Abstract

This paper suggests a new approach to the empirical analysis of market structure. Market concentration is an aspect of distribution of market shares of firms, and market shares are best modelled at the firm level, bringing into play strategy choices made by firms. It follows that a useful approach to explaining concentration would be a two stage one: to estimate firm size or market shares as a function of firm level determinants, and to use the information in these estimates to assess the relative contributions of firm characteristics to concentration. The method is illustrated by application to selected Polish manufacturing industries in the early transition period.

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Strategy Choices of Firms and Market Structure[1]

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1 Introduction

Over the last half century, mainstream empirical analysis of market structure and performance has been guided by the structure conduct performance (SCP) paradigm which interlinks three questions: What determines firm and market (or industry) performance? What determines firm conduct in the market? What determines market structure? The key relationship among these has been the one that seeks to explain performance measured in terms of profitability. The general premise has been that concentrated size structures facilitate conduct aimed at the exercise of market power by incumbent firms, to the detriment of consumers. Firms in concentrated industries are likely to be more profitable. It could also be that concentrated structures result because large firms are more efficient and competitive; the observed effect is again likely to be higher profitability of concentrated industries. Studies of performance are estimated at the firm level and even at the level of line-of-business.

The advent of game theory into industrial economics in the 1980s highlighted the endogeneity of market structure. Game theoretic models established conditions under which structure, conduct and performance are jointly determined, depending only on consumer preferences and technology, and assuming non-cooperative behaviour of firms in using opportunities to influence or change these, through advertising, R&D and investment in capacity. The message of game theoretic models was the potential for equilibria with asymmetry in firm level strategy choices in equilibrium: in some industries the result of competition among firms will be cross sectionally dispersed and displaying unequal distributions of variables such as investment, advertising, and R&D. It is the joint distribution of strategy profiles

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chosen by firms - some distributed more unequally, and some less - that will determine the distribution of firm sizes and market shares.

Notwithstanding the role assigned by theory to firm level strategy in determining market structure,[2] empirical work till recently followed in the old tradition. Concentration is a market or industry characteristic, and the standard method is to examine the relationship - static, or dynamic - across industries, between concentration levels and potential explanatory variables (such as advertising, minimum efficient scale, growth of the industry, profitability) subsuming variations across firms in their choices into industry averages.[3] One reason why asymmetry in firm level choices has been ignored in empirical work is the fragility of game theoretic models in confronting the observable real world; they do not supply robust testable propositions. The recent exception, Sutton's bounds approach to market structure (1991,1998) based on a "robust" game theoretic model, has led to a resurgence of empirical work.[4] The bounds approach predicts a lower bound to the decline of market concentration as a market grows in size, conditional on the potential for competitive escalation of R&D and advertising expenditures by firms. Though escalation suggests potential for asymmetry, the theoretical model assumes symmetry for reasons of tractability. Crucially the bounds approach has shown how market structure is determined by firm level conduct. While some empirical tests have followed the cross industry estimation route (Lyons and Matreves, 1996 ; Symeonidis, 2000), others have examined individual industries (Asplund and Sandin, 1999; Walsh and Whelan,1999; Buzzacchi and Valletti, 2000).

This paper is motivated by issues raised in this body of work, but is specifically aimed at the gap left by the empirical work which subsumes cross sectional distributions of firm level choices and characteristics into "averages". Davies and Geroski (1997) pointed out a key aspect of this gap in methodology when they noted "…a curious disjunction between studies of … industrial concentration and the studies of market shares of individual firms … . Even the obvious link, via aggregation of market shares ... has been insufficiently explored". They analysed how the dynamics of market shares of largest firms feed into the concentration ratio (such as C_5). Following that line of thought further, cross industry models ignore the effect of firm

[2] Including not just direct action on costs and demands, but also strategic commitments which influence expectations, beliefs and behaviour of other firms, incumbents and potential entrants, on costs and demands, especially in the face of incomplete information.

[3] The usual method of measuring the contribution of a firm characteristic (for example, ownership) to concentration is to partition the population of firms into a collection of relatively homogenous subgroups based on a given attribute, and to measure the degree of concentration 'between' groups (see Kattuman and Domanski, 1997). However, slicing up the population in alternative ways, considering one characteristic at a time, does not help in isolating the contribution of each characteristic independent of the effects of others. In the structure-conduct-performance tradition, on the other hand, the potential determinants of concentration are considered simultaneously but models are estimated across industries.

