THE USEFULNESS OF OLIGOPOLY MODELS FOR EXPLAINING FIRM DIFFERENCES IN PROFITABILITY

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Karl Aiginger

Austrian Institute of Economic Research
University of Linz

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Address: Karl Aiginger, WIFO
A- 1103 Wien, Box 91
Fax: 43 1 7989368

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Abstract: This paper tries to explain profitability differences on the firm level. Four different schools in industrial organizations give us predictions about candidate variables. furthermore we have to controll for capital intensity and market openess and to incorporate persistency effects. According to a current trend in industrial organization, game theoretical models are especially closely screened for suggestions about potential determinants of profitability. We use a sample of 300 industrial firms in Austria over 1983 - 92 for testing, and compare the results with similar empirical studies on the industry level.

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Karl Aiginger

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The usefulness of oligopoly models for explaining firm differences in profitability

1. The structure of the paper [1])

The explanation of differences in the profitability of firms and markets is a seminal topic in industrial organization. This paper does not aim at developing a new theory or another model, but tries to explain the differences in the price cost margins reported by firms in their balance sheets by available theoretical hypotheses. There are different strands of partly overlapping theories which try to perform this task. We distinguish four sets of presumed determinants of profit margins and add a set of "structural variables". Following today's fashion in industrial organization we specifically screen supergames for testable forecasts. We use a panel of 274 manufacturing firms reporting regularly balance sheets data to the Austrian Central Bank (OeNB).

The paper is structured as follows. In section two we sum up the predictions of industrial organization literature, about which variables should explain profitability differences of firms and industries. The next section describes the data and the test strategy used. Section 4 reports the main results for the specific models. Then we test a comprehensive model and investigate the endogeneity problem. Section 6 compares the result with similar studies and the final section summarizes the results.

2. Schools in explaining profitability differences

It is to some degree ambiguous how to structure the hypotheses which emerged in industrial organization during the last fifty years. We decided to distinguish four different schools: the Bain story, the static Cournot prediction, portfolio theory and the class of supergames. The schools differ in several respects, be it the degree of formalization, the stringency of the theoretical derivation, the presumed degree of cooperation, the horizon of the play, and the importance of real versus financial variables. No scholar honestly believes that a single hypothesis can explain all the differences in profitability, each author implicitly or explicitly assumes that

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[1]) The author acknowledges the research assistance of Franz Partsch and Christine Gartner who selected the OeNB panel used for this work with extreme skill, diligence and expertise and performed the necessary calculations. I also thank Traude Novak and Sonja Patsios for valuable statistical and econometric support and for reading various drafts of this paper.

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it is natural to add a set of control variables for "structural" or "intrinsic" differences between industries. We therefor combine the theories into a comprehensive megaequation.

$$(1)\quad PCM = \alpha + ß_1\ \mathbf{B} + ß_2\ \mathbf{C} + ß_3\ \mathbf{P} + ß_4\ \mathbf{SUP} + ß_5\ \mathbf{STF}$$

Each of the four bold variables **B**, **C**, **P**, **SUP** denotes a set of variables predicted to be important by one of the four theories (**$ß_1$**....$ß_4$ are the vectors of the coefficients). STF denotes a set of stylized facts characterizing industrial structure in general and purported to be important for profits in specific. There is some overlapping between these structural variables and the variables thought to be important in the theory groups, capital intensity, market openness, past profits are considered as important in any of the specific theories too. In the empirical part we start with estimating the influence of this group, find robust structural variables, then we screen the variables proposed by B, C, P and SUP, and combine them with STF and with each other.

The Bain story

This is the oldest and most frequently tested story in Industrial organization. The story tells that an industry characterized by a small number of competitors is prone for collusion. We do not replicate Bain's much richer arguments (for example emphasizing entry conditions), not the critique of the argument (see Demsetz 1973, 1974), nor discuss the problems underlying the econometric tests (see Schmalensee 1989, Bresnahan 1989).

We include in our B-variable set the concentration rate (employment share of largest 4 firms in 1988 CRM), and a Herfindahl index (HERFM). Following Bain we constructed a dummy indicating whether concentration exceeded a critical level (CRGT70M) [2]. We have data on the number of enterprises in an industry (BUSM) and on the number of employees (EMPLF) on the firm level.

$$(2)\quad PCM = \alpha + ß_1\ \mathbf{B} + ß_5\ \mathbf{STF}$$
$$\mathbf{B} = \{CRM,\ CRGT70M,\ HERFM,\ BUSM,\ NUMBERM,\ EMPLF\}$$

The static Cournot model

The static Cournot model yields the testable implication that on the firm level the price cost margin of each firm depends on its market share and on the inverse (industry) price elasticity of demand. Firms with larger market shares are predicted to have higher margins (due to differences in their efficiency). The aggregate margin on the industry level depends on the Herfindahl and again the inverse price elasticity of demand.

We have to construct a primitive indicator on the price elasticity of demand. We did this by regressing the quantity (production) in each industry on a relative price index for that industry and on the GNP (as proxy for

[2]) Following Bain the dummy was set 1 if concentration exceeded 70 %,. Thus we are allowing for the simplest kind of non linearity between the margin and the concentration rate

product substitutes). Doing this in the logarithmic form we got a primitive proxy for demand elasticity (and its inverse, ELASTM). The majority of the elasticities for the 19 2-digit industries had the correct sign and approximately one half of the coefficients were significant. Therefor we multiplied ELASTM by a dummy taking the value 1 if the coefficient was significant and zero otherwise to get ELASTMSIG [3]). A justification for this is that observable price - output combinations are influenced by supply and demand conditions and if estimated elasticities were not different from zero this most likely does not come from facts, but from the incomplete estimation model.

