Onderzoeksrapport Nr. 7910

CORPORATE MONOPOLY POWER AND RISK.

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Wettelijk depot : D/1979/2376/21.

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The author is indebted to Prof. R. De Bondt who brought him in touch with the aspects of corporate monopoly power. His and Prof. L. Vanthienen's comments are acknowledged.

All errors remain the author's responsibility.

I. INTRODUCTION

The study of the relation between monopoly power and concentration has presented difficulties at both the theoretical and policy level of analysis.

Businessmen, as well as researchers agree that this relation may be affected by the "riskiness" of the firms (and of the industry) but more theoretical work is needed to understand :

- 1) the impact of the market structure and conduct on the risk itself; and
- 2) the (related issue) of the impact of risk on the relation between monopoly power (profitability) and concentration.

Both problems are dealt with in this study.

SCHERER [16] notes that although one would expect profits to be higher in industries that are in some sense risky than in low-risk industries, greater riskiness cannot fully explain the higher returns observed in more highly concentrated industries. He further argues that it is possible that riskiness and concentration are correlated but the evidence on whether such a relationship exists is ambiguous (cfr. HURDLE [10]). Also NEUMANN, BÖBEL and HAID [13] suggest that it is important to investigate the interdependencies between the explanatory variables of their model, such as risk, concentration, size, etc....

Although the issues can only be fully resolved by empirical research, gaining a better understanding of the a priori relation between risk, the market structure and profitability is useful. This paper attempts to achieve this in the mean-variance framework of the Capital Asset Pricing Model (FAMA and MILLER [7] , LINTNER [12] , SHARPE [20]). The implications of this model for business firm behavior are manifold (SCHRAMM and SHERMAN [17] , [18] , [19]).

II. THE CAPM-FRAMEWORK

The analysis in this paper is carried out in the mean-variance framework of the Capital Asset Pricing Model (CAPM) [7] [12] [20]. The use of this model as a tool for an investigation of firm behavior under uncertainty differs from the expected utility approach used in [2] [3] [11] [14], which cannot analyse firms owned by many investors. The CAPM based on the assumption that investors are risk-averse expected utility maximizers overcomes this limitation and generates empirical testable insights.

The well-known CAPM-equation (1) is an expression for the market value of the firm that, appropriate to financial market theory, management is trying to maximize :

$$(1) \quad V_j = \frac{1}{R_f} [E(\tilde{X}_j) - \mu \text{cov}(\tilde{X}_j, \tilde{X}_m)]$$

where

$$(2) \quad \mu = \frac{E(\tilde{X}_m) - R_f \cdot V_m}{\text{var}(\tilde{X}_m)}$$

In (1) and (2), V_m represents the value and X_m is the net income, respectively, of all assets comprising the market portfolio; μ is referred to as the "market price of risk" reflecting the community's aggregate risk behavior. X_j and V_j denote the firm's net income and market value; R_f is the risk free rate of return.

Equation (1) states that the equilibrium value of the firm j is the present value of the expected future income ($E(\tilde{X}_j)$), which is assumed to be a perpetuity, taking into account the value of the riskiness ($\mu \text{cov}(\tilde{X}_j, \tilde{X}_m)$).

The model described in this study assumes that the insights and the results derived from the CAPM (although some of its assumptions are violated) can be applied to individuals and firms and that management acts as if maximizing the market value of the firm as defined by (1).

III. THE MODEL

The focus is on a firm j , producing a single commodity, and choosing the production amount in order to maximize the value of the firm (1). The only kind of uncertainty related to future net income concerns the price that will be obtained for the product. Assuming a downward sloping relationship, one way to introduce uncertainty is using a "multiplicative" demand curve :

$$(3) \quad \tilde{p} = \tilde{u} f(q)$$

where $\tilde{u}$ is a random variable with $E(\tilde{u}) = 1$; q denotes the total industry output supposing there are N firms in that industry ($q = \sum_{i=1}^N q_i$). Let $s_j = \frac{q_j}{q}$ represent the share of the j -th firm in industry sales. By definition $\sum_{j=1}^N s_j = 1$. The total costs are linear : $C_j = c_j q_j$ ($c_j > 0$).

