presented by the supergame literature. The number of firms may be a bridge between the old and the new story.

will probably vary with demand uncertainty α and exit probability σ. And detection and punishment lags will not be exogeneous, but depend on uncertainty of markets and the patience of participants.

To sum up the most robust implication of supergames is the following: the feasibility of collusion depends positively on the discount factor (and therefore negatively on the discount rate and its components time discount rate proper, risk, lags, exit probability). Of course there are modifications depending on the game played (Bertrand reversion versus Cournot reversion), on the sophistication of the punishement structure (two or three tier strategies) and whether we allow strategic interactions (signalling, reputation). And changing the scope for collusion does not mean that profits should be linearily related to indicators for "the relevant time discount". We have to keep in mind that many outcomes different from collusion are also equilibria in supergames. But at least the models suggest to look for such indicators as a preliminary test.

Predicting a negative influence of risk and uncertainty on profits sounds natural as seen from the supergame and collusion perspective. However portfolio theory would suggest that in equilibrium risky markets[10)] should need higher "target rates of profits" (because of higher risk premia). If target rates of profits are higher (due to risk) and actual rates are lower (due to less collusion), exit and entry must be blockaded in some way (as the empirical literature on the persistence of profit differences tells). The predicted negative impact of proxies for uncertainty (and relevant discount rate in general) on profits is an interesting and refutable implication of supergames.

4. Transfer into an empirical model

The step between the theoretical prediction and empirical testing is a large one. This is true (and well described in literature) for the old positive concentration margin story and maybe even more for the implied negative relation between profits and "relevant time discount rate".

We follow traditional lines to test the old story. Profit is the net profit margin (PCN), concentration is the share in value added by the largest four firms in 1983 (CR4). Indicators on employment per plant (SIZE), heterogeneity (PROD), market openess (EXP, OPEN) and capital intensity (INV) are added to correct for structural factors other than concentration.

To test the relationship suggested in the supergames we proxied the "relevant time discount rate" by time volatility of production (VOLPROD) and exports (VOLEXP) and by the unpredictability of production and exports. (NPREDPROD, NPREDEXP). The first set is calculated as standard deviation of

10) More exactly firms facing undiversifiable risk.

the annual growth rates of production and exports in each of the 97 industries (1980-87), the second group as the standard error of the loglinear regression of production respective exports on time again for the 97 sectors.

The economic rational for VOLPROD and VOLEXP is that heavy fluctuations of demand will endager tacit collusion due to information lags, noisiness of information etc. Markets with large fluctuations will also be those with uncertain future and higher exit probability. Export data are used since the volatility of the export market may indicate fuzziness of information and riskiness better than the domestic market in a small open economy like Austria. Even more important than fluctuations will be their unpredictable part. We apply the "naive forceast" of a time trend to proxy the predictable part and assert that the remaining variance of production and exports is unpredictable (NPREDPROD respective NPREDEXP). All four variables are supposed to proxy the "relevant time discount *rate*", so we expect them to be negatively related to profits.

Still there is a large difference between the concept of "relevant time discount" and our empirical variables, but at least we get some information whether it is worth to continue on the line suggested by this model class.

5. The empirical evidence

In the "plain vanilla equation" (the term was used by *Salinger*, 1990) *concentration* is - if anything - negatively related to profits. The negative coefficient is significant according to the usual t-test, but this should not be interpreted rigorously because of the specification problems in this simple equation. The coefficient is strikingly robust (always between .15 and .17) if *structural variables* like export ratio (EXQ), market openess (OPEN), or capital intensity (INVEST) are added. The coefficent of variation is low (adjusted R^2 = .07 to .08, table 1).