We constructed market shares (MAF) as the sales of each firm in percent of the gross value added of the two digit industry it belonged too. We know that this kind of calculation brings severe problems, since the two digit industries delineate a market much too broad to be the relevant one for the perspective of the firms. We will correct for this problem if we report on an alternative concept of specifying market shares (Aiginger 1994B). To correct for the fact that the measured market shares will be much smaller for most firms than the actual one according to this calculation method, we put in a dummy for larger vs. smaller firms (MALARGE), then for firms with a market share larger/smaller than 1 % and finally we introduced dummies for 5 classes of market shares (MSDUMMY, 0-1, 1-2, 2-5, >5).

$$(3)\quad PCM = \alpha + ß_1\, C + ß_5\, \mathbf{STF}$$
$$C = \{ELASTM,\ ELASTSIGM,\ MAF,\ MALARGE,\ MSDUMMY\}$$

Portfolio theory

The portfolio theory predicts that the undiversifiable risk is a crucial part of the costs of capital and should therefor be included in the profit margin. See equations 4a - 4 b for the usual portfolio argument (where r_i, r_m, r_f are firm specific, market and risk free rates of returns) [4]). We estimated the degree of non diversifiable risk by the coefficient in regressing the annual GPCMS for each firm i on the industry margin. The coefficients of these 274 regressions were taken as the individual BETAF.

[3]) Actually we tried two strategies to get rid of unplausible and insignificant coefficients for some industries. First we multiplied the elasticities by their t-value (this weights them with the confidence we could have into this elasticity and finally). The second and more successful strategy was to multiply the elasticities by a dummy, which was one if the elasticities were plausible and the coefficients were significant and zero otherwise. The justification for both procedures is that it can be expected a priori for some branches that actual price and output data revealed demand elasticities (as is well known output- price - pairs are influenced by supply and demand conditions). If they did not reveal plausible demand elasticities then the resulting data should not be used.

[4]) Martin (1993) is surveying studies combining portfolio arguments, and structure and conduct variables in explaining profitability differences. Following Bothwell and Keeler (1996) he merges the influence of capital intensity and the riskiness of the investment in one coefficient. For the importance of riskiness on profits see also Mueller (1986) and Neumann et al. (1979).

(4a) $E(r_i) = r_f + beta \cdot [E(r_m) - r_f]$

(4b) $BETA_i = cov(r_i, r_m) / var\ r_m$

(4) $PCM = \alpha + ß_3\ \mathbf{P} + ß_5\ \mathbf{STF}$

$\mathbf{P} = \{BETAFF\}$

Supergames

Supergames is that class of models in non cooperative game theory in which the same game is repeated infinitely. Though it is unrealistic to assume that firms live infinitely and that the circumstances do not change over time this class seems to be more realistic than static models. Supergames are much easier to handle than multi stage models with more than two firms and two stages.

Applying supergames as basis for empirical research has important advantages but also some disadvantages (Aiginger 1994). One advantage is that supergames are easily to be solved analytically in the sense that there is an straightforward way to define the boundary condition for collusion. The way is to calculate the stream of (properly discounted) future payoffs from the collusion strategy and compare it to the stream resulting from defection plus punishment. Under certain circumstances the calculation of three one period profit figures - those under the regimes of collusion, defection and punishment [5]) - are sufficient to calculate the condition for implicit cooperation.

One disadvantage of the application of supergames for empirical research is that these models do not predict actual profits, but only a lower boundary for the feasibility of collusion (FOC). *The models yield a critical discount factor, δ, which has to be compared to the actually prevailing one.* We have then to hypothesize that actual profits are larger in an industry in which the FOC is large, since the critical discount factor is not too high and the empirical frequency of collusion should therefor be high. I do not find this as too large a price [6]), but theoretical economists tend to be horrified about this second step.

Supergames predict that the critical discount factor δ depend on the number of firms in Bertrand models and in Cournot models. In either model the critical discount factor increases in n, the feasibility of collusion (FOC) declines with n . See equation (5) for Bertrand and equation (6) for Cournot supergames.

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[5]) The critical discount factor is $\delta > (\eth^{def} - \eth^{coll}) / (\eth^{def} - \eth^{pun})$

[6]) Under certainty price wars never occur for optimal behavior. Actually uncertainty is large enough, suboptimal behavior and disequilibria exist and industries are in fact aggregates of well defined markets, so that it sound reasonable to me that industries in which collusion is easy will show larger profits than industries in which collusion is difficult

The FOC is larger for Bertrand models with a small number of firms (see n = 2), but the FOC is larger for Cournot models if the number of firms is large (see n = 100). The underlying logic is that punishment becomes weaker in both models, but profits from defection remain larger in Bertrand models.

What is interesting is that though profits are very different between static Cournot and static Bertrand models, and while profits are much larger under collusion (with a greater difference for few firms and for the Bertrand model), the FOC conditions do not differ too much between quantity and price model for a given number of firms. This comes from the canceling out of two effects. The gain of defection is much larger for Bertrand firms, but so is the effect of punishment

What is interesting for us is that in both models the critical discount factor is increasing in n, showing that the feasibility of collusion decreases with a larger number of firms (and deconcentration)

(5) Price game

$\delta > (n-1)/n$ for $n = 2$ $\delta > 1/2$, for $n = 100$ $\delta > 0{,}99$

(6) quantity game

$\delta > (n+1)^2 / [(n+1)^2 + 4n)]$

for $n = 2$ $\delta > 9/17$, for $n = 100$ $\delta > 10201/10601$

Supergames predict that the FOC increases with product differentiation (decreases with θ, the parameter of product differentiation, see Martin 1993, p 116). For more on product differentiation and supergames see Häckner 1994.

