MARKET STRUCTURE, INNOVATION AND THE PERSISTENCE OF COST DIFFERENCES

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Abstract: This paper investigates the size and the persistence of cost differences (*TCDs*) within European 3 digit industries. If these differences arise form imperfect competition they constitute a welfare loss which should be added to the usual demand side loss as calculated by the Harberger triangle. However, *TCDs* may also originate from other sources like innovation activity, vertical product differentiation and/or they represent a transitory phenomenon or simply measurement errors. We use a panel European 3 digit industries for 1989 - 1995 to get some information about the source of the cost differences. We confirm earlier results that cost differences (TCD) are larger than the usual size of the deadweight triangle. As to their source, our panel shows that (i) *TCDs* are quite persistent, but less so in R&D intensive industries and more in concentrated industries or in industries where product differentiation is pronounced (ii) *TCDs* increase with market power.

JEL.: L13, D43, D61, L61, L73

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1. Introduction

In assessing the welfare costs of imperfect competition, mainstream literature focus on the demand side, calculating the deadweight triangle coming from higher prices and lower output under monopoly resp. oligopoly. Empirical literature has found the triangles to be very small. We have claimed in Aiginger, Pfaffermayr (1997) that an additional source of welfare loss should be added which comes from the fact that in markets with imperfect competition the efficient firms hold too small a market share and that the pressure for eliminating cost differences is lower. This adds a cost side component of the welfare loss. Empirical calculations in that paper, but also in the literature on the persistency of profit differences have shown that the cost differences are empirically large. If we calculate the relation of total cost differences (TCDs) relative to sales we get large one digit, or even two digit, percentages.

However, not all cost differences come from inefficiencies. In Aiginger, Pfaffermayr (1998) we developed a model in which vertical product differentiation is explicitly allowed and it is demonstrated that the correction of the original calculation depends on (i) the amount to which higher quality raises cost and prices to a different degree and (ii) whether the most efficient firm produces higher or lower quality. The empirical correction for a specific industry did not prove to be too large.

In this paper we want to find out which the main determinants of the size and the persistency of cost differences are. Collusion and market structure remains one candidate, we also maintain that vertical product differentiation could play a role. Furthermore we use a proxy for research intensity to get a feeling for the importance of innovation. We investigate how persistent the cost differences are, and whether they depend on the cyclical situation. The complexity of the individual strands of literature prevents that we can start from a fully specified model incorporating innovation, product differentiation, collusion and time structure. We therefore start from a flexible conjectural variation model to calculate the cost staircase, then we parameterize the model and add proxies on innovation, product differentiation and demand. We estimate cross section regressions, a static panel and a dynamic panel for 3-digit European industries.

2. Market structure and cost differences

In order to derive a simple econometric specification, consider the simplest case of market with isoelastic demand: $p(Q) = AQ^{-\frac{1}{e}}$ (with $Q = \sum_{i=1} q_i$ and demand elasticity e) which is served by *N* firms. Each firm *i* produces q_i units of a homogenous good under different constant marginal costs, c_i and fixed costs F_i. We use the simple conjectural variation model as starting point without modelling cost reducing effort and we interpret this game as a reduced form of a dynamic game by introducing uniform conjectural variations in quantities $l = \frac{\partial q_j}{\partial q_i} \frac{q_i}{q_j}$ (Dockner, 1992, Cabral, 1995, Pfaffermayr, 1997).

Under these assumptions, the profits of a firm are given by

(1) $$\Pi_i = p(Q)q_i - c_i q_i - F_i \,, \quad i = 1 - N$$

The best responses are defined by the first order conditions:

(2) $$PCM_i = \frac{p - c_i}{p} = \frac{l + (1 - l)s_i}{e} \,, \quad s_i = \frac{q_i}{\sum_{j=1}^{N} q_j} = \frac{q_i}{Q}$$

Denoting the Herfindahl index by *H* and Aggregation of (2) over all firms with market share as weights leads to

(3) $$\overline{PCM} = \frac{p - \bar{c}}{p} = \frac{l + (1 - l)H}{e}$$

From (2) and (3) the cost side welfare loss is easily calculated as difference of condition (2) - evaluated for the most efficient firm- and the average (3) plus the differences in fixed costs. The crucial point is the implied assumption concerning the reference price (and implicitly the cost level) in the competitive reference scenario. Usually a comparison of oligopoly and competitive outcomes is based on the assumption of identical linear costs, homogeneity of demand and pricing at marginal costs. In our model, however, this would imply negative profits due to the fixed costs. In an asymmetric oligopoly with differing fixed costs, several scenarios of strategic interaction are possible and it is difficult to define the hypothetical costs which would exist under competition from the actual data pertaining to oligopoly. Dixit and Stern (1982), Daskin (1991) and our own linear model without fixed costs (Aiginger, Pfaffermayr, 1997) assume that in the reference scenario, the hypothetical reference price p^c under competition is revealed by the costs of the most efficient i.e. the firm with lowest marginal costs. We modify that assumption by setting the reference price equal to that of the firm with the lowest average costs (since marginal cost pricing would imply losses). Denoting the marginal cost of the most efficient firm by an asterisk, the total cost differences (*TCDs*) in terms of overall market sales is given by (4) which serves as a starting point in the econometric estimates below.