The rather robust negative influence of concentration vanishes if we add a size variable (SIZE is employment per plant). In this case the coefficient for concentration becomes insignificant, the t-value for SIZE is larger than that of concentration, both coefficients are insignificant probably due to multicollinearity (the adjusted coefficient of determination rises after including SIZE). This suggests that concentration maybe is a proxy for size and that profits and size are negatively related. This puts the old *Demsetz* hypothesis upside down, that concentration is the consequence of successful growth of market shares and that concentration may follow from efficiency. It is more in line with organizational slacks or X-inefficiency raising with size as proposed by *Leibenstein* (1966) and *Frantz* (1988). The significance of the negative influence is not so strong that we want to push this point without further investigation.

table 1

Profit margins and concentration –
the old story plus structural variables
(t-value in parenthesis below coefficient)

CR_4	EXP	OPEN	PROD	SIZE	INVEST	R^2	STE
– .16						.074	15.1
(– 2.83)							
– .15	– .007					.071	15.2
(– 2.77)	(– .21)						
– .15		– .008				.076	15.2
(– 2.72)		(– .78)					
– 0.16			– .01			.071	15.2
(– 2.81)			(– .32)				
– 0.08				– .02		.095	15.0
(– 1.11)				(–1.62)			
– .16					.76	.087	15.1
(– 2.95)					(1.35)		

Dependent variable: PCM = (S-W-D-M)/(S-M); average 1980-1987, 97 3-digit sectors in Austrian manufacturing.

S = sales

W = payroll

D = depreciation

M = material

CR_4 = share of value added in 4 largest firms, 1983

EXP = export in % of production

OPEN = export plus import (=openess) in % of production

PROD = number of 4-digit industries in 3-digit industries

SIZE = employment per plant

INVEST = investment in relation to total costs

STE = standard error of residuum

R^2 = coefficient of determination (adjusted) *table 2*

Profit margins, volatility, non-predictability – proxies for the "relevant time discount" (t-value in parenthesis below coefficient)

VARPROD	VAREXP	NPREDPROD	NPREDEXP	CR_4	SIZE	R^2	STE
– .66						.084	15.1
(– 2.94)							
	– .44					.126	14.7
	(– 3.77)						
		– 9.86				.003	15.7
		(– .59)					
			–50.02			.140	14.6
			(– 4.00)				
– .54				– .13		.122	14.8
(– 2.40)				(– 2.27)			
	– .40			– .13		.173	14.3
	(– 3.48)			(– 2.47)			
– 0.54				– .05	– .02	.141	14.6
(– 2.40)				(– 0.71)	(– 1.63)		
	– .41			– .05	– .02	.196	14.1
	(– 3.57)			(– .72)	(– 1.81)		
			–43.90	– .06	– .02	.195	14.2
			(– 3.55)	(– .83)	(– 1.51)		

Dependent variable: PCM = (S-W-D-M)/(S-M); average 1980-1987, 97 3-digit sectors in Austrian manufacturing.

VARPROD = standard deviation of production growth 1980-1987

VAREXP = standard deviation of export growth 1980-1987

NPREDPROD = standard error of "naive trend forecast" of production

NPREDEXP = standard error of "naive trend forecast" of exports

CR_4 = share of value added in 4 largest firms, 1983

SIZE = employment per plant

The indicators on volatility and unpredictibility all have the expected negative sign. In the single equations three of the four are significant. The coefficient of determination for the characteristics of the export markets is .13 respective. .14, which is quite high for cross section studies and nearly double as high as that for concentration. The sign is negative as suggested by the models indicating higher profits for stable and predictable markets. The results are robust to modifications in the profit concept, to change of the year of investigation, and to the inclusion of additional variables (see appendix).

If concentration, size and volatility (or unpredictability) are put into the same equation volatility and unpredictability dominate. Concentration sometimes influence profits in an inplausibel negative way, but if size is added this influence is no longer significant. Volatility and unpredictability especially of export markets is the best determinant in equations explaining up to 20% of the variance in net profit margins.

The micro data set (886 firms) confirms the robustness of the results. If anything concentration (whether rates or market shares or Herfindahls are used) decrease profits, but size is more important (in the anti Demsetz way). Market volatility decreases profits and is the strongest single variable. Again the robustness of the findings was tested by changing profit concepts, time period and additional structural variables.