[4] Market structure is important in its own right to students of industry even when structural conditions do not suffice to predict anti-competitive behaviour (Waterson, 1993). Another reason for the resurgence of interest in the dynamics of market structure has been the dramatic changes in transition economies.

level strategy heterogeneity on the firm size distribution and thereby on market concentration, and its evolution.

To fill that "disjunction", we propose a two-stage approach to modelling concentration in any single market: model market shares at the firm level, and use the information in these estimates to explain the distribution of market shares. Concentration is an aspect of the distribution of market shares of firms within an industry. Sizes (or equivalently, market shares) are "determined" due to the interplay, within the market or industry, of firm level choices of conduct conditioned by firm level characteristics. This suggests that the size of the firm could be modelled in terms of firm level choices of strategic variables and firm characteristics. The information in these estimates could then be used to explain the cross sectional distribution of market shares (in other words, the concentration level in the industry), and its evolution.

The paper is organised as follows. In section 2 we present a method of firm size model based decomposition of market concentration, measured by the Hirschman-Herfindahl Index (HHI). In section 3, the proposed method is illustrated with an application to Polish manufacturing. Poland constitutes a good example to demonstrate the potential of the proposed method because of the rapidly changing industrial structure as a result of transition. It is important to not only monitor the changing structure and determine the magnitude of change, but to identify the factors that drive this change. Internal and external liberalisation might be viewed as competition shocks, which provoke changes in firm level choices of strategies. Section 3.2 compares pre- and post-transition determinants of concentration. Section 3.3 examines the role of entrants in bringing the concentration levels down. Section 4 concludes the paper.

2 Regression-based Decomposition of Market Concentration

How do firm choices affect market concentration? In a textbook example Martin (1993, pp. 181-186) considers investment by a single firm in the industry. The impact on concentration is ambiguous; investment by large firms should increase concentration, while concentration should decline if the smallest firms undertake investment. In a more general setting, competition between firms in a market is articulated through their price and non-price strategies. Non-price competition takes a variety of forms, including market promotion expenditures that boost sales and profit margins. Conditional on past market shares, these choices of firms influence their current market shares. Each firm can be expected to choose their competitive strategies purposively.[5]

With many firms making choices along many dimensions at the same time, the outcome depends on all the choices made by all the firms. A method that disentangles these effects is useful. For example, greater cross sectional inequality in the distribution of advertising expenditure across firms may not translate into a higher

[5] To maximise profits or market shares. We do not need to make explicit assumptions about the nature of the optimisation exercise in this class of models approach.

level of market concentration, if the distribution of some other sales effective variable has a countervailing effect.[6]

Our objective is a method that identifies the forces driving market structure in any industry. In accounting for concentration, one should be able to ascribe responsibility to different firm level features – such as investment, and marketing efforts. Of course, after allowing for the key determinants, market shares will inevitably have a remaining random component, and some proportion of concentration will remain essentially unattributable. It will also be necessary to restrict analysis to markets where the assumptions of the model are not unrealistic; for example, markets where critical strategy variables are not observed cannot be analysed. Subject to the above caveats, how can we characterise the way the distribution of firm characteristics and strategies and the covariance between them translate into the distribution of firm sizes or market shares?

2.1 Firm Size and Market Share Models

The method we introduce below is based upon a regression model of firm size.[7] In the marketing literature, market share models are estimated to diagnose the effectiveness of marketing instruments. Among many different specifications, linear market share models are deemed to perform well (Kumar and Heath, 1990; Brodie and Bonfer, 1994). The linear model specifies the market share of any brand as a linear function of its marketing instruments (e.g., advertising expenditure, distribution effort, price etc.)

In Industrial organisation, empirical models of firm size and market share (for example, those presented in Cable (1997) and Davies and Geroski (1997)) have not been derived from explicit theoretical models. Cable's model has market share determined by the current and past values of strategy variables. Among a range of potential strategy variables (e.g. advertising, pricing, new product development), Cable admits advertising and price as two dimensions of strategic rivalry between firms. The impact of past decisions on size is captured by a lagged market share variable, so that the estimated model includes current strategic variables and past market share. Davies and Geroski (1997) focus on advertising and innovation. These examples also suggest that a linear model of firm size is satisfactory.

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[6] From a diagnostic point of view, if any variable (for example, investment) that has a large effect upon market share is very unequally distributed across firms, it would be useful to be able to identify the inequality of that distribution and examine the nature of competition in that light.