(4) $$TCD = PCM^* - \frac{F^*}{pq^*} - \sum_{i=1}^{N}\left(PCM_i - \frac{F_i}{pq_i}\right)s_i = \frac{1-l}{e}\left(s^* - H\right) - k^* + \bar{k}$$

Given an understanding of the reference price, we are able to investigate the determinants of the cost side welfare loss[1] as part of the *TCDs*. This is done by arranging firms in an increasing order of their total unit costs and then calculating the area between the step function (drawn by the quality adjusted unit costs), and the cost floor. The floor is defined by the most efficient firm and the total height of the "staircase" is the difference between the most efficient and the most inefficient firm in the market.

There exist several sources of the cost side welfare loss. First, a cost side welfare may arise because the efficient firms do not get a large enough market share in a collusive oligopoly (Clarke, Davies, Waterson, 1984) and/or less efficient firms do not lose market shares and therefore have less incentives to adopt low cost technologies. In this case unit costs averaged over all firms are higher than in the competitive or welfare maximising reference scenario. This source of welfare loss is the only one arising in the simple, static CV-model which treats costs exogenously. In general, the extent of this component of cost side welfare loss strongly depends on the shape of the cost curve. If there is no capacity restriction and marginal costs are constant, total welfare is maximised if the most efficient firm gets the whole market. This is assumed in the reference scenario defined above. If marginal cost curves are upward sloping, however, the cost side welfare loss is overestimated by (4). In contrast, with downward sloping average variable unit costs, it is underestimated with the

1 As already mentioned, this is that part of the consumer surplus, which is lost due to a higher price, but which is not regained by producers due to their cost inefficiency.

present approach. Summing up, the maintained hypothesis for the empirical work below may be formulated as:

(H1) In a world approximately in line with the simple CV-model the TCDs are positively related to the difference of the market share of the most efficient firm and the Herfindahl.

Secondly, cost differences may persist over time because of differences in the effort to hold costs low, because of different incentives for investment in capital and R&D or because the degree of competition affects the speed of adoption of newly available technologies. In this case part of cost differences represent innovation rents as successful innovating firms may have accumulated non-transferable firm specific assets like production know-how. On the other hand more efficient firms may spend more on R&D and may thus have higher fixed costs. The opposite hypothesis states that more intensive competition induces firms to exert more cost reduction effort or to adopt newly available technologies earlier in order to stay competitive and to preserve their market shares (see Arrow, 1962 for the case of a non-drastic innovation and where firms do not strategically engage in R&D races). In general, the impact of the intensity of competition on cost efficiency is therefore ambiguous and it is not clear which part of cost differences arising from this source should be counted as a welfare loss.

In a non-tournament model of monopolistic competition with free entry where products are strategic substitutes Beath, Katsoulacos, and Ulph (1995) demonstrate that R&D intensity is negatively associated with the degree competition measured by the number of firms. The driving force of their model lies in the fact that an increasing number of firms reduces the appropriability of the gains from R&D and, secondly, that the incentive for a firm to engage in R&D is proportional to its output which falls as the number of firms increases. If the number of firms stays constant, however, this latter assertion does not hold anymore as the output of each firm increases along with more intensive competition. Spence (1984) similarly concludes from his simulations that more intensive competition does not necessarily lead firms to intensify their cost reducing efforts. This leads Beath, Katsoulacos and Ulph (1995) to a decomposition of the social welfare loss from oligopoly into four components, two static and two dynamic ones. There is a dynamic welfare loss, because there is less cost reduction than socially optimal, and secondly, because the market may operate the wrong number or R&D laboratories. The static components comprises the traditional Harberger triangle as well as the welfare loss when the market fails to produce the optimal number varieties (Yarrow, 1985). Katsoulacos and Ulph (1991) investigate the trade-off between the dynamic and static component and find a negative dynamic welfare effect for the case where regulation is increased and prices are forced closer to marginal costs. They conclude that dynamic components dominate once R&D is product specific.

The results in game theoretic models of oligopolistic competition with cost reducing investments are also ambiguous. Thomas (1996) , for example, demonstrates that price setting-firms may have no incentive to adopt technologies that are likely to reduce their cost. This result relies on the assumption of incomplete information about rivals costs at the price setting stage and that firms pursue a puppy dog-strategy. Klette, Grilliches (1998) set-up a model of firm growth and R&D-investments in a quality latter framework and they likewise find that R&D activity is positively related to profit margins and, therefore, negatively to the degree of competition. On the other hand Lewis (1996) concludes from a simple two stage game, where firm choose between a high fixed cost/low marginal cost and low fixed cost/high marginal cost in the first stage of the game and compete in quantities in the second stage, that for a range of parameters a Nash-equlibrium with different cost structures and therefore cost differences exists. Although the relationship between *TCDs* and R&D effort is an empirical matter, one may formulate as an empirical hypothesis:

(H2) Part of the TCDs has to be considered as innovation rents, it is probably positively related to innovative activity ant it will be higher the larger R&D intensity of an industry.