6. Caveats, conclusions, further research

The old story of a positive concentration - margin relation is not supported by the data. If anything the relation is negative, but concentration seems to be a proxy for size (which is related negative to profits as proposed by X- inefficiency theory, *Frantz*, 1988).

Supergames predict - for a given number of firms - the feasibility of collusion to decrease with time discount rate, market uncertainty, exit probability, detection and punishment lags. This set of related factors - the "relevant time discount *rate*" - is proxied by variables on the volatility and unpredictablity of demand in the empirical part. These variable successfully explain a certain part of the cross section profit variance, with the correct signs and robust coefficients. Data are more consistent with the supergame prediction of less collusion in volatile markets than with the portfolio theory demanding higher profits in riskier markets. This result hints at considerable mobility barriers for capital in Austria.

We do not claim to test supergame models. Their variety is too large, many outcomes may be equilibria, model assumptions and real world circumstances are too different. But we find that empirical data are more in line with some proxies for riskiness and volatility in a way predicted by supergames than with the older story of a positive relationship between concentration and margins. More work need to be done (preferable with the micro data set or with panel data) to bridge the gap between the theory of supergames and empirical data, but it seems to be a "stylized fact" that volatility and unpredictability depress real world profits. The channel may or may not be that modelled in supergames. The suggestion to test these determinants however came from non cooperative game theory.

Appendix: On the robustness of the findings[8])

In assessing the problems and merits inter-industry studies *Schmalensee* (1989) emphasized that cross section evidence should be robust. Even then it may not be an adequate test of specific theories, but it helps to formulate stylized facts, which could be used as starting points for more theoretical reasoning.

We tested this robustness by calculating a variety of concept for most variables. For *profit margin* we calculated gross and net margins, we calculated them for a single year (1983) and for the whole period (1980-87). Correlation between the ratios is rather high. For concentration we calculated CR4 and CR8, we used shares of value added. Data are available for 1976, 1983, 1988. The correlation between all these data is more than .90.

For the functional relation we used linear regressions, semi logarithmic, non parametric methods. We excluded several basic sectors (oil, mining) and eliminated outliers.

The main findings - negative impact on margins by concentration and size, with the latter as stronger determinant - and negative impact on profits by volatility and nonpredictibility of demand remained statistically significant for the impressive majority of all these variations.

We had also the possibility to use a recently available data panel (firm data for 886 manufacturing firms) to check whether the simultaneous inclusion of concentration and market shares or of Herfindahls and market shares did matter. If two of the three variables are combined usually both have a negative coefficient. Again SIZE can capture much of the negative impact of market shares and concentration.

The influence of volatility is stronger than that of market shares, Herfindahls, concentration rates and size.

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8) The micro data set for 886 firms became recently available. See: Aiginger, K., Gartner, Ch., Partsch, F., Empirische Industrie- und Außenhandelsökonomie, unpublished, 1991.

Robustness test:

Concentration and gross profit margins (t-value in parenthesis below coefficient)

CR_4	EXP	OPEN	SIZE	ENERG	INVEST	R^2	STE
− .12						.070	11.6
(− 2.74)							
− .11	− .04					.094	11.4
(− 2.53)	(− 1.74)						
− .10		− .02				.115	11.3
(− 2.52)		(− 2.34)					
− .11			− .007			.068	11.6
(− 2.71)			(− .52)				
− .14				.83		.147	11.1
(− 3.45)				(3.05)			
− .13					1.45	.174	10.9
(− 3.19)					(3.57)		

Dependent variable: PCM = (S-W-M)/(S-M); average 1980-1987, 97 3-digit sectors in Austrian manufacturing.
S = sales
W = payroll
M = material
CR_4 = share of value added in 4 largest firms, 1983
EXP = export in % of production
OPEN = export plus import (=openess) in % of production
SIZE = employment per plant
ENERG = share of energy costs of total costs
INVEST = investment in relation to total costs
STE = standard error of residuum
R^2 = coefficient of determination (adjusted)

appendix: table 2

Robustness test:
Gross profit margins and proxies
for the discount factor
(t-value in parenthesis below coefficient)