[7] A regression model of firm size is a summary description of the way the observed strategy choices and firm characteristics across the population of firms relate to observed market shares. If the outcome observed is an equilibrium, the regression model describes the equilibrium in the sense that the product of the regression coefficient and the average value of the strategy or characteristic explains some portion of the average firm size. The coefficients do not admit comparative statics; small changes in strategies may provoke retaliation by other firms and drive the equilibrium far out.

Following these antecedents, we model firm size as a linear function of strategies and characteristics.[8] The coefficients of the size model will reveal how, on average, strategies translate into size. Using this as a benchmark, we use techniques similar to analysis of variance to pin down how the distribution sizes of firms relate to the distribution of strategies deployed by firms, and the covariances between them.[9] This is described below.

2.2. Decomposition[10]

We measure concentration using the popular, well-understood and enduring Hirschman-Herfindahl index (HHI). HHI is defined as a sum of squared market shares s_i of all firms in an industry, and lies in the interval [1/N,1]. See Chakraborty (1995) for a review of the properties of the measure.

HHI can be written as a weighted sum of firm sizes X_i

$$HHI = \sum_i s_i^{\,2} = \sum_i \left(\frac{X_i}{\sum_i X_i} \right)^2 = \sum a_i(\boldsymbol{X}) X_i \qquad (2.1)$$

with weights given by $a_i(\mathbf{X}) = \frac{X_i}{\left(\sum_i X_i\right)^2}$

We write the linear model of firm size in the market under consideration as

$$\mathbf{X} = \mathbf{Z}\beta + \varepsilon \qquad (2.2)$$

where X is a n-vector of firm sizes, Z is a n x M matrix of determinants of size, and β represents the link between size and various firm characteristics and strategies. ε, a n-vector of residuals represents purely random influences on size.

In empirical implementation, the first column in Z can be a n-vector of ones (1,…,1), and β is a K-vector of regression coefficients. With β estimated using

[8] A model assumption that firms compete in non-price variables will be consistent with an empirical specification that does not use price information. In many firm level data sets, price data is not available, and that assumption becomes crucial.

[9] Some caveats. Regression analysis is not possible if there are very few firms, For small number of firms, the case study would be better. Secondly, if the outcome does happen to be symmetric, ie, if there is no heterogeneity, a regression based analysis is not possible or interesting. So we are restricted to the case of moderate numbers of firms and when there is some asymmetry in the strategies. In these cases, we can characterise the equilibrium by examining the degree of asymmetry in strategies, and the asymmetry in size.

[10] The issue of decomposition has been widely discussed in the inequality literature, with important contributions by Shorrocks (1982) Fields and Yoo (2000) and Morduch and Sicular (1998). However, inequality measures are different from market concentration measures and the decompositions in the above papers cannot be applied directly; however, the above papers have been influential in the development of the decomposition set out below.

appropriate econometric techniques, $\hat{\mathbf{X}} = \mathbf{Z}\,\hat{\beta}$ gives predictions of firm size. The relationship between the size of firm i and firm-level characteristics will be given by

$$X_i = \hat{\beta}_0 + \hat{\beta}_1 Z_{i1} + \hat{\beta}_2 Z_{i2} + ... + \hat{\beta}_K Z_{iK} + \hat{\varepsilon}_i \qquad (2.3)$$

The Z_{ik}s are scaled by the value of kth variable averaged across all firms in the market. Since prices charged by firms are not known, the model is based on the implicit assumption that competition takes the non-price form. This empirical regression model nests the class of theoretical models described by Sutton (1998) where firms compete in choosing their "locations" in product characteristics space in the first stage, and in the second stage they compete on the basis of these givens. If the observed configuration of sizes and strategy choices is a stable equilibrium in non-price strategies, the estimated regression model is a description of that equilibrium.

Consider a firm level choice variable such as investment (or a feature such as past size, or past performance) indexed by k. The contribution, due to factor k, to the size of firm i can be summarised as:

$$X_i = \sum_{k=1}^{K+1} \hat{X}_{ik} \qquad (2.4)$$

where $\hat{X}_{ik} = \hat{\beta}_k Z_{ik}$ for k = 1,…K

$\hat{X}_{ik} = \hat{\beta}_0 + \hat{\varepsilon}_i$ for k = K+1.