A third set of determinates of the *TCDs* refers to vertical product differentiation and quality differences. In general cost differences arising from different quality should not fully be counted as cost side welfare loss as it usually higher quality requires higher unit costs. In Aiginger, Pfaffermayr (1998) it is shown that the impact of vertical product differentiation strongly depends on extent to which higher quality translates in higher variable and higher fixed costs. If the higher quality approximately generates the higher unit costs in the same amount, the effect is on the *TCDs* is negligible in model with simultaneous competition in price and quality. The correction of the *TCDs* for quality differences can go in either direction and it is easy to understand that it depends on the quality provided by the most efficient, most profitable firm. If this firm also provides the highest quality (define this case "efficiency- quality match"), it is earning the highest profits despite of higher variable and fixed costs. The effect on welfare comprises two components: the higher fixed costs of providing quality leads to an upward correction of the *TCDs*, the higher variable costs, however, are translated into lower quality adjusted *per unit* variable costs. The combined effect depends on the relative size of fixed vs. variable costs and implies a downward correction for the staircase proper. If, on the other hand the firms with the highest profits in the sample provides low quality (no "quality-efficiency" match), the effect has opposite sign. Along this line we state as hypothesis to test:

(H3) The quality adjusted TCDs are smaller the higher the quality provided by the most efficient firm in comparison to the average firm. Generally, measured TCDs are expected to increase with the degree of vertical product differentiation and with heterogeneity in supplied quality .

A further issue is the conjecture that the observed *TCDs* are transitory and do not persist. This implicitly refers to the height of entry barriers and asks the question whether and how fast cost differences are competed away in longer run. In the literature on the persistency of profits (e.g. Mueller, 1986, 1990) a series of hypotheses have been formulated and tested which - under the assumption of homogenous markets- perfectly match to the *TCSs*. Especially, it is argued that persistence of profits is higher the more concentrated industries are, the faster industries grow, and the larger economies of scale and sunk costs are. To some extent these hypotheses also apply in our context, but we restrict - mainly for reasons of data availability- the attention to concentration, R&D-intensity and product differentiation as determinants of the persistence of cost differences. Although not fully specified in a formal model, we formulate and test the following hypothesis (Kessides, 1990):

(H4) The cost differences are the more persistent the lower R&D intensity, the higher concentration and the higher horizontal and vertical product differentiation.

The size the *TCDs* may also change over the business cycle. The supergame literature suggests that market shares and profitability of firms vary over the business cycle in a systematic way. The expectation of prospering demand fosters collusion with high cost firms holding lower market shares than in a more competitive scenario. Rotemberg, Saloner, 1986 have demonstrated that the contrary can be true i.e. that price wars are more likely during booms. Furthermore, firms cope with recession quite differently (Geroski, 1998) and we expect that in a collusive market high cost firms are not likely to loose market shares during recessions so that the *TCDs* widens.

(H5) While theoretic models are inconclusive many economists expect that the TCDs should decrease during recessions since inefficient firms have to exit.

3. Data, sources and definitions

In order to drive figures for the most efficient firm as well as for the average firm we use balance sheet data from “Standard and Poors Global Vantage Data Bank“. The database contains detailed balance sheet information on about 10,000 primarily larger firms in 60 countries. We use the European Union in its present form with 15 countries as the geographic dimension of our market and include on European firms. We eliminate industries with low representation in the data base, firms with irregular reporting behaviour and firms whose activity do not fit roughly into the schemes of 3 digit industries according to NACE, ending up with 700 firms in 28 industries. National markets seem today to be a too narrow concept; most of the larger firms produce and sell in more than one country, especially within the area of the European Union. We aggregate firm level information to three-digit industries which define our markets. Further information like production valued added, exports and imports, etc. for 3-digit industries is taken from DEBA-EURSTAT (see appendix for details and descriptive statistics)[2].

A sensitive task is defining a proper measure of profits. We define costs as the sum of expenditures on material, wages and interest, and depreciation divide these expenses into sales to calculate unit costs. It forms an upper bound of profits, neglecting the opportunity cost of equity. A further sensitive task is to define the top performing, most efficient firm. For robustness we characterise the most efficient firm by the weighted average of those three top performing firms with highest average profits (after depreciation) during the period

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2) The "Standard and Poors Global Vantage Data Bank" allocates firms according to the most important line of business to one single 3 digit US-SIC industry. DEBA from EUROSTAT in contrast is classified according to NACE Rev.1, so we had to use concordance tables and map all US-SIC industries into NACE Rev.1. Both the lacking line of business data and the mapping to NACE Rev. 1 form severe short comings of our database. To derive robust results we took a very restrictive approach and eliminated all industries, with (i) valid data with less than six firm, (ii) market coverage below 5% and (iii) all firms which have been assigned to a 2 digit, but not do a 3-digit because they are diversified or a holding