CR_4	VARPROD	VAREXP	(SIZE)	(VALADD)	R^2	STE
− .09 (− 2.14)	− .45 (− 2.62)				.127	11.2
− .10 (− 2.42)		− .24 (− 2.68)			.130	11.2
− .02 (− .30)		− .25 (− 2.82)	− .02 (− 2.44)		.176	10.9
− .18 (− 5.00)		− .31 (− 4.17)		.07 (7.06)	.425	9.1

Dependent variable: PCM = (S-W-M)/(S-M); average 1980-1987, 97 3-digit sectors in Austrian manufacturing.
S = sales
W = payroll
M = material
CR_4 = share of value added in 4 largest firms, 1983
VARPROD = standard deviation of production growth 1980-87
VAREXP = standard deviation of export growth 1980-87
SIZE = employment per plant
VALADD = value added per employee

Robustness test:

Concentration, (net) profit margins 1983, volatility (t-value in parenthesis below coefficient)

CR_4	PLANTS	SIZE	VARPROD	VAREXP	VALADD	R^2	STE
			− .86 (− 3.14)			.090	18.4
				− .50 (− 3.46)		.108	18.2
− .23 (− 3.45)						.107	18.2
− .23 (− 3.17)	− .002 (− .17)					.103	18.3
− .16 (− 1.78)		− .02 (− 1.29)				.118	18.2
− .29 (− 4.33)					.06 (2.90)	.175	17.6
− .19 (− 2.87)			− .68 (− 2.50)			.157	17.7
− .20 (− 3.12)				− .44 (− 3.14)		.186	17.4
− .12 (− 1.46)		− .02 (− 1.43)		− .45 (− 3.19)		.198	17.3
− .27 (− 4.24)				− .50 (− 3.75)	.07 (3.54)	.276	16.5

Dependn variable: PCM = (S − W − M)/(S − M); 97 3−digit sectors in Austrian manufacturing, 1983.

S = sales

W = payroll

M = material

CR_4 = share of value added in 4 largest firms, 1983

PLANTS = number of plants in 3-digit sector

SIZE = employment per plant

VARPROD = standard deviation of production growth 1980−87

VAREXP = standard deviation of export growth 1980−87

VALADD = value added per employee

Robustness test : Microdata (886 firms) 1983
(t-value in parenthesis below coefficient)

CR_4	MS	HERF	VARPROD	VAREXP	EXP	INV	VALADD	R^2	STE
	- .173		- 1.169		.021	- .335	.497	.400	15.2
	(- 1.670)		(- 6.974)		(1.357)	(- 4.447	(18.25)		
		- .033	- 1.284		.023	- .335	.500	.399	15.2
		(.541)	(- 6.889)		(1.413)	(- 4.424)	(18.137)		
- 0.01			1.230			- 0.331	.498	.399	15.2
(- .032)			- 5.380)			(- 4.337)	(18.164)		
	- .371			- .906	.0222	- .311	0.556	.408	15.1
	(- 3.704)			(- 7.660)	(1.400)	(- 4.142)	(17.795)		
		- .178		- .899		- .280	.557	.406	15.1
		(- 3.375)		(- 7.595)		(- 3.704)	(17.744)		
- .082				- .757		- .285	.552	.402	15.2
(- 2.512)				(- 5.832)		(- 3.758)	(17.555)		

MS = Market share of firm in 2-digit industry
HERF = Herfindahl Index for 2-digit industry
CR_4 = share of 4 largest firms, 1983
EXP = Export / sales ratio
INV = Investment / sales ratio
VARPROD = standard deviation of production growth 1980-87 in 2-digit industry
VAREXP = standard deviation of export growth 1980-1987 in 2-digit industry

References:

Adelman, M.A., Stangle, B.E., "Profitability and market share", in Fisher, F., M., Antitrust and Regulation, MIT Press, Cambridge, London, 1985.