Putting (2.1) and (2.4) together, the decomposition of HHI in terms of contributions by firm level characteristics and choices is given by:

$$HHI(\boldsymbol{X}) = \sum_i a_i(\boldsymbol{X})\left(\sum_k X_{ik}\right) \qquad (2.5)$$

The proportional contribution of factor k to HHI is given by:

$$p(\mathbf{X}_k, \mathbf{X}) = \frac{\sum_i a_i(\mathbf{X}) X_{ik}}{\sum_i a_i(\mathbf{X}) X_i} \qquad (2.6)$$

which simplifies to:

$$p(X_k, \boldsymbol{X}) = \frac{\sum_i (X_i X_{ik})}{\sum_i (X_i X_i)} \qquad (2.7)$$

The decomposition given by (2.7) is exact, that is the proportional contributions add up to 1 ($\sum_k p(\mathbf{X}_k, \mathbf{X}) = 1$). It is also unique in the sense that there is no other set of weights $b_i(\mathbf{X})$, such that $b_i(\boldsymbol{X})$ is increasing in X_i and $HHI(\boldsymbol{X}) = \sum_i b_i(\mathbf{X}) X_i$.[11]

[11] Let us suppose that the decomposition is not unique. If there is another set of weights $b_i(\mathbf{X})$, such that $b_i(\mathbf{X})$ is increasing in X_i then

It is useful to rewrite (2.7) using the definition of covariance, $Cov(X_k, \mathbf{X})$ and variance $\sigma^2(\mathbf{X})$:

$$p(X_k, \mathbf{X}) = \frac{Cov(X_k, \mathbf{X}) + \overline{X}_k \overline{X}}{\sigma^2(\mathbf{X}) + \overline{X}^2} \qquad (2.8)$$

Further, using the definition of covariance between a variable and the product of a constant and another variable, (2.8) can be written as

$$p(X_k, \mathbf{X}) = \frac{Cov(\beta_k \mathbf{Z}_k, \mathbf{X}) + \beta_k \overline{\mathbf{Z}}_k \overline{X}}{\sigma^2(\mathbf{X}) + \overline{X}^2} = \frac{\beta_k \left(\sigma(\mathbf{Z}_k)\sigma(\mathbf{X})cor(\mathbf{Z}_k, \mathbf{X}) + \overline{\mathbf{Z}}_k \overline{X}\right)}{\sigma^2(\mathbf{X}) + \overline{X}^2}$$

for k=1,…,K (2.9a)

$$p(X_k, \mathbf{X}) = \frac{\beta_0 \overline{X}}{\sigma^2(\mathbf{X}) + \overline{X}^2} + \frac{\mathrm{cov}(X_i, \varepsilon_i)}{\sigma^2(\mathbf{X}) + \overline{X}^2} \qquad \text{for k=K+1} \qquad (2.9b)$$

This method apportions concentration in an industry to selected firm-level endogenous and exogenous variables and identifies the sources of concentration. According to formula (2.9a), the contribution to concentration of a firm-level factor depends on its size impact represented by the regression coefficient, its mean value and its dispersion, as well as its correlation with size.

(2.9) can be used to compare industries as well as to compare the evolution of concentration in a single industry over time. Differences in concentration can be understood in terms of differences in size coefficients, reflecting changes in size effectiveness of firm-level features; and the differences in dispersions and mean values of firm-level features in response to changing market conditions.[12] It must be noted that this framework is bound to ignore the effect, if any, of common elements in the environment, for example, macro-economic shocks, that are shared by all firms. It must also be noted that the model must be estimated using data from all firms in the industry under study as the estimates of firm size are used to decompose a measure of market concentration.

$HHI(\mathbf{X}) = \sum_i b_i(\mathbf{X}) X_i \quad \Rightarrow \quad HHI(\mathbf{X}) = \sum_i (a_i(\mathbf{X}) + \delta_i) X_i = \sum_i (a_i(\mathbf{X})) X_i + \sum_i (\delta_i) X_i$

$\Rightarrow \quad HHI(\mathbf{X}) \neq \sum_i (a_i(\mathbf{X})) X_i$

[12] Firm responses could be characterised by inertia, due to, for instance, sunk costs. Also, they could be affected by strategic pre-emptive choices by influential incumbents. This method enables us to identify leaders and laggards in adjustment in any choice variable, in particular, those that substantially contribute to the observed concentration levels. It is thereby possible to identify firms worth special attention by competition policy authorities.