1989-1995. We additionally calculated a Herfindahl index of concentration from the market shares of the firms in the sample by dividing firm's revenues into industry demand. The calculated Herfindahl is far from a perfect concentration measure, although all available information is put to use. In calculating the Herfindahl only those firms are included which report valid data over the whole estimation period. Since our database mainly contains the large firms the Herfindahl is well approximated although the market coverage considerable varies across industries. The Herfindahl is corrected for exports (under the assumption that all firms have the same ratio of exports to sales) and by imports at the industry level (see Salinger, 1990). To control for the missing firms we used the number of firms in each three digit industry (which is available for 1994[3]) and corrected the Herfindahl under the assumption that the missing firms divide the remaining market equally. Therefore, the calculated Herfindahl index of concentration has to be viewed as a lower bound. Measurement errors only effect the cross-section estimates, however, since in the panel we control for fixed industry and time effects.

Price cost margins based on marginal costs remain unobserved, instead margins defined $\frac{pq_i - wL_i - mM_i - d_i}{pq_i}$ are available. Since both the interest rate as opportunity cost of equity and the price of capital goods are netted out when calculating the *TCDs*, out of all components we include only firm specific depreciation rates, denoted by d_i as cost of capital. We assume that a share a represents variable costs and remaining $1-a$ fixed costs., i.e.

$$(4') \qquad TCD = \frac{pq^* - wL^* - mM^* - d^*}{pq^*} - \sum_{i=1}^{N} \left(\frac{pq_i - wL_i - mM_i - d_i}{pq_i} \right) s_i = \left(\frac{1-l}{e} \right) \left(s^* - H \right) - \left(1 - a \right) \left(\frac{d^*}{pq^*} - \frac{\bar{d}}{pQ} \right)$$

Depending on the availability of variables with enough time variation the cross section and the dynamic panel-specification is derived by augmenting (5) with appropriate indicators suggested by the formulated hypothesis. Unfortunately, R&D intensities are not available, so we impute R&D expenditures in relation to sales from US-3 digit industries. The indicator of

3 For some EU-countries the number of firms is only available the year before or after 1994. For these countries we have imputed the corresponding values to construct a the time invariant number of firms variable.

vertical product differentiation is based on unit values (i.e. volume, usually kilos, divided into values) derived from highly detailed 6 digit trade figures of the EU15 (with trade between EU-member countries excluded). We define the degree of vertical product differentiation as share of those 6 digit trade volumes in intraindustry trade of the corresponding 3 digit figures, in which export unit and import unit values differ by more than 15% (see Greenaway, Milner, 1995).

In both specifications we additionally control for competition form abroad by introducing the Extra-EU import ratio (IMQ). In the panel estimation we additionally account for cyclical variation in industry specific demand (*DEMAND)* defined as apparent consumption well as by time effects capturing the overall business cycle. The cross-section specification reads:

(5) $TCD_i = b_o + b_1 SMH + b_2 DP_i + b_3 IMQ_i + b_4 RD_i + ß_6 DIFF_i + e_i$

with $SMH = s^* - H$ and $DP = \left(\frac{d^*}{pq^*} - \frac{\bar{d}}{pQ} \right)$. *RD* denotes R&D-intensity and *DIFF* our measure of product differentiation. Note that the latter two variables have no time variation. The panel specification is given by

(6) $TCD_{it} = (g_0 + g_1 RD_i + g_2 DIFF_i) TCD_{it-1} + b_1 SMH_{it} + b_2 DP_{it} + b_3 IMQ_{it} + b_4 DEMAND + m_i + l_t + e_{it}$

with m_i denoting fixed industry effects and l_t fixed time effects.

4. Estimation results

Although the cross section of industries is rather small[4], the estimations seem to be well specified and sufficiently robust. As it is often the case, cross section estimates and panel estimates differ substantially. Table 1 reports 2SLS estimates over a small cross-section of 33 industries averaged over the period 1989-1995. We instrumented *SMH* since price cost margins, and therefore our measure of *TCDs* are related to market shares but not caused

4 Note that the cross section includes a few more industries with very low coverage rates than the panel.

by it (Clarke, Davies, 1982). We do not reject the Hausman WU-test on exogeneity, but this may partly reflect our poor performing instruments. The significant negative coefficient of *SMH* is not in line with the basic CV-model. There could be several reasons for this finding. First, the negative association may be caused by measurement errors, especially of the Herfindahl index of concentration. However, specification II which introduces the market share of the top performing firms and the Herfindahl separately suggests that the negative association of *SMH* rests on the negative sign of the market share of the top performers. Secondly and more importantly, the negative association may arises because the most efficient firms are not the larger ones. Indeed we find several industries where *SMH* is negative (see appendix). That the small firms are the more efficient ones can be explained along several lines. Often small firms can profitable exploit market niches so that the negative association with the *TCDs* mirrors a significant amount of product differentiation which could not be controlled for adequately. Another possibility is implicit collusion which doesn't allow a small cost efficient firm to grow. Thirdly, cross-section estimates have to be interpreted as long- run relationships which does not necessarily hold true in our sample of industries. As in the old literature on the profitability-concentration research, we will see that dynamic specification will alter the sign.