Supergames predict that the FOC decreases with demand uncertainty. If each firm faces a certain exit probability ε future gains of cooperation have to be stronger discounted, the critical DF needed for collusion increases, FOC decreases.

(7) $\delta = \delta^{\text{without exit}} / (1 - \varepsilon)$

A detection lack increases the benefits from defection and decreases FOC, uncertainty about the partners behavior incurs search and information costs and decreases benefits from collusion.

(8) for two period lag $\tau = 2$

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

Supergames predict that the FOC increases with output growth and should be very difficult in declining markets. Growth by ϕ % is equivalent to lowering the critical discount rate since future profits of cooperation are higher valued as compared to today's profits form defection.

(9) $\delta = \delta^{stat} / (1 + \phi)$

The relation between collusion and economies of scale is not clearcut. In static models flat cost curves are considered as pro competitive and economies of scale should do the same job, while raising marginal cost curves are told to favor Cournot models with positive margins. In supergames economies of scale increase the value of defecting, but are also the precondition for punishment, so that some topsy turvy results are available. In non game theoretical industrial organization economies of scale are seen as a profit enhancing entry barrier.

To sum up, supergames predict that

- o the FOC decreases with the number of firms n
- o the FOC increases with the degree of product differentiation (decreases in θ)
- o the FOC decreases with uncertainty α (standard deviation of demand or the spread of the probability that there will be some positive demand and the probability of no demand), with exit risk ε
- o the FOC decreases with the length of detection lags τ, with information costs
- o the FOC increases with the growth rate of markets ϕ
- o there is an ambiguous relation between FOC and economies of scale (in contrast to static models and to non game theoretical models)

The first two prediction are overlapping with B and C. We concentrate therefor on finding proxies to test the other qualitative predictions. The time variability of value added and exports (SDM, SDXM) on the industry level and then on the firm level (SDF, SDXF) are taken to measure *risk* (see Aiginger 1993 for this approach). The annual increase of nominal value added over the period 1980-88 is taken to measure the *dynamic* of industries (GROWTHM, GROWTHXM), alternatively the dynamic of the firm (GROWTHF, GROWTHXF). The cost disadvantage ratio (CDRM) is taken as indicator whether the ambiguous relation between economies of scale and profits exist as forecast by supergames or the positive one (as a proxy for entry barriers) predicted by non game theoretic industrial organization. In static models economies of scale tend to increase competition.[7])

(10) $PCM = \alpha + ß_1\ \mathbf{SUP} + ß_5\ \mathbf{STF}$

SUP = {SDM, SDF, SDXM, SDXF, GROWTHM, GROWTHF, GROWTHXM, GROWTHXF, CDRM}

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[7]) We tried several measures relating net profits, gross profits and efficiency (value added per employee). CDR1 is the measure for the gross profits rate (with the value added as denominator). The results are not robust as to changes in the variables.

Stylized facts as source of control variables

Schmalensee (1989) gives a survey about stylized facts in cross section studies, a subset of these relate to profitability and is exploited here. There is also a specific need originating from theoretical considerations for two types of control variables.

The first is related to the concept of price cost margin needed. Since we use a gross concept for margins (we do not deduct depreciation) we have to control for the capital input. We used the investment/sales ratio (CSRF) as control variable. This variable may to some degree also grasp other forms of fixed or set up cost, it can also be interpreted as a proxy for entry barriers.

A second control needed urgently is one for the openness of the market to foreign competition. Concentration rates and market shares are calculated for the domestic market only. Therefor a correction for imports is needed. Exports are on one hand another indicator for the openness on the other hand profits are according to some models lower in export markets than in domestic markets. We choose as the indicator of market openness the sum of imports and exports on the level of the 2 digit industries (in relation to sales, OPENM). On the firm level we have no imports, so we had to use the export intensity (EXPINF).

We finally chose a sort of panel approach insofar as we added a lagged dependent variable (PCMLAG = PCM83). This can be justified as a partial adjustment approach. It can be seen as one of different techniques to incorporate structural and persistent differences in profitability of industries. Since we could argue that this job should be done by the other variables, we are eager to report equations with and without the lagged dependent variable.

(11) $PCM = \alpha + ß_5 \, STF$

$$STF = \{CSRF,\ OPENM,\ EXPINF, PCMLAG)$$

3 .The data and the test strategy

We used a sample of 274 Austrian manufacturing firms which consistently reported balance sheets between 1983 and 1992 for a fairly comparable range of economic activity. This is a subset of those firms which has neither merged with other firms nor restructured their own activity by breaking down their activity in independent units during these 10 years. The typical firm in this sample has 212 employees, nominal production grows at 6,4 % p.a., exports by 9,0 %. See the appendix for the more characteristics.

There are several ways to construct a price cost margin. We calculated the gross margin (nominator: sales minus payroll minus material) and chose sales as denominator, therefor we call the dependent variable

GPCMS88 in the empirical part (**g**ross **p**rice **c**ost **m**argin divided by **s**ales), its lagged value for 1983 is GPCMS83. The way the variable is constructed implies constant marginal costs and the absence of fixed costs as usual.

We first try to explain the profit margins by the **STF** group alone. We choose some "basic" structural equations according to economic content and statistical significance. The next step is to calculate the equations for **B**, **C**, **P**, **SUP** alone, then we merge the specific blocs with the variables in the structural bloc or a subset of the latter. Finally we estimate "megaequations" in which we explain price cost margins by variables out of all variable sets in equation 1, and perform tests whether the coefficients of each bloc can be set zero.