3 Empirical Application: Market Structure in Poland in Transition

3.1 Data, Firm-level Variables and Market Concentration

We illustrate the use of this method in the context of a transition economy. The choice of firm level strategic variables has been guided by the institutional background of transition. Following Martin (1994, pp. 90-2) we focus on two broad directions of strategy: pure capacity expansion, and market orientation. The former is the arch-typical strategy of a socialist firm, where managers strive for size through investment. This is the behaviour that leads to 'insatiable investment hunger' (Kornai, 1980, pp. 191-195), a phenomenon associated with soft budget constraints and shortages. We call this strategy 'capacity' and measure it by investment expenditure reported by a firm. The market-oriented strategy applies to the firms focussing on increasing the value of the product in the market through quality increase and attention to marketing. We call this strategy 'market'.

Among data reported by firms, there is no separate information on variables that capture attention to market -- R&D expenditure, advertising or sales effort. However, the assets of the firm held in the form of patents, brand name, quality awards and good will are collectively valued as intangible assets in the balance sheet. We use this capitalised value of a number of key value creating expenditures aimed at technology (in the form of patents) and market development (in the form of brand name, quality awards and goodwill) to proxy the orientation of the firm towards quality and market development: the 'market' strategy.

We assume that these observable non-price competitive measures - capacity increase and value creating expenditures, are the proximate determinants of size and market share, and all other determinants except lagged market share are captured in a random term. All variables are measured in relation to industry average for a given year. This facilitates comparison across industries and over time.

The basic model takes the following form[13]

$$\text{Size} = f(\text{Past\_Size}, \text{Capacity}, \text{Market}) \qquad (3.1)$$

where the dependent variable is size of firm i, measured by sales; Past_Size is firm size in the previous year; Capacity measures capacity expansion in terms of investment expenditure by the firm, and Market is an indicator of the market oriented strategy, proxied by the intangible assets of firm i.

The data used in this study comes from the company records of Polish manufacturing firms. The Polish Central Statistical Office routinely collects data from all firms employing at least 5 people. Various aspects of functioning of enterprises are reported on separate questionnaires and stored in independent databases. We utilise data from two different databases (namely questionnaires on financial results and company balance sheets) and merge them so that there is a full range of available

[13] We examine different functional forms and introduce dummy variables.

information for each firm. The number of firms included in the database varies from about 5000 in the late eighties to around 11000 in 1993, and they represent some 90% of total sales in manufacturing. Each firm is identified as belonging to a 3-digit SIC level.

The specification given by (3.1) was tested across a number of industries for which complete firm-level data were available and where the number of firms in an industry was large enough to carry out regression analysis. For this reason the sample is representative of industries characterised by a relatively low level of concentration (the Hirschman Herfindahl index below 0.20). Industries turn out to be individual, and it is difficult to generalise across many industries. The empirical analysis reported below illustrates how the method developed in section 2 can be applied to analyse concentration for different industries and over a period of time.

The first stage involved the estimation of a size equation corresponding to (3.1). The results of the estimation for a selected industry ('Garments including Hosiery' in 1990) are given below.

Size =	-0.04	+0.966*Past_Size	+0.139*Capacity	-0.013*Market
	(0.059)	(0.111)	(0.068)	(0.005)

N=273 R^2=0.85

(Size regression for Garments and Hosiery, 1990. Heteroscedasticity adjusted standard errors in brackets)

Past size, 'Capacity' and 'Market' are all significant. The coefficient of past size indicates that current sizes are close to past sizes. As for the coefficients of 'Capacity' or 'Market' strategy, a positive sign suggests a positive relationship between the given strategy and size. A firm investing 1% more than average will be 0.14% larger than average. 'Market' is negatively related to size. Small firms appear to pursue market-oriented strategies. A firm with intangible assets 1% larger than the average was 0.01% smaller.

The regression coefficients feed into the decomposition formula given by (2.9) to produce relative contributions of firm-level characteristics to industry concentration. The results of the decomposition are given in Table 1. The contribution of each characteristic is calculated using the regression coefficient, the average and standard deviation of a given explanatory variable, and its correlation with size. The remaining unexplained concentration is given by the residual. In 'Garments and Hosiery' the past size has the strongest effect; 75% of concentration is explained by past concentration. Investment decisions account for 14% of concentration. Market promotion has a potentially concentration-lowering effect; it is not yet translating into larger firm size. Its effect on concentration is very weak, and there is large variation among firms in this strategy. 11% of concentration remains unattributable.