The other robust result is the positive impact of R&D intensity on *TCDs.* This supports our hypothesis that part of the *TCDs* is related to innovation activity and to some extent represent innovation rents. It raises some doubt on the hypothesis that a competitive environment stimulates cost reducing effort and that the *TCDs* are competed away in the longer run. The evidence on hypothesis 3 indicates no association of the *TCDs* with vertical product differentiation suggesting that high quality seems to be more ore less reflected in higher costs. One should bear in mind, however, that our indicator of vertical product differentiation is an imperfect one since we don't observe quality (e.g. measure by unit values) at the firm level. A significant effect of import penetration likewise is not present (most probably it is already accounted for in the correction of the Herfindahl). The estimated sign of the deprecation variable is significant negative (at least at a10% level of significance), which is in line with the assumption that part of it forms fixed costs.

Drawing on longitudinal within group variation the fixed effects estimates tell another story. Here, *SMH* is significantly positive and possibly endogenous. The Hausman-WU on exogeneity of *SMH* test is rejected at the 10% level of significance. Thus an increase in concentration implied by an expansion of market share of the average top3 performer, increases the *TCDs* as suggested by the CV-model. The *TCDs* are negatively related to industry demand (although not significantly), which would imply an expansion of *TCDs* during phases of low output growth. The time effects, which measure the impact of overall business cycle do not show a clear pattern. We find insignificant negative effects in the beginning of the nineties and the once again in 1993-recession.

Table 1: Static 2SLS estimates

	Cross section				static fixed effects[d)]	
	I		*II*		*III*	
	ß	*t*	*ß*	*t*	*ß*	*t*
SMH [a)]	-0.48	-2.09$^{**)}$	-	-	1.85	2.38$^{**)}$
market share: s_{TOP3} [a)]			-0.34	-2.17$^{**)}$	-	-
Herfindahl: *H* [a)]			0.09	0.43	-	-
Deprecation: *DP*	-0.66	-2.06$^{**)}$	-0.46	-1.72$^{*)}$	0.37	1.11
Import penetration: *IMQ*	-0.09	-1.82$^{*)}$	-0.07	-1.59	0.28	2.39$^{**)}$
ln DEMAND	-	-	-	-	-2.46	-1.11
R&D: RD	0.73	3.23$^{**)}$	0.74	3.57$^{**)}$	-	-
Product differentiation: *DIFF*	-0.70	-0.19	-1.14$^{**)}$	-0.35	-	-
Constant	3.44	2.32$^{**)}$	5.00	2.99$^{**)}$	25.12	1.08
N	33				181	
R^2	0.21		0.33		0.83	
s	3.01		2.76		2.05	
fixed industry effects	-		-		185.17$^{**)}$	(29)
fixed time effects	-		-		19.98$^{**)}$	(7)
Jarque-Bera Normailty [b)], c^2	0.44	(2)	0.83	(2)	1.10	(2)
Ramsey-RESET test	-0.82		1.78$^{*)}$		3.46$^{**)}$	
Hausmann-Wu Test [b),c)], c^2	1.39	(1)	2.69	(2)	3.18$^{*)}$	(1)
I vs. II [b)], c^2	-	-	1.65	(1)	-	-

a) *SMH*, $s_{TOP3,}$ *H* are taken endogenously and instrumented by equity in relation revenues (top performers - average) and the average number of firms in Specification I and II. Specification III uses labour intensity measured by labour costs over value added instead of the time invariant average number of firms.
b) Degrees if freedom in parenthesis.
c) Hausmann-WU test on the endogeneity of *SMH* and $s_{TOP3,}$ *H,* respectively. Greene, 1993, p. 618f. ´
d) Covariance two stage least squares, Krishnakumar (1992). The fixed time and industry effects as well as seven outlier dummies are not reported

The dynamic panel estimates are based on the work of Arellano and Bond (1988, 1991). They propose to transform that data to first differences and apply GMM estimation with proper instrumentation to get unbiased estimates of the lagged endogenous variable which is introduced to measure the degree persistence of the *TCDs.* The estimations are well specified: the test of second order autocorrelation (its absence is a precondition to use levels lagged twice as instruments) as well as Sargan test on overidentifying restriction cannot be rejected.