Aiginger, K., Production and Decision Theory under Uncertainty, Blackwell, 1987.

Aiginger, K., "The optimal reaction of production and investment on uncertainty", in Funke, M., Factors in business investment, Springer, Augsburg, 1989.

Bain, J.S., "Relation of profit rate on industry concentration: American manufacturing, 1936 - 1940", Quarterly Journal of Economics, 65, 1951, pp 293-324.

Bain, J.S., Barriers to new competition, Harvard Press, Cambridge, 1956.

Blair, J., Economic concentration, Hartcourt, New York, 1972.

Baum, C., "Systematische Fehler bei der Darstellung der Unternehmenskonzentration durch Konzentrationskoeffizient auf Basis industriestatistischer Daten", Jahrbuch für Nationalökonomie und Statistik, 193 (1), 1978, pp 30-53.

Blanchard, O.J., Discussion on Hart 1986, see Hall.

Bradburd, R.M., Over, A.M., "Organizational costs, "sticky" equilibria and critical levels of concentration", Review of Economics and Statistics, 64, 1982, pp 50-58.

Bresnahan, T.F., "Duopoly models with consistent conjectures", American Economic Review, 71, 1981, pp 934-994.

Bresnahan, T.F., "Empirical Studies of Industries with Market Power", in Schmalensee, R., Willig, R.D. (eds.), Handbook of Industrial Organization, II, Elsevier Publishers, Amsterdam, New York, 1989.

Bulow, J., Geanakopolos, J., Klemperer, D., "Multimarket oligopoly, strategic substitutes and complements", Journal of Political Economy, 1985, pp 488-511.

Buzzel, R.D., Gale, B.T., The PIMS Principles: Linking Strategy to Performance, Free Press, New York, 1982.

Caves, R.E., Barton, D.R., "Efficiency in US Manufacturing", MIT Press, Cambridge, London, 1990.

Cheng, L., "Comparing Bertrand and Cournot equilibria: a geometric approach", Rand Journal of Economics, 16, 1985, p 146-152.

Cowling, K., Waterson, M., "Price cost margins and market structure", Economica, 38, 1976, pp 378-394.

Curry, B., George, K.D., "Industrial Concentration: A survey", Journal of Industrial Economics, 1963 (March).

Davis, S., Geroski, P., Vlassopoulos,D., How concentrated are markets in the U.K.?, mimeo, Lille, 1990.

Demsetz, H., "Industry structure, market rivalry, and public policy", Journal of Law and Economics, 16, 1973, pp 1-10.

Demsetz, H., "Two systems of belief about monopoly", in Goldschmid, H.J., Mann, H.M., Weston, J.F. (eds.), Industrial concentration: The new learning, Little, Brown & Company, Boston, 1974.

Dixit, A.K., "The role of investment in entry deterrence", Economic Journal, 90, 1980, pp 95 106.

Domowitz, I., Hubbard, G., Petersen, B.C., "Oligopoly supergames: some empirical evidence on prices and margins", Journal of Industrial Economics, 35, 1987, pp 379-398.

Fisher, F.M, Gowan, J.J., "On the misuse of accounting rates of return to infer monopoly profits", American Economic Review, 73 (1), 1983, pp 82-97.

Frantz, R.S., X-Efficiency: theory, evidence and applications, Kluwer, Boston, 1988.

Fudenberg, D., Maskin, E., "The folk theorem in repeated games with discounting and incomplete information", Econometrica, 54, 1986, pp 533-554.

Fudenberg, D., Tirole, J., Game Theory, MIT Press, Cambridge, London, 1991.

Gale, B.T., "Market share and the rate of return", Review of Economics and Statistics, 54, 1972, pp 421-423.