The expected net income of firm j is

$$(4) \quad E(\tilde{X}_j) = q_j f(q) - c_j q_j$$

The risk of firm j is

$$(5) \quad \mu \text{ cov}(\tilde{X}_j, \tilde{X}_m) = \mu q_j f(q) \text{ cov}(\tilde{u}, \tilde{X}_m)$$

The optimal value of q_j is most readily obtained from the expression for the value of firm j

$$(6) \quad v_j = \frac{1}{Rf} [q_j f(q) - c_j q_j - \mu q_j f(q) \text{cov}(\tilde{u}, \tilde{x}_m)]$$

The optimal quantity satisfies

$$(7) \quad E(\tilde{p}) - c_j = -\epsilon \frac{df}{dq} \left[1 + \sum_{\substack{i=1 \\ j \neq i}}^N \frac{\delta q_i}{\delta q_j} \right] + \mu \text{cov}(\tilde{u}, \tilde{x}_m) \left\{ E(\tilde{p}) + \epsilon \frac{df}{dq} \left[1 + \sum_{\substack{i=1 \\ j \neq i}}^N \frac{\delta q_i}{\delta q_j} \right] \right\}$$

In [7] is the term $\sum_{\substack{i=1 \\ j \neq i}}^N \frac{\delta q_i}{\delta q_j} \equiv \lambda_j$ the sum of the conjectural variations.

A conjectural variation $\frac{\delta q_i}{\delta q_j}$ indicates the variation in firm i 's output per unit change in firm j 's output anticipated by firm j and which firm j takes into account when trying to choose its optimal output.

Substituting λ_j in [7] and introducing the expected Lerner index ($E(\tilde{L}_j)$), the market-share (s_j) and the expected elasticity of demand ($E(\tilde{\eta}) = -\frac{dq}{df} \cdot \frac{f}{q}$) it is easy to verify that [7] implies

$$(8) \quad E(\tilde{L}_j) = \frac{E(\tilde{p}) - c_j}{E(\tilde{p})} = \frac{s_j}{E(\tilde{\eta})} [1 + \lambda_j] + \mu \text{cov}(\tilde{u}, \tilde{x}_m) \left[1 - \frac{s_j}{E(\tilde{\eta})} (1 + \lambda_j) \right]$$

This result indicates the appropriate functional form for explaining price-cost differentials as a function of industry concentration, demand elasticity, conjectural variations and riskiness. The result confirms the finding of COWLING [5] who showed under certainty conditions that $L_j = \frac{p - c_j}{p} = \frac{s_j}{\eta} [1 + \lambda_j]$.

IV. THE DEPENDENCE OF RISK ON MARKET STRUCTURE AND CONDUCT

As shown in (8), one factor explaining the price-cost differential is the risk. The impact of risk, however, is in itself not independent of the market share and the conjectural variations coefficient. This dependence of risk on market structure and conduct will be analysed in this section.

Defining riskflexibility (γ) as the relative change of the risk of the firm caused by a relative change in production of the firm :

$$(9) \quad \gamma_j = \frac{d\mu \operatorname{cov}(\tilde{X}_j, \tilde{X}_m)}{dq_j} \cdot \frac{q_j}{\mu \operatorname{cov}(\tilde{X}_j, \tilde{X}_m)}$$

it follows from (5) and (7) that

$$(10) \quad \gamma_j = 1 - \frac{s_j}{E(\tilde{\eta})} [1 + \lambda_j]$$

so that the expected Lerner index (8) results in

$$(11) \quad E(\tilde{L}_j) = \frac{E(\tilde{p}) - c_j}{E(\tilde{p})} = \frac{s_j}{E(\tilde{\eta})} [1 + \lambda_j] + \mu \operatorname{cov}(\tilde{u}, \tilde{X}_m) \gamma_j$$

If $\operatorname{cov}(\tilde{u}, \tilde{X}_m) > 0$, there is a positive relationship between the expected Lerner index and riskflexibility. The higher γ_j , the higher $E(\tilde{L}_j)$ (ceteris paribus). In order to understand the relation between the expected Lerner index and the market structure and conduct, it is necessary to analyse the relation between risk(flexibility) and market share, demand elasticity and conjectural variations, because the value of γ_j is a function of those variables.

Referring to (10) the higher the market share, the lower the risk flexibility (if $1+\lambda_j > 0$). This inverse relationship is provided some support by the findings of SULLIVAN [22]. The more intuitive argument: "At different levels of market share, a company's risk also changes Risk reaches a low point at a high share level" ([4]) is also related to our result.

A second insight from (10) is the positive relationship between the riskflexibility of firm j and the expected demand elasticity. If $\frac{1}{E(\tilde{\eta})}$ is called the expected price flexibility, the conclusion is that a higher expected price flexibility causes a lower risk flexibility (if $1+\lambda_j > 0$).

A third factor influencing the riskflexibility is the firm's coefficient of conjectural variations (λ_j). The values of this coefficient can be divided into three classes [1], corresponding with "Cournovian", "adaptive" and "matching" behavior.

A zero value of λ_j may be referred to as Cournovian. In the Cournot model the firms attempt noncooperatively to maximize their own profits. The j -th firm believes that all other firms will hold their output constant when it changes its own output; hence $\lambda_j = 0$. It corresponds to a minimum degree of collusion between sellers of the same industry [6]. In the Cournovian case, the riskflexibility coefficient is smaller than one ($\gamma_j < 1$).