Specification I in Table 2 produces a dynamic version of the within estimate. The estimated speed of adjustment is significant and amounts to 0.5, comparable to other studies

(Mueller, 1990). Again the changes in the *TCDs* are positively related to market structure as measured by *SMH.* An increase in industry specific demand growth rates exert a significant negative effect providing also some indication that the *TCDs* widen during recessions. We don't want draw a firm conclusion on this finding, however, as our time period is rather short and includes at best one cycle including the 1993 recession. The time effects indicate negative growth rates of the *TCDs* in 1992 and 1993. Although the

Table 2: Dynamic panel model: two-step GMM-estimates in 1. differences

	I		II		III		IV	
	ß	*t*	*ß*	*t*	*ß*	*t*	*ß*	*t*
TCD_{-1}	0.50	7.17**)	0.96	4.40**)	-0.06	-0.23	0.19	1.21
TCD_{-1} *RD	-	-	-0.18	-4.15**)	-	-	-	-
TCD_{-1} *DIFF	-	-	-	-	1.47	1.70*)	-	-
TCD_{-1} *H	-	-	-	-	-	-	0.05	3.15**)
$s_{Top3} - H$	0.46	1.81*)	0.81	3.22**)	0.77	2.06**)	0.13	0.49
Deprecation: *DP*	-0.51	-2.36**)	-0.29	-1.24	-0.49	-2.53**)	-0.38	-2.58**)
Import penetration: *IMQ*	-0.10	-1.27	0.02	0.19	-0.09	-0.98	-0.04	-0.43
ln DEMAND	-12.03	-3.37**)	-10.52	-2.71**)	-11.03	-3.41**)	-12.35	-3.36**)
Constant	1.45	3.53**)	1.70	-2.97**)	1.25	2.39**)	1.40	2.93**)
N	123		123		123			
R^{2} a)	0.45		0.25		0.36		0.41	
s b)	2.38		2.79		2.58		2.47	
Overidentifying restrictions, c^2	11.69	(9)	12.09	(9)	8.84	(9)	12.09	(9)
time effects, c^2	21.27**)	(5)	17.00**)	(5)	40.79**)	(5)	39.89**)	(5)
2nd order autocorrelation of the error term (ass. normal)	0.71		0.29		0.66		0.70	

Note all variables are transformed to first differences, 5 outlier are included but not reported. Instruments include lagged levels of the lagged endogenous variables (also the interaction terms) as suggested in Arellaneo, Bond, (1991), all other right hand side variables and the own equity/sales ratio.

a) Calculated as $1-\frac{RSS}{TSS}$ from one step estimates

b) Calculated as $\sqrt{\frac{1}{NT}RSS}$ from one step estimates.

**) significant at a 5% level.
*) significant at a 10% level.

data do suggest that the *TCDs* have been exogenously diminished in the nineties. In contrast to the within model the dynamic model points to a negative impact of deprecation rates as suggested by our basic specification. The sign of import penetration ration is insignificantly negative contrary to the within estimates.

Our cross section is to small to estimate the industry specific determinants of persistence in a full model. Since these have to interacted with the lagged endogenous variables they have to be instrumented along the lines suggested by Arellano and Bond (1998, 1991).

Including all interaction effects would lead to a too large number of moment conditions rendering two-step estimation impossible. Furthermore, too many interaction effects commonly lead to multicollinearity. Thus we introduce only one interaction term at a time and estimate three additional specifications. Bearing in mind that this procedure may introduce some missing variable bias, the results are well in line with our maintained hypothesis and compare well to the findings of the cross section estimates. Specification II points to a significant higher speed of adjustment in R&D intensive industries. So the *TCDs* are higher in these industries, but they are also less persistent. This confirms our hypothesis that part of *TCDs* form transitory innovation rents. The effect of vertical product differences on persistence is positive (but only at the 10% level of significance, see specification III). Market concentration likewise increases persistence (specification IV) as the formulated hypothesis suggests.

5. Conclusions

If cost differences between firms within an industry arise from imperfect competition and are made sustainable by some sort of collusive behaviour, they should be counted as welfare loss and added to the usual welfare losses on the demand side (deadweight triangles). This had been argued by many authors (Dixit, Stern 1882, Aiginger Pfaffermayr 1997), empirical data indicate that the "cost staircase"[5] is larger than the "triangle" (Daskin 1991, Aiginger, Pfaffermayr 1997, 1998). However not all cost differences will reflect waste and collusion, some are the results of optimising behaviour in a non collusive environment.

Cost differences may come from product differentiation implying that the true model should incorporate product differentiation (Aiginger Pfaffermayr 1998), they may be the result of innovation activity or differences in effort, they may be the result of short term phenomena or even of measurement errors. There is no stringent way to differentiate the effects since we would need a super model in which innovation and vertical product differentiation are modelled and the time pattern between investment and profits can be specified. We

[5] The cost differences depict a staircase if firms are ordered increasingly according their to their average costs.

alternatively start form a simple conjectural variation model, to develop a formula to calculate the cost staircase for 28 European industries, then we parameterize the equation for the price cost margins and add proxies for product differentiation, innovation and demand growth. We calculate the persistency of the profit differences, and their potential interactions with the presumed determinants.

Our main findings are:

(1) Empirical profit differences are very large. In the average of our 28 industries the staircase (TCD´s) amounts to 5 % of sales. Comparing this with deadweight triangles of about 1 % or less, this indicates that the focusing on cost differences may be more important than calculating deadweight triangles. The largest cost differences exist in pharmaceutical industry and in the computer industry, these high tech industries are followed by the cement and glass industry indicating that cost differences also persist in rather mature industries

(2) Econometric evidence shows that some part of the TCD is related to innovation activity, the influence of product differentiation, demand growth and cyclical effects is small.