The order of these steps decreases the acceptance of the four main strands for the case that the theories and the structural factors overlap. Moreover the multicollinearity between a control variable and an specific determinant proposed by some theory will reduce the significance of a variable entering in the second step. We cope with this problem by reporting the results for the individual variables alone [8]), and with subsets of the structural bloc so that each advocate of a specific theory can extend his claim if necessary.

We want to acknowledge all the problems connected with the cross section approach as such (direction of causality, lacking of a structural form, assumption of equilibrium). We add that we consider problems of calculating profits from statistical data is a serious source for errors (though we do not assess the problems as that grave as Fischer, 1987, in his campaign against the misuse of accounting data on profits). We have to confess that the difference between the concepts of some variables in theory and the proxies actually used may seem to be too large for some theories and many preconditions of the theoretically models are far from existing in an real economy. These are the usual caveats before we can start with empirical work, but in our case they may be even more important.

4. The results

STF

We started with the set of control variables. We got good results for the variable needed most urgently namely CSRF (table 1), it is significant and can explain alone 10 % of the profit differences. OPENM has the expected negative sign but is not significant [9]). The export sales ratio of the individual firm (EXPINF) has an positive influence (at the 10 % level of significance), it seems to be more an indicator for the competitive performance of the firm than on the openness of the market). The profit margin in 1983 are highly significant (with a coeffi-

[8]) This procedure creates a new bias insofar as the equation is misspecified, if significant variables are excluded

[9]) This is a difference to the results on the industry level were the indicator on market openness proves to be a robust and significant determinant

cient of .48) and can explain 25 % of the variance of profits in 1992. This is a remarkable high degree of persistence in profit differences.

Summing up we were successful as far as our basic need was concerned, namely to get a control for capital input. We were less successful to incorporate a measure of market openness, the MOM variable is not significant, the export intensity on the firm level is a measure of competitiveness of a firm rather than of openness of the market. The persistence of profit differences across firms over 10 years is remarkable high. We will test the robustness of the specific theories by adding CSRF, GPCMS83 as independent variables, and - despite their limited success - try also OPENM and EXPINF in some combinations.

The Bain group

Profit margins are not related positively with the 4 firm concentration rate (**CRM**) or with the Herfindahl (HERFM) and do not decrease with the number of firms (**NUMBER**F) or their size (**EMPLF**) in an industry (table 2). Most of the coefficients of concentration rates CRM are negative. This is also true for the proxy for significantly concentrated industries (CRGT70M). The omission of structural variables seems to play some role for the robustness of the wrong sign of the concentration variables, since adding variable out of STF decreases size and lowers the t- values (which however are insignificant from the beginning) of the concentration rate. So we conclude that the Bain story [10]) does not hold for the sample, eventual perverse effects are due to missing structural variables.

Supergame group

Profit margins are positively related with industry growth (t = 1.85) and negatively related to the standard deviation of industry growth (t = 1.96) as predicted by supergames but the explanatory power of the single equation explanations is rather small. The same variables on the firm level (firm's growth and individual standard deviation of production) are significant with higher t- values (4.18 resp 2.52) and a higher explanatory power.

If we combine the indicators on growth and variability with the standard set of variables, GROWTHF and SDIMPF remain significant in most variants. Best combinations can explain 36 % of cross panel variance of profits. The cost disadvantage ratio has a positive sign (CDR), in combination with structural variables it can explain up to 35 % of the profit variance.

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[10]) Insofar as Bain focused on entry conditions as equal important determinant of profits, one could claim that the importance of capital intensity in explaining profits is Bain'sian in spirit

Portfolio group

The empirical influence of the degree of undiversifiable risk is not straightforward (see table 4). In the single equation BETAF is insignificant. Combined with the standard set of STF variables, BETAF becomes significant (with t- values between 4 and 5). A similar picture has been detected for the aggregate level in Aiginger (1994A) with a complete different data set and method of calculating BETA. The significance of BETAF depends crucially on the inclusion of the lagged dependent variable. If it is deleted BETAF becomes insignificant.[11])

The static Cournot model

The negative result for **B** implies that we will not find much hope for the static Cournot model. Indeed neither the elasticity variable nor the market share is significant. As for the elasticity variables it did not help to estimate alternative elasticities or to sort out significant from insignificant ones. One alternative is to ask firms to assess their own demand elasticity (see Aiginger 1994B for a successful attempt to do so). [12])

More astonishing is the failure to get some significance of the market shares for profits. We used dummies for different sectors of industries, we restricted the equation to larger firms, we split the firms into those with small or large market shares but nothing helped. Size and concentration is in this sample not positively related with profits, so we cannot arrive at a positive impact of market shares on profits.

5. Testing a comprehensive model

We finally estimated a comprehensive model in which 18 determinants were included, with a minimum out of each set. This equation could explain 37% (R^2 corrected) of the variance of the margins. We then excluded step by step the variables belonging to one set, but containing all the other variables (whether significant or not) and tested the restricted model against the unrestricted.

At the 5 % level the exclusion of BETA1 and the exclusion of the supergame variables matters. The variables in the Bain bloc and in the static Cournot model are (as a bloc) insignificant.