Gale, B.T., Branch, B.S., "Concentration versus Market Share", Antitrust Bulletin, 1982, pp 83-106.

Geroski, P.A., "Specification and testing the profits - concentration relationship: Some experiment for the U.K.", Economica, 48, pp 279-288.

Geroski, P.A., Competition and innovation, Report prepared for the EC Commission, Brussels, 1987.

Geroski, P.A., "Innovation and the evolution of market structure", The Journal of Industrial Economics, 1990, 38 (March), pp 299-314.

Geroski, P.A., Jacquemin, A., "The persistence of profits: A European comparison", Economic Journal, 98, 1988, pp 375-389.

Gilbert, R.A., "Bank structure and competition", Journal of Money, Credit and Banking, 16 (4), 1984, pp 617-660.

Gort, M., Singamsetti, R., "Concentration and profit rates: New evidence on an old issue", Explorations in Economic Research, 3, 1976, pp 1-20.

Grabowski, H.G., Mueller, D.C., "Industrial research and development, intangible capital stocks, and firm profit rates", Bell Journal of Economics, 9, 1978, pp 328-343.

Green, E.J., Porter, R.H., "Non-cooperative collusion under imperfect price information", Econometrica, vol 52, 1984, pp 87-100.

Hall, R.E., "Market Structure and Macroeconomic Fluctuations", Brookings Papers on Economic Activity 2, 1986, pp 285-322.

Hall, R.E., "The Relation between Price and Marginal Cost in U.S. Industry", Journal of Political Economy, 96 (5), 1988, pp 921-947.

Harris, F., "Testable competing hypotheses from the structure performance theory: efficient structure versus market power", Journal of Industrial Economics, 36, 1988, pp 267-280.

Hirschey, M., "Market structure and market value", Journal of Business, 58, 1985, pp 89-98.

Jacquemin, A., "Horizontal concentration and european merger policy", European Economic Review, 1990, 34, pp 539-550.

Jacquemin, A., Buigues, P., Ilzkovitz, F., "Horizontal mergers and competition policy in the European Community", European Economy 40 (May), 1989.

Jacquemin, A., de Ghellinck, E., Huveneers, C., "Concentration and profitability in a small, open economy", Journal of Industrial Economics, 29, pp 131-144.

Jacquemin, A., De Jong, H.W., European industrial organization, Wiley, New York, 1977.

Kreps, D., Scheinkman, J., "Quantity precomittment and Bertrand competition yield Cournot outcomes", Bell Journal of Economics, vol 14, 1983, pp 326-337.

Leibenstein, H., Allocative Efficiency versus X-Efficiency, American Economic Review, vol 56, June 1966, pp 392 - 415

Martin, S., Market, firm and economic performance, New York, Salomon Brothers Center, 1983.

Maskin, E., "The existence of equilibrium with price setting firms", American Economic Review, vol 76, 1986, pp 382-386.

Maskin, E., Tirole, J., "A theory of dynamic oligopoly III; Cournot competition", European Economic Review, vol 31, 1987, pp 947-968.

Maskin, E., Tirole, J. (1988A), "A theory of dynamic oligopoly I", Econometrica, vol. 56, pp 549-569.

Maskin, E., Tirole, J. (1988B), "A theory of dynamic oligopoly II", Econometrica, vol. 56, pp 571-599.

Neumann, M., "Marktmacht und Kosteninflation", Jahrbuch für Nationalökonomie und Statistik, vol 195, 5/198O, pp 477f.

Neumann, M., Boebel, I., Haid, A., "Business Cycle and Industrial Market Power", Journal of Industrial Economics, vol 32, December 1983, pp 187-195.

Neumann, M., "Industrial policy and competition policy", European Economic Review, 34, 1990, pp 562-567.

Neumann, M., Boebel, I., Haid, A., "Domestic concentration, foreign trade and economic performance", International Journal of Industrial Organization, 3, 1985, pp 1-19.