(3) The TCD´s are quite persistent, but less so in research intensive industries and more in industries with higher product differentiation

(4) As far as concentration is concerned the panel estimates show that the TCD´s increase with market power and that cost differences are more persistent with higher concentration. The cross section results had indicated that the cost differences were negatively related with market power (repeating similar switches of signs in the old literature on profitability and concentration). The static conjectural variation model is not fully consistent with the data, since in many industries the most efficient firm is not that with the largest market share. This indicates that other factors, like product differentiation, different conjectural reaction parameters or innovation are likely to intervene.

In searching for the sources of the cost differences some well known problems of cross industry investigations arise again. If we want to learn about the sources by looking at the differences in the pattern and extent across industries, we return to the cross section analysis, with all its problems of fully specified models, endogeneity, comparing differences in ill defined broad markets. The results - applying static and dynamic panels - nevertheless provide some insights: profit differences are large in some high tech industries as well as in some mature industries, they do not come from purely transitory effects and are not easily related to demand or cyclical effects. Since the cost differences are very large it is worthwhile to investigate their sources.

Appendix

1. Data definitions:

All variables are transformed in ECUs using average exchange rates. All variables refer to the 3-digit NACE. Rev. 1 level. The variables put to use are defined as follows:

PCM: (Revenues - wage - material - interest paid-depreciation and amortisation)revenues from *Global Vantage*
market shares: (1-V211(v290)*revenue/v901; v211 is extra EU exports and v901 is apparent consumption from *DEBA-EUROSTAT.*

3 top Performing Firms: weighted average over the 3 firms which had highest average PCM over the period 1989-1995.
Number of firms: 1994 values of V01 from DEBA-EUROSTAT, for some countries 1994 is missing, and values of 1993 or 1995 have been imputed.
H: Herfindahl $\sum_{i=1}^{N} s_i^2 + \frac{Cov*Cov}{N}$, Cov denotes revenues of all Global Vantage firms in relation to apparent consumption.

SMH: weight average market share of top 3 performers over the period 1989-1995 - H.

TCDs: PCM_Top3-PCM_average

DP: depreciation and amortisation as a share of revenues from *Global Vantage.*

DEMAND: v901 from *DEBA-EUROSTAT*

IMQ: v111/V68 from DEBA-EUROSTAT

RD: US-RD intensities from Compustat

DIFF: We define the degree of vertical product differentiation as the share of the 6 digit trade volumes in intraindustry trade of the corresponding 3 digit figures, in which export unit and import unit values differ by more than 15% (see Greenaway, Milner, 1995), Unit values are calculated from *COMPET-EUROSTAT*.

EQUITY: own equity as share of revenues from *Global Vantage*

Number of firms: V01 from *DEBA-EUROSTAT*

2. Descriptive statistics

Table 3: Industries sorted by *SMH*

INDUSTRY	*TCD*	*SMH*	*DP*	*IMQ*	*R&D*	*DIFF*
Cement, lime and plaster	8.86	-18.94	3.59	2.50	0.54	0.03
Glass and glass products	9.40	-18.28	0.08	6.04	2.55	0.51
Basic iron and steel, ferro-alloys	4.30	-3.36	2.25	4.56	1.10	0.42
Detergents, cleaning and polishing	3.83	-2.20	0.04	2.54	2.78	0.22
Beverages	3.00	-1.23	2.67	1.43	0.76	0.25
Other special purpose machinery	8.44	-1.03	-0.14	10.33	2.49	0.22
Aircraft and spacecraft	5.08	-0.69	4.14	24.89	4.14	0.30
Machinery for production	5.79	-0.34	0.01	9.81	2.30	0.49
Other textiles	5.35	-0.18	1.41	15.16	1.74	0.19
Basic precious and non-ferrous metals	1.51	-0.02	3.11	49.32	1.04	0.23
Furniture	5.12	0.00	0.86	5.25	1.32	0.59
Other general purpose machinery	6.60	0.02	-2.87	7.75	2.01	0.29
Plastic products	7.66	0.09	1.83	5.76	2.02	0.67
Office machinery and computers	11.48	0.11	0.02	47.21	6.91	0.48
Pulp, paper and paperboard	6.19	0.17	-1.25	13.58	1.05	0.12
Articles of paper and paperboard	1.92	0.20	2.32	1.66	3.40	0.32
Miscellaneous manufacturing n. e. c.	1.26	0.52	1.05	35.04	2.13	0.49
Basic chemicals	2.57	0.62	9.74	12.17	3.55	0.30
Pharmaceuticals	14.61	0.89	-0.82	8.97	12.97	0.43
Other food products	3.23	1.17	0.77	2.64	0.65	0.13
Motor vehicles	0.02	1.76	3.17	6.29	4.31	0.27
Medical equipment	3.35	3.24	-0.32	29.28	7.15	0.29
Tanks, reservoirs, central heating radiators	2.30	3.41	0.09	2.48	0.40	0.16
Machine-tools	3.18	5.90	0.09	16.15	2.31	0.50
Other first processing of iron and steel	1.75	6.50	0.40	15.42	0.88	0.34
Ships and boats	1.07	7.79	-0.45	11.00	0.97	0.45
Parts and accessories for motor vehicles	4.16	13.15	-0.63	7.70	2.62	0.25
Bodies for motor vehicles, trailers	0.03	23.75	0.23	2.11	0.70	0.44