Negative values of the conjectural variations coefficient indicate what may be referred to as "adaptive behavior": it implies that j expects firm i to contract its output if firm j expands its output [1]. The riskflexibility coefficient depends on the degree of adaptation. It follows from (10) that riskflexibility is smaller in the Cournovian case than with adaptive behavior.

A special case of adaptive behavior is when firms are cooperating by real-locating production among themselves such that total output remained unchanged. We'll call this situation, a case of "perfect negative adaptation". Hence, $\lambda_j = -1$ and $\gamma_j = 1$. It is easy to verify that for a firm in a perfect competitive market, also $\gamma_j = 1$. Riskflexibility is thus identical in a perfect competitive situation and in a case of "perfect negative adaptation". Some authors [8] even define perfect competition as being a market characterised by "perfect negative adaptation".

Positive values of the conjectural variations coefficient may be thought of as "matching" behavior. In this case, riskflexibility is smaller than in the Cournovian and the "adaptive" case. The characteristic γ_j for "matching" behavior approaches the monopoly case, with very low riskflexibility. For a monopolist, γ_j can even be zero (if $E(\tilde{\eta}) = 1$) or negative (if $E(\tilde{\eta}) < 1$).

Using those insights, in next section, the effect of risk on the relation between monopoly power and concentration is studied.

V. THE EFFECT OF RISK ON THE RELATION BETWEEN MONOPOLY POWER AND CONCENTRATION

If the market is perfect competitive, the Lerner index is zero under certainty conditions. With price uncertainty and perfect competition, the expected Lerner index equals $\mu \text{cov}(\tilde{u}, \tilde{X}_m)$. This expected profit margin has to be considered as a return for the marginal risk of the perfect competitive firm. The same value for the expected Lerner index is found for the "perfect negative adaptation" case.

Focusing on the relationship between the expected Lerner index and the market share under uncertainty, from (8) one finds in general that

$$(12) \quad \frac{\delta E(\tilde{L}_j)}{\delta s_j} = \frac{1+\lambda_j}{E(\tilde{\eta})} [1 - \mu \text{cov}(\tilde{u}, \tilde{X}_m)] > 0 \quad \text{if } 1+\lambda_j > 0$$

because $1 - \mu \text{cov}(\tilde{u}, \tilde{X}_m) > 0$ (assuming that $v_j > 0$ in (6)). Under uncertainty, there is a positive relationship between the expected Lerner index and the market share. If $\text{cov}(\tilde{u}, \tilde{X}_m) > 0$, then the influence of the market share on the expected Lerner index is smaller under uncertainty than under certainty conditions. It means that the influence of the risk on the market share-expected Lerner index relationship is negative, as indicated by

$$(13) \quad \frac{\delta^2 E(\tilde{L}_j)}{\delta s_j \delta \mu \text{cov}(\tilde{u}, \tilde{X}_m)} = - \frac{1+\lambda_j}{E(\tilde{\eta})} < 0 \quad \text{if } 1+\lambda_j > 0.$$

Those findings hold for all market structures for which $1+\lambda_j > 0$. E.g. in the Cournovian case is the expected Lerner index equal to $\mu \text{cov}(\tilde{u}, \tilde{X}_m) + \frac{s_j}{E(\tilde{\eta})} [1 - \mu \text{cov}(\tilde{u}, \tilde{X}_m)]$, so that $\frac{\delta E(\tilde{L}_j)}{\delta s_j} = \frac{1}{E(\tilde{\eta})} [1 - \mu \text{cov}(\tilde{u}, \tilde{X}_m)]$ as follows also from (12). The expected Lerner index in the Cournot situation under uncertainty is greater than for the perfect competitive firm case. The marginal riskeffect in the Cournot case is equal to $-\frac{1}{E(\tilde{\eta})}$.

For a monopolist, it is well-known that profit maximisation leads to a value $\frac{1}{\eta}$ for the Lerner index. The expected Lerner index under uncertainty equals then $\mu \text{cov}(\tilde{u}, \tilde{X}_m) + \frac{1}{E(\tilde{\eta})} [1 - \mu \text{cov}(\tilde{u}, \tilde{X}_m)]$ being greater than the Cournotindex.