This test procedure looks innocent but small variations of the test design matter. The first change was that we started from a model without the lagged dependent (unrestricted model 2, 17 independent variables). The

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[11]) The direct correlation between GPCBS and BETA1 is -.369

[12]) In the WIFO. Entrepreneurial Survey firms are asked to assess the price elasticity of demand in their market by choosing one of the following three answers:

- o the price is the most important determinant of sales
- o demand depends inter alia on the price, but other factors are important too
- o quality, goodwill and service are more important for sales than the price

A ordered probit model was estimated explaining the price cost margin by market shares and price elasticity of demand as given by this question rationale was, that while the explanation of current profits by past profits demonstrates the high degree in profit persistence over 10 years, but is not an ultimate explanation of the sources of profit variance. If we now test the exclusion of the individual blocs, the exclusion of BETA1 is not significant, that of the supergame variables is significant even at the 1 % level.

The second arbitrariness lies is the treatment of insignificant variables or how many variables of each bloc we put into the megaequation. In the first test we had nine variables for bloc S, if we restrict to the three best performing (MWGROWTHF, SDF, CDM) we get a significant difference for excluding the supergame bloc even at the 1 % level and including the lagged dependent.

The coefficients in the megaequations and these F- test supports the robustness of the variables contained in **S**. BETA1 proves again as a valuable but capricious variable. The static Cournot model is not adequately tested here (for an alternative see Aiginger 1994), the factors in B do not play any role.

A critical point for all cross section studies is, whether the explanatory variables are really exogenous. This is especially important for variables like concentration and market shares. There is no doubt that from the theoretical model we have to be aware that a feedback from profits to market shares and/or concentration can happen.

We used two methods to deal with this problem. First we changed the time dimension of the variables for the concentration rate, for the Herfindahl and for the market shares variables. In no case we got significant results or results different from the equations using average values for the full period. As an alternative we instrumented these variables, using skill intensity (wages per employee), the number of firms in the industry, and minimum efficient scale as instruments. Again the coefficients of the critical variables did not change.

6. Comparison with results from other data sets and caveats

In a twin paper to this one (AIGINGER, 1994A) the same strands of literature and the same methodology was used on the aggregate level for 97 3-digit industries. The results are to a large extent similar, especially as far as the poor performance of the Bain group is concerned and as far as the significant results for growth, market variability of demand as determinants for differences now in the industry margins is concerned. The mixed results for the portfolio variables are replicated too. Past profits are a robust determinant of today's profits. Margins are positively related to the investment sales ratio, and market openness. The results on the industry level seem however not as robust as those on the firm level. Instrumentation of the concentration variable does matter on the industry level and the standard deviation of sales is not a robust determinant (its significance is lost after deleting outsiders or introducing fixed effects).

The Cournot model (Aiginger 1994B) performed much better on a level of "quasi-firms". As "quasi- firms" this paper uses grouped data, specifically the group of the largest four firms, then the firms ranked between 5 and

9, then firms ranked from 9-12, and finally the fringe (we get 348 quasi firms, 97 industries times four groups). The Cournot model gave an better performance if market shares were not calculated by comparing firm sales with statistical data published at some x-digit level. Firms were allowed to assess their own market share on their subjectively defined "relevant" market. [13])

What is out of the scope of the current paper is to use panel techniques (fixed and random effect models) or to model more explicitly the dynamic adjustment process (by an Arrelano Bond technique). This should be done in a second step, it would however imply that we have to delete those variables which have no or very little time variance (like industry growth rate, beta or demand instability).

[13]) The relevant market is much more narrow than that calculated by the industry groups. In our panel the market share of the majority of the firms is lower than 1 %, in the subjective assessment the median market share is about one third of the market

7. Summary

We have screened four strands of theoretical models for possible determinants of differences in the firms` price cost margins. Additionally we used a set of structural variables whose influence is partly supported by theoretical considerations, partly suggested as stylized facts or control variables. Out of the structural determinants capital intensity (+), and past profit margins (+) proved to be powerful and robust determinants. Market openness on the industry level has the expected sign but is not significant, export intensity on the firm level is a indicator on the individual firm's competitiveness rather than of market openness. Out of the theoretical strands the Bain group did not give good results. Concentration rates, the Herfindahl index, the number of firms and absolute size do not explain profit differences in our panel of 274 Austrian manufacturing firms between 1983 and 1992. This holds if we use lagged values or if we instrument these variables because of alleged endogeneity.

The Cournot model has problems insofar as the tendency of profit margins to increase with market shares is not replicated in the sample. Price elasticity is not significant, probably due to insufficient estimation of the true market price elasticity. The portfolio approach forecasts profits to increase with undiversifiable risk. Our estimators of the firms` "BETA" has no influence if taken alone, it can however explain profits if taken together with structural variables (specially past profits) and remains highly significant in "megaequations". The supergame models find the best support. GROWTH is a significant indicator, to some extent if taken as an industry variable, to a larger extent if taken as firm variable. Profit margins decline with market instability, again whether measured on the industry level or on the firm level, this is true for variability measured at the domestic market or for exports. This influence is predicted by supergames [14]), since it lowers the feasibility of collusion. All these variables have a significant influence if taken alone, and reduce the influence of structural variables (especially that of capital intensity) if combined with them.

We do not want to claim that the equations estimated *prove* the importance of supergames for at least two reasons. First the role of growth (+) and variability (-) on profits can be supported by alternative stories. Secondly the circumstances of real world manufacturing are quite different from the clean logical assumption in the models. Thirdly measuring profits from real world data remains a problem. The variables used for profit margins as well as determinants of profitability are at best proxies for those needed. What we can say is, that some of the variables seen as important for the sustainability of collusion in supergames are also important for actual profits.