SMH … S_i^{Top3}
DP … investment sales ratio Top3 - industry average
IMQ … import ratio
R&D … R&D/sales in US firms
DIFF … degree of vertical product differentiation within INTRA trade (EU)

References

Aiginger, K., Pfaffermayr, M., Looking at the Cost Side of 'Monopoly' *Journal of Industrial Economics*, XLV, 1997, pp. 245-267.

Aiginger, K., Pfaffermayr, M., Product Quality, Cost Asymmetry and the Welfare Loss of Oligopoly forthcoming in International Journal of the Economics of Business, 1998.

Arellano, M., Bond, S., Dynamic Panel Data Estimation Using DPD - a Guide for Users, IFS-Working Paper, 88/15, 1988.

Arellano, M., Bond, S., Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, Review of Economic Studies, 58, 1991, pp. 277-297.

Arrow, K, J., Economic Welfare and the Allocation of Resources to Inventions, in Nelson, R.R., ed., The Rate and Direction of Inventive Activity, Princeton, Princeton University Press, 1962.

Beath, J., Katsoulacos, I., Ulph, D., Game-theoretic Approaches to the Modelling of Technological Change in Stoneman, P., ed. Handbook of the Economics of Innovation and Technological Change, Oxford, Blackwell, 1995.

Cabral, L. M.B., Conjectural Variations as a Reduced Form, Economics Letters, 49, 1995, pp. 397-402.

Clarke, R., Davies, St.W., Market structure and price cost-margins, Economica 49,1982, pp. 277-287.

Clarke,R, Davies, St. W., Waterson, M., The Profitability-Concentration Relation: Market Power or Efficiency?, Journal-of-Industrial-Economics; 32(4), 1984, pp 435-50.

Daskin, A.J., Deadweight loss in oligopoly: a new approach, Southern Economic Journal 58 (1), 1991, pp. 171-185.

Dixit, A., Stern, N., Oligopoly and welfare, A unified representation with applications to trade and development, European Economic Review 19, 1982, pp. 123-143.

Dixit, A.K., The Role of Investment in Entry Deterrence, Economic Journal, 90, 1980, pp. 95-106.

Dockner, E.J., A Dynamic Theory of Conjectural Variations, Journal of Industrial Economics, 40(4),1992, pp. 377-395.

Geroski, P. A., Coping with Recessions, London, 1998.

Greenaway, D., Milner, Ch., Vertical and Horizontal Intra-industry Trade: A Cross Industry Analysis for the United Kingdom, Economic-Journal; 105(433), 1995, pp 1505-1518.

Greene, W.H., Econometric Analysis, Macmillan, New York, 1993.

Katsoulacos, I., Ulph D., R&D Rivalry under Product Differentiation: Market Equilibria and Social Optimum, Discussion Paper, University of Liverpool, 1991.

Kessides, I. N., The Persistence of Profits in US Manufacturing Industries, in Mueller, D.C., ed., The Dynamics of Company Profits, Cambridge, Cambridge University Press, 1990.

Klette, T. J., Grilliches, Z., Empirical Patterns of Firms Growth and R&D Investment: A Quality Ladder Interpretation. NBER-Working paper 5945, 1998.

Krishnakumar, J., Simultaneous Equations, in Mátyás, L., Sevestre, P. (ed.), The Econometrics of Panel data, Handbook of Theory and Applications, Kluwer, 1992.

Lewis, A., On technological Differences in Oligopolistic Industries, 1996, mimo.

Mueller, D.C., ed. , The Dynamics of Company Profits, Cambridge, Cambridge University Press, 1990.

Mueller, D.C., Profits in the Long Run, Cambridge, Cambridge University Press, 1986.

Pfaffermayr, M., Conjectural Variation Models and Supergames with Price-Competition in a Differentiated Product Oligopoly, Discussion paper 9704, 1997, The Economics Research Center, University of East Anglia.

Rotemberg, J.J., Saloner, G., A Supergame-theoretic Model of Price Wars During Booms, American Economic Review, 76(3), 1986, pp.433-466.

Salinger, M., The Concentration-Margins Relationship Reconsidered, in Brookings Papers: Microeconomics, 1990, pp. 287 - 321.

Spence, M.A., Cost Reduction, Competition and Industry Performance, Economtrica, 52(1), 1984, pp. 101-121.

Thomas, Ch. J., Disincentives for Cost Reducing Investments, Economics Letters, 57, 1997, pp.359-363.

Yarrow, G.K., Welfare losses in oligopoly and monopolistic competition, Journal of Industrial Economics XXXIII (4), 1985, pp. 515-529.