Neumann, M., Haid, A., "Concentration and Economic Performance", in Schwalbach, J. (ed.), Industry Structure and Performance, WZB Edition Sigma, Berlin, 1985.

Ordover, J., Baumol, W., "Antitrust policy and high technology industries", Oxford Review of Economic Policy, 4, 1988.

Perry, M., "Oligopoly and consistent conjectural variation", Bell Journal, 1982, pp 197-205.

Phillips, A., "A critique of empirical studies of relations between market structure and profitability", Journal of Industrial Economics, 24, 1976, pp 241-249.

Posner, R., "The social costs of monopoly and regulation", Journal of Political Economy, 83, 1975, pp 807-827.

Porter, R. (1983A), "Optimal cartel trigger price strategies", Journal of Economic Theory, 29, 1983, pp 313-338.

Porter, R. (1983B), "A study of cartel stability: the joint executive comittee 1980-86", Rand Journal of Economics, 14, 1983, pp 301-314.

Ravenscraft, D.J., "Structure Profit Relationships at the Line of Business and the Industry Level", Review of Economics and Statistics, 1983, pp 22-31.

Rotemberg, J., Saloner, G., "A Supergame theoretic model of business cycles and price war during booms", American Economic Review, 1986, pp 390-407.

Salinger, M., "The concentration - margins relationship reconsidered", Brookings papers: microeconomics 1990, pp 287-335.

Scherer, F.M., "Market Structure and the Stability of Investment", American Economic Review, 59, 1969, pp 72-79.

Schmalensee, R., "Do markets differ much?", American Economic Review, 75, 1985, pp 341-351.

Schmalensee, R., "Collusion versus differential efficiency: testing alternative hypotheses", Journal of Industrial Economics, 35, 1987, pp 399-425.

Schmalensee, R., "Interindustry Studies of Structure and Performance", in Schmalensee, R., Willig, R.D. (eds.), Handbook of Industrial Organization, II, , Elsevier Publishers, Amsterdam, New York, 1989.

Shaked, A., Sutton, J., "Relaxing price competition through product differentiation", Review of Economic Studies, 49, 1982, pp 131-146.

Shaked, A., Sutton, J., "Multiproduct firms and market structure", Rand Journal of Economics, 21, 1990, pp 45-62.

Shapiro, C., "Theories of oligopoly behavior", in Schmalensee, R., Willig, R.D. (eds.), Handbook of Industrial Organization, Elsevier Publishers, Amsterdam, New York, 1989.

Singh, N., Vives, X., "Price and quantity competition in a differentiated duopoly", Rand Journal of Economics, 15, 1984, p 546-554.

Spence, M., "Entry, capacity, investment and oligopolistic pricing", Bell Journal, 1977, pp 534-544.

Staiger, R.W., Wolak, F.A., Collusive pricing with capacity constraints in presence of demand uncertainty, Rand Journal of Economics, 23 (2), Summer 1992, pp 203 -220.

Stigler, G., "A theory of oligopoly", Journal of Political Economy, 1964, pp 44-61.

Sutton, J., Sunk costs and market structure, MIT Press, Cambridge, London, 1991.

Tirole, J., The Theory of Industrial Organization, MIT Press, Cambridge, London, 1989.

Vives, X., "On the efficiency of Cournot and Bertrand competition with product differentiation", Journal of Economic Theory, 36 (1), 1985, pp 166-175.

Waterson, M., "Price cost margin and successive market power", Quarterly Journal of Economics, 94, 1980, pp 135-150.

Waterson, M., "Product differentiation and profitability: an asymmetric model", Journal of Industrial Economics, 39, 1990, pp 113-130.

Weiss, L.W., "The concentration - profits relationship and antitrust", in Goldschmid, H.J., Mann, H.M., Weston, J.F., (eds.), Industrial concentration: The new learning, Little, Brown & Company, Boston, 1974.

Weiss, L.W., Concentration and price, MIT Press, Cambridge, London, 1989.

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