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[14]) Of course there are other models and intuition too, which tells us that growing firms on growing markets could be more profitable than others, but there are always counterarguments that profit differences should level out. Supergames give a nice explanation why profits could differ in a specific kind of equilibrium. The prediction that profits are larger on more stable markets has again some intuition on its side, but remind that portfolio related arguments contradict this prediction. In principle measured profits on risky markets should be higher. See then the continuation of the argument that only undiversifyable risk matters

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Table 1F

Structural determinants of the price cost margin

(Firm level)

equation L if log	R^2	CSRF	OPENM	EXPINF	GPCMS83
1	.10	.14 (5.51)			
2	.004		−1.34 (−1.46)		
3	.25				.481 (9.72)
4	.01			2.42 (1.89)	
5	.29	.17 (2.32)	3.37[1]) (2.01)		.44 (4.06)
6	.30	.10 (4.25)			.43 (8.90)
7	.30	.10 (4.25)	.29 (.37)		.44 (8.88)
8	.31	.09 (3.77)	.41 (.44)	1.65 (1.45)	.44 (8.58)

Dependant variable: $GPCMS88 = \frac{S\text{-}PA\text{-}M}{S} \cdot 100.$

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[1]) Wrong sign.

Table 2F

Bain determinants of the price cost margins

(Firm level)

equation L if log	R^2	CRM	CRGT70M	HERFM	MAF	SIZEF	BUSM (UNT)	EMPLF	OPENM	CSRF	GPCM83
1	.01	−3.71 (1.54)									
2	.001			−6.72 (1.08)							
3	.001					−.75 (.81)					
4	.002						.001 (.57)				
5L	.01	−.05 (.47)						−.03 (.49)	−.21 (2.21)		
6L[1])	.01		−.61 (.73)					.03 (.55)	−.21 (2.28)		
7L	.01				.01 (.12			−.04 (.49)	−.21 (2.23)		
8L	.21	−.01 (.11)			.01 (.27				.11 (1.28)	.43 (7.10)	
9L	.10	−.04 (.35)			−.001 (.029)					.32 (3.58)	.17 (3.20)

Dependant variable: GPCMS88 = $\frac{S\text{-}PA\text{-}M}{S}$. 100.

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[1]) With the exception of CRGT70.

Table 3F

Supergame determinants of the price cost margins

(Firm level)

equation L if log	R^2	GROWTHM	SDM	GROWTHF	SDFIRM	SDEXGRF	CSRF	GPCMS83
1	.01	32.68 (1.85)						
2	.01		−24.23 (1.96)					
3	.06			.28 (4.18)				
4	.02				−1.12 (2.52)			
5	.33			.22 (3.89)			.09 (4.10)	.42 (8.86)
6	.30	27.1 (1.82)					.09 (4.09)	.44 (8.97)
7	.30				−.07 (1.81)		.09 (4.17)	.43 (8.76)
8L	.11		−.16 (1.72)				.31 (3.49)	.16 (3.28)
9L	.14					−.21 (3.64)	.33 (3.31)	.15 (2.81)
10	.11			.38 (5.47)	−.20 (4.29)			
11	.33			.31 (5.14)	−.15 (3.67)			.44 (9.29)
12	.36			.29 (4.91)	−.14 (3.45)		.09 (9.90)	.40 (8.97)
13L	.15			3.59 (3.25)	−.25 (1.67)		.29 (3.32)	.15 (3.13)

Dependant variable: GPCMS88 = $\frac{S\text{-}PA\text{-}M}{S} \cdot 100.$

Table 4F

Portfolio determinantes of the price cost margin

(Firm level)

equation L if log	R^2	BETAF	GROWTHF	CSRF	OPENM	EXPINF	SDFIRM	COSTDIS	GPCMS83
1	.001	.06							
		(.92)							
2	.34	.27		.075	−.02				.52
		(4.23)		(3.23)	(−.03)				(10.10)
3	.33	.30			.14	1.30			.57
		(4.70)			(−.01)	(1.16)			(10.42)
4	.11	.04	.38				−.20		
		(5.77)	(5.41)				(4.27)		
5	.35	.28	.22					4.01	.55
		(4.66)	(3.85)					(2.02)	(11.16)
6	.37	.27	.28				−.13		.52
		(4.57)	(4.73)				(3.42)		(10.63)
7L	.07	.05	5.30				−.28		
		(.81)	(3.42)				(12.09)		

Dependant variable: GPCMS88 $= \frac{S\text{-}PA\text{-}M}{S} . 100.$

Table 5F

Cournot determinants of the price cost margin

(Firm level)

equation L if log	R^2	MAF	ELASTM	ELASTSIGM
1	.002	−17.29 (−1.31)		
2	.003		.62 (1.37)	
3	.004			−.06 (−.17)

Dependant variable: GPCMS88 $= \frac{S\text{-}PA\text{-}M}{S} \cdot 100.$

The significance of the variable sets B, C, S, P in a megaequation (unrestricted model)

	unrestricted model 1 (18 independent variables)					unrestricted model 2 (lagged dependent deleted)				
	R^2	RSS	ESS	F 1	FEXCLUDE	R^2	RSS	ESS	F 1	FEXCLUDE
unrestricted model	.369	3,607	5,060	8.79	–	.156	1,868	6,800	37.87	–
deleting B (1)	.374	3,557	5,111	11.24	0.65	.151	1,708	6,960	1.51	1.51
deleting S (9)	.341	3,706	6,509	16.70	2.30[1])[*])	.099	1,282	8,934	8.93	8.93[**])
deleting P (1)	.338	3,335	5,333	8.20	13.97[**])	.159	1,868	6,780	0.00	0.00
deleting C (2)	.371	3,575	5,092	9.82	0.82	.163	1,863	6,804	0.08	0.08

R^2: corrected coefficient of determination.
RSS: sum of squares regression.
ESS: sum of square residuals.
F 1: test variable (degrees of freedom) for all the depedent variables.
FEXCLUDE: test variable for the exclusion of the specific set mentioned in column one.