Even though transition in Poland officially started in January 1990, we choose 1990 to depict a pre-transition situation as industrial structure started changing dramatically only after 1990. In 'garments and hosiery', past concentration is the main determinant of current concentration, and this will be true for many other industries at

this time. A strategy of capacity expansion through investment is far more popular than a more market-oriented approach, and the role of advertising and more sophisticated technology is negligible.

Table 1 Relative contributions to concentration for a selected industry (Garments and Hosiery, 1990, HHI = 0.0165)

	Coefficient	Average	Standard deviation	Correlation with Size	Contribution
Past size	0.97	0.95	1.53	0.90	**0.75**
Capacity	0.14	1	3.32	0.58	**0.14**
Market	-0.01	1	8.05	0.0007	**-0.003**
Residual					**0.11**

3.2 Changing Determinants of Market Concentration: Pre-transition and Transition

The decomposition methodology can be used to analyse how determinants of concentration change over time. Below we examine an industry in 1990 depicting the pre-transition situation and 1992, by which time the Polish industrial structure had changed substantially. The data was comparable for these two years. We illustrate the method using 'Agricultural machinery' industry.

Table 2 contains the relative contributions to concentration as well as information used for decomposition in each year. The relevant size regression coefficients are reported when significant. Descriptive statistics are also reported. In this particular industry, concentration, measured by the HHI, declined from 0.062 to 0.040. The number of firms more than doubled but there was also some increase in size variability, with the standard deviation of size growing from 1.26 to 1.63. In 1990 the only significant variable in the size regression was past size, and past concentration determined 83% of current concentration. Random factors accounted for almost 17% of concentration. Strategies of capacity expansion and market promotion were weakly associated with size.

By 1992, strategies followed by firms had come to have more of a role in explaining concentration. In size regression all three variables are significant. The relationship between market promoting strategies and size was non-linear. The suggestion is that very small firms as well as very large ones engage relatively weakly in this strategy. This strategy is pursued most intensely by firms about 3 times larger than the average firm. The increased importance of market promotion is associated with an increased diversification among firms suggested by much higher standard deviation (7.09 in 1992, as compared with 3.21 in 1990). The actual contribution of

this strategy to concentration is relatively small and market promotion accounts only for 5% of concentration.

Table 2 Decomposition of concentration in 'machinery for agriculture and forestry' in 1990 and 1992

	Past size	Capacity	Market	Residual
1990				
N = 42 HHI = 0.0616 Std (Size) = 1.2601				
Regression coefficient	0.9548	insign.	insign.	
Average	0.97	1	1	
Standard deviation	1.14	2.09	3.21	
Correlation with size	0.90	0.37	0.38	
Contribution	**0.83**	**0**	**0**	**0.17**
1992				
N = 91 HHI = 0.04 Std (Size) = 1.63				
Regression coefficient	0.73	0.29	0.29; -0.005*	
Average	0.59	1	1	
Standard deviation	1.09	2.59	7.09	
Correlation with size	0.76	0.68	0.27	
Contribution	**0.38**	**0.31**	**0.05****	**0.26**

Notes: Only coefficients significant at a 10% or better level are included. Insignificant coefficients are entered as 'insignif.'.

* Coefficients by Market and Square of Market

** This is the joint contribution of variables Market and Square of Market

By 1992, compared to 1990, the importance of past size had declined quite substantially and only 38% of concentration could be explained by the past size structure. The smaller effect is due to a smaller regression coefficient, a weaker correlation between past and current size and a higher variability in firm sizes. Capacity expansion became more important and investment decisions explained 31% of concentration. As compared with 1990, investment decisions were more strongly correlated with size. Despite this wider range of significant determinants of concentration, the unexplained portion increased to 26% in 1992. Similar transformations were taking place in many other industries.

3.3 Fall in Market Concentration and the Role of Entrants

A key phenomenon in transition was the substantial increase in the number of firms. Between 1991 and 1992 the number of firms registered in our database doubled. What was the role of entrants in bringing concentration down? In order to examine the role of entrants we estimate the following equation

$$\text{Size} = a_1 + \text{If\_entry} + a_2\ \text{Past\_size} + a_3\ \text{Capacity} + a_4\ \text{If\_entry} * \text{Capacity} + a_5\ \text{Market} + a_6\ \text{If\_entry} * \text{Market}$$

where If_entry is a dummy variable equal to 1 for new firms and the remaining variables are defined as in (3.1). This equation was estimated for a number of industries using data for 1992 and the concentration level was decomposed in terms of different strategies and relative contributions of entrants and incumbents[14].