The results also imply that the influence of the market share on the risk-expected Lerner index relationship is negative : a greater market share implies a lower influence of the risk on the Lerner index. This insight may be an alternative explanation for the risk-return results of NEUMANN, BÖBEL and HAID [13, p. 229] who argue "Actually, it turned out that the two samples had to be handled in a different way. For the big firms the covariance either did not significantly contribute to the explanation of the rate of return or it carried a wrong sign. For the smaller firms it was the variance which showed up with the wrong sign. We found it unreasonable to accept the implication that investors are risk lovers. An alternative and more plausible explanation seems to be that the big firms, being widely diversified, are considered as a portfolio by investors and managers. The smaller firms, on the other hand, are viewed as single assets by stockholders". Our results indicate that insofar that big firms hold large market shares (which may but need not be the case) and insofar that there is a positive relation between the expected Lerner index and the expected rate of return (f.i. defined as the ratio of profits to equity capital), that one would expect a relative smaller impact of the risk (measured by the covariance as the CAPM dictates) on the rate of return. The reverse is true for the smaller firms.

The Lerner index is sometimes defined as the ratio of monopoly rent, $(p-c)q$, to the monopolist's total receipts (pq) . This definition is readily extended to industries containing N firms. The generalized Lerner index (L_g) is given by

$$(14) \quad L_G = \frac{\sum_{i=1}^N (p - c_i) q_i}{\sum_{i=1}^N p q_i}$$

It is the ratio of the sum of the monopoly rents to all firms in the industry, to total industry receipts. At the Cournot-Nash equilibrium, this index equals $\sum_{i=1}^N \left(\frac{s_i}{\eta}\right) s_i = \frac{H}{\eta}$ being the product of the reciprocal of the industry demand elasticity and the Herfindahl index ($H = \sum_{i=1}^N s_i^2$). It has been shown that the Herfindahl index satisfies all properties that a "good" measure of concentration must have [6].

The expected generalized Lerner index ($E(\tilde{L}_G)$) becomes

$$(15) \quad E(\tilde{L}_G) = \frac{H(1+\bar{\lambda})}{E(\tilde{\eta})} + \mu \operatorname{cov}(\tilde{u}, \tilde{X}_m) \left[1 - \frac{H(1+\bar{\lambda})}{E(\tilde{\eta})} \right]$$

$$\text{with } \bar{\lambda} = \frac{\sum_{i=1}^N \lambda_i s_i^2}{H}$$

The relationship between the expected generalized Lerner index and concentration under uncertainty, for the Cournot-Nash case is

$$(16) \quad \frac{\delta E(\tilde{L}_G)}{\delta H} = \frac{1}{E(\tilde{\eta})} [1 - \mu \operatorname{cov}(\tilde{u}, \tilde{X}_m)] > 0.$$

Under uncertainty, there is a positive relationship between the expected generalized Lerner index and concentration. The influence of risk on this relationship is again negative, as shown by

$$(17) \frac{\delta^2 E(\tilde{L}_g)}{\delta H \delta \mu \operatorname{cov}(\tilde{u}, \tilde{x}_m)} = - \frac{1}{E(\tilde{\eta})} < 0$$

From the study of the expected Lerner index as well as the analysis of the generalized expected Lerner index one can conclude that the effect of risk on the relation between monopoly power and concentration is negative.

VI. CONCLUSIONS

In this paper, two related problems are dealt with : the impact of the market structure and conduct on the risk of the firm and the impact of the risk on the relation between monopoly power and concentration.

Central in the discussion of the first problem is the concept of riskflexibility, defined as the relative change of the risk of the firm caused by a relative change in production of the firm. The value of this riskflexibility coefficient is relevant for industrial organization because a higher riskflexibility causes a higher expected Lerner index (*ceteris paribus*).

Riskflexibility of a firm is shown to be a function of its market share, the expected demand elasticity and the coefficient of conjectural variations. So, the risk is in itself depending on the market structure and conduct.

The higher the market share, the lower the riskflexibility. A second insight is the positive relationship between riskflexibility and expected demand elasticity, or a higher expected price flexibility causes a lower riskflexibility. The influence of the coefficient of conjectural variations on riskflexibility is analyzed for "Cournovian", "adaptive" and "matching" behavior. For a

perfect competitive firm and for "perfect negative adaptation", the riskflexibility parameter is unity. Its value is less than unity for the Cournovian case, whose parameter being smaller than for adaptive behavior in general. Matching behavior and the monopoly case are characterized by the lowest riskflexibility parameter.

With respect to the relation between monopoly power (profitability) and concentration under uncertainty, we found a positive relation between the market share (resp. the Herfindahl index) and the expected (resp. generalized) Lerner index. A greater risk implies however a smaller influence of the market share (resp. Herfindahl index) on the expected (resp. generalized) Lerner index (or a greater market share (resp. Herfindahl index) causes a smaller impact of the risk on the Lerner indices.

The value of the expected Lerner index is greater for a monopolist than for a Cournot case ; the latter index is above the perfect competitive margin. This expected positive perfect competitive margin is a return for the marginal risk of the perfect competitive firm.

Based on those findings, empirical research about the influence of the risk of the firm on some aspects of industrial organization is possible.

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