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[1]) F = 20.2 if only 3 variables in S.
[*]) significance at 5% level.
[**]) significance at 1% level.

Megaequation 1 (18 variables)

Multiple R	.64515
R Square	.41622
Adjusted R Square	.36888
Standard Error	4.77419

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	18	3607.60580	200.42254
Residual	222	5060.02100	22.79289

F = 8.79321 Signif F = .0000

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
SAI8392	.059895	.025299	.132785	2.367	.0188
PCBS1983	.476022	.054488	.509257	8.736	.0000
CONC8391	-3.951036	6.666825	-.095822	-.593	.5540
HERF8391	1.940553	12.002862	.015183	.162	.8717
UNT1988	-.005515	.004758	-.139948	-1.159	.2477
EMP8392	-1.60178E-04	5.3599E-04	-.022962	-.299	.7653
MWNPW	-10.562793	32.782617	-.037636	-.322	.7476
SDDEVNPW	-6.127946	22.608851	-.028774	-.271	.7866
MWEXPORT	22.961817	31.591913	.186468	.727	.4681
SDDEVEXP	-2.966038	11.817594	-.056723	-.251	.8021
MWGROW	.269113	.068823	.234691	3.910	.0001
SDGROW	-.079953	.046711	-.105560	-1.712	.0884
MWEXGROW	.015677	.012723	.141332	1.232	.2192
SDEXGROW	-.013859	.009172	-.175507	-1.511	.1322
COSTDIS	3.904733	2.601511	.100411	1.501	.1348
BETA_1	.218751	.063238	.202097	3.459	.0006
MA8391	-25.054911	21.025569	-.111971	-1.192	.2347
PREISEL	-.023878	.744374	-.002971	-.032	.9744
(Constant)	.574288	3.135709		.183	.8549

End Block Number 1 All requested variables entered.

Megaequation 2 (17 variables)

Multiple R	.46423
R Square	.21551
Adjusted R Square	.15571
Standard Error	5.52192

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	17	1867.99143	109.88185
Residual	223	6799.63537	30.49164

F = 3.60367 Signif F = .0000

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
SAI8392	.087746	.029028	.194531	3.023	.0028
CONC8391	-7.639779	7.695503	-.185282	-.993	.3219
HERF8391	.169860	13.880772	.001329	.012	.9902
UNT1988	-.008240	.005492	-.209102	-1.500	.1349
EMP8392	-6.92677E-04	6.1591E-04	-.099298	-1.125	.2620
MWNPW	-3.694320	37.906125	-.013233	-.097	.9224
SDDEVNPW	-6.084166	26.149850	-.028568	-.233	.8162
MWEXPORT	30.964141	36.524477	.251454	.848	.3975
SDDEVEXP	-5.852207	13.663124	-.111919	-.428	.6688
MWGROW	.369758	.078479	.322463	4.712	.0000
SDGROW	-.129189	.053633	-.170564	-2.409	.0168
MWEXGROW	-2.58984E-04	.014564	-.002335	-.018	.9858
SDEXGROW	-.003916	.010527	-.049592	-.372	.7102
COSTDIS	2.862983	3.005798	.073622	.952	.3419
BETA_1	-8.55576E-04	.067115	-7.904E-04	-.013	.9898
MA8391	-9.305361	24.229037	-.041586	-.384	.7013
PREISEL	3.89789E-04	.860952	4.850E-05	.000	.9996
(Constant)	5.816163	3.559808		1.634	.1037

End Block Number 1 All requested variables entered.

Megaequation (lagged dependant deleted)

* * * * M U L T I P L E   R E G R E S S I O N * * * *

Listwise Deletion of Missing Data

N of Cases = 241

Correlation:

	PCBS1992	SAI8392	PCBS1983	CONC8391	HERF8391	UNT1988	EMP8392	MWNPW
PCBS1992	1.000	.260	.484	-.060	-.060	.020	-.090	.141
SAI8392	.260	1.000	.100	.004	.019	-.097	.075	.101
PCBS1983	.484	.100	1.000	-.075	-.073	-.018	-.070	-.011
CONC8391	-.060	.004	-.075	1.000	.656	-.791	.186	.223
HERF8391	-.060	.019	-.073	.656	1.000	-.364	.077	.084
UNT1988	.020	-.097	-.018	-.791	-.364	1.000	-.135	.043
EMP8392	-.090	.075	-.070	.186	.077	-.135	1.000	.091
MWNPW	.141	.101	-.011	.223	.084	.043	.091	1.000
SDDEVNPW	-.085	-.008	-.111	.646	.523	-.412	.039	.209
MWEXPORT	.163	.069	.030	.096	.191	.085	.004	.568
SDDEVEXP	.085	.038	.016	.095	.266	.004	-.052	.275
MWGROW	.274	.127	.093	.109	.169	.089	.013	.242
SDGROW	-.116	-.020	-.069	.192	.251	-.010	-.076	.083
MWEXGROW	-.024	.031	-.022	-.123	-.033	.131	-.044	-.009
SDEXGROW	-.084	.013	.013	-.060	-.012	.055	-.060	-.104
COSTDIS	.036	.050	-.076	-.003	-.111	.110	.030	.225
BETA_1	.055	.167	-.369	.138	.088	-.070	.042	.105
MA8391	-.057	.140	-.011	.495	.424	-.497	.620	-.043
PREISEL	.065	-.083	.074	-.394	-.531	.202	-.045	-.217