We look at four different industries, where concentration declined and which saw large increases in the number of firms. The industries chosen for presentation are electromechanical goods, food equipment, cement, and fish products. Relative contributions of incumbents and entrants to market concentration are presented in Table 3. The number of incumbents and entrants and the Hirschman-Herfindahl index are also given. The relative contribution of past size varies between 0.20 and 0.46. The unexplained portion of concentration ranged between as low as 0.12 (fish products) and as high as 0.43 (cement). As a prelude to the discussion of the respective contributions of entrants and incumbents, note that industries differed in the relative importance of particular strategies. For ‘electromechanical goods’ and ‘equipment for food industry’, capacity expansion was important. In contrast to this, in ‘fish products’, market promotion played the major role in explaining concentration, and capacity expansion is relatively unimportant. The negative sign implies that this small firms were the investors, and this lowered concentration.

If contributions by entrants and incumbents are aggregated independent of strategy pursued, in ‘electromechanical goods’ over 30% of concentration is explained

[14] If slope dummies are used in regressions, the decomposition formula given by (2.9) has to be modified so that contributions of different strategies can be attributed to incumbents and entrants separately. In particular, in the modified formula, sizes and strategy indicators have to be averaged separately across entrants and incumbents and coupled with the appropriate regression coefficient.

by decisions taken by incumbents. On the other hand, in 'equipment for food industry' concentration is mostly determined by entrants. In this particular industry there is a strong polarisation among entrants. Large new firms engage in capacity expansion and their investment decisions explain 49% of concentration. Small new firms, on the other hand, follow a more market oriented approach. Their decisions contribute quite substantially to lowering concentration, as a relative contribution of –0.15 suggests. In this particular industry incumbents are not involved in market promotion and the contribution of their investment decisions to concentration is also relatively minor (0.068).

In all four industries the number of entrants is quite large, with the number of new firms exceeding the number of incumbents in 'cement' and 'fish products'. However, looking merely at the numbers of entrants is misleading, as new firms might make negligible contributions to concentration. For example, in 'cement', even though there are 194 new firms, competing with 180 incumbents, their decisions explain less than 0.5% of concentration, while incumbents' decisions account for 10% of concentration.

Table 3 Relative contributions of incumbents and entrants to concentration

	Electromechanical goods	Equipment for food industry	Fish products	Cement
HHI_91	0.0374	0.0494	0.1229	0.0097
HHI_92	0.0306	0.0301	0.0711	0.0071
Past size	0.4117	0.1996	0.4432	0.4640
Capacity	0.3781	0.5614	-0.0184	0.0796
by incumbents	0.2863	0.0677	-0.0126	0.0771
by entrants	0.0918	0.4937	-0.0058	0.0025
Market	0.0604	-0.1520	0.4539	0.0262
By incumbents	0.0192	0	0.2054	0.0243
By entrants	0.0412	-0.1520	0.2485	0.0019
Residual	0.1498	0.3910	0.1212	0.4302
No of incumbents	95	51	37	180
No of entrants	57	29	56	194

4 Conclusions

Concentration is usually explained at an industry level, in relation to past concentration levels, technological barriers (such as minimum efficient scale), product differentiation barriers, and endogenous sunk costs. However, strategic behaviour of individual firms directed at rival incumbents or potential entrants may lead to higher levels of concentration than warranted by the underlying technology and organisation. Concentration should then also be seen as a result of choices made by firms on strategies, conditional on their other characteristics. In order to capture firm-level determinants of concentration we propose a two stage method, where market shares are modelled at a firm level and the estimates obtained are used to assess the relative contributions of firm characteristics to concentration.

The method of decomposing concentration presented in the paper is based on models of firm level variables determining firm size. We made a distinction between purely technology based capacity expansion and a more market oriented strategy. This distinction is appropriate in examining changes in market structure in a transitional economy. Selected manufacturing industries in Poland were examined for 1990 and 1992. Although the results of size estimation and concentration decomposition are unique for each industry, some generalisations can be made.

Before transition, inherited concentration was the main determinant of current market structure. The strategy of capacity expansion was the popular one. In the course of transition the market oriented approach became significantly more important, but the variety in the intensity with which this strategy was pursued by firms in most industries increased; in general, new firms have been oriented to this approach to increasing market shares.

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