	SDDEVNPW	MWEXPORT	SDDEVEXP	MWGROW	SDGROW	MWEXGROW	SDEXGROW	COSTDIS
PCBS1992	-.085	.163	.085	.274	-.116	-.024	-.084	.036
SAI8392	-.008	.069	.038	.127	-.020	.031	.013	.050
PCBS1983	-.111	.030	.016	.093	-.069	-.022	.013	-.076
CONC8391	.646	.096	.095	.109	.192	-.123	-.060	-.003
HERF8391	.523	.191	.266	.169	.251	-.033	-.012	-.111
UNT1988	-.412	.085	.004	.089	-.010	.131	.055	.110
EMP8392	.039	.004	-.052	.013	-.076	-.044	-.060	.030
MWNPW	.209	.568	.275	.242	.083	-.009	-.104	.225
SDDEVNPW	1.000	.143	.344	.178	.355	-.112	-.096	-.008
MWEXPORT	.143	1.000	.868	.204	.040	.032	-.073	-.207
SDDEVEXP	.344	.868	1.000	.133	.095	.012	-.057	-.319
MWGROW	.178	.204	.133	1.000	.338	.038	-.038	-.072
SDGROW	.355	.040	.095	.338	1.000	.033	.110	-.097
MWEXGROW	-.112	.032	.012	.038	.033	1.000	.875	-.060
SDEXGROW	-.096	-.073	-.057	-.038	.110	.875	1.000	-.056
COSTDIS	-.008	-.207	-.319	-.072	-.097	-.060	-.056	1.000
BETA_1	.155	.088	.060	.059	-.020	-.080	-.088	.078
MA8391	.341	.117	.194	.022	.012	-.081	-.076	-.019
PREISEL	-.500	.040	-.128	-.033	-.142	-.008	-.050	-.282

	BETA_1	MA8391	PREISEL
PCBS1992	.055	-.057	.065
SAI8392	.167	.140	-.083
PCBS1983	-.369	-.011	.074
CONC8391	.138	.495	-.394
HERF8391	.088	.424	-.531
UNT1988	-.070	-.497	.202
EMP8392	.042	.620	-.045
MWNPW	.105	-.043	-.217
SDDEVNPW	.155	.341	-.500
MWEXPORT	.088	.117	.040
SDDEVEXP	.060	.194	-.128
MWGROW	.059	.022	-.033
SDGROW	-.020	.012	-.142
MWEXGROW	-.080	-.081	-.008
SDEXGROW	-.088	-.076	-.050
COSTDIS	.078	-.019	-.282
BETA_1	1.000	.100	-.055
MA8391	.100	1.000	-.232
PREISEL	-.055	-.232	1.000

Appendix: Sources and variables

Sources : Austrian Statistical Office: Census (Nichtlandwirtschaftliche Bereichszählung) 1883, 1988 (BZ)
and Annual Industrie- and Gewerbestatistik, 1980 -88 (ISGS)
and Audoklassys (trade and production statistics), Audo
WIFO- databank
Balance data: Firm Data Bank of the Austrian Central Bank (OENB)

Manufacturing industries, 3 digit level No 311-594 (excluding 328 tabacco)

Variables {internal name in small letters in curled brackets}:

M as the last letter indicates aggregate variables (market), F denotes firm data

GPCMS83, GPCMS92 : Gross Price Cost Margin (sales as denominator) = 100.(Sales - Payroll - Material)/Sales 1992, 1983, OENB {PCBS1983, 1992}

CRM: share of the largest four firms 1983 -91 in 2-digit industries (criterion calculating the share and for ranking: sales), OENB {CONC 9391}
CRGT70M: CR488 > 70 % = 1, otherwise 0 {CONCGT70}
HERFM: Herfindahl concentration index for 2 digit industries {Herf8392}
CSRF: investment/sales average 1983-1988, firms, OENB {SAI9392}, OENB
OPENM: export share + import share of 2- digit industry, Audo {MO8391}
BUSM: number of firms in industry (BZ) {UNT1988}
EMPLF: employees firms {BESCH}
GROWTHM: annual growth of nominal production of 2 digit industry, 1980-88, Audo {MWNPW}
GROWTHXM: annual growth of exports of 2 digit industry 1980-88, Audo {MWEXPORT}
GROWTHF: annual growth of nominal production of firm, 1983-92, OENB {MWGROW}
GROWTHXF: annual growth of nominal exports of firm, 1983-92, OENB {MWEXPORT}
SDM: standard deviation of annual growth of nominal exports of 2 digit industry, 1980-88, Audo {SDDEVNPW}
SDXM: standard deviation of annual growth of exports of 2 digit industry 1980-88, Audo {SDDEVXPORT}
SDF: standard deviation of annual growth of nominal production of firm, 1983-92, OENB {SDGROW}
SDXF: standard deviation of annual growth of nominal exports of firm, 1983-92, OENB {SDEXGROW}
CDR: cost disadvantage of small firms , BZ {COSTDIS}
BETAF: coefficient of regression : annual GPCM in firm i = f Annual GPCMS in total industry 1983 - 92, OENB, {BETA1}
ELASTM: coefficient price in regression of *output in industry i = f (price, GNP)*, in logs, inverse value {PREISEL}
ELASTMSIG = ELAST*Dummy: Dummy 1 if t value of ELAST in demand function > 2; otherwise 0, ISGS
EXPINF: relation of exports to sales on the firm level, 1983-92, OENB {EXPINT92}
MAF: market share of firms in 2 digit industries 1993-91, OENB {MA8391}
MESBETRM: minimum efficient scale for 2 digit industry, BZ, {MESBETR}
EMP8392: employment in 2 digit industry, 1983-92, IS+GS {number}

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