# FIRM SPECIFIC CAPITAL AND CORPORATE DIVERSIFICATION

by

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# CHAPTER I

# INTRODUCTION

> As it is the power of exchanging that gives occasion to the division of labor, so the extent of this division must always be limited by the extent of the market.[1]

Much of what Adam Smith said two centuries ago is still recognized to be of central importance in modern theoretical discussions. Many of his arguments, while they have gone through centuries of technical refinement, are still taken quite literally. The problem with this is that too literal, or perhaps more correctly too narrow, of an interpretation of a basic economic principle, can cause confusion when interpreting modern economic phenomenon. This has been the case for many economists when they have tried to explain the modern trend toward diversification.

As shown by Smith's statement above, it has long been recognized that growing markets should lead to ever increasing specialization. The basic rationale is that when a particular market is quite small the firms in that market may need to be vertically integrated since there is not enough of a market for specialized input suppliers to develop. Consequently, small markets in some sense lead to more diversification

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[1]Adam Smith, An Inquiry Into the Nature and Causes of the Wealth of Nations, New York: Random House, 1937, p. 17.

by firms. A simple extension of this principle is that diversification in some sense should be decreasing as markets grow. Actual experience though seems to cause problems for those who would like to apply this simple principle. Michael Gort, a pioneer in the study of diversification has observed:

> There has been so much discussion of diversification that the phenomenon seems perfectly natural and something to be taken for granted. But in fact it runs against a pervasive trend in our society toward greater specialization in most channels of economic life. The broader the market for a given product and the more complex the production process, the more specialized one would normally expect producers to be. And yet, notwithstanding the growth in markets and the increasing complexity of technology, the trend for companies seems to be toward greater diversification rather than toward specialization.[2]

The fact that diversification has been increasing is well documented. Michael Gort in a major study found that diversification was increasing, and he found the apparent link between research and diversification.[3] The importance of this study was that it outlined a methodology for the study of diversification, suggesting measures of diversification. Another detailed study of diversification has been provided by Charles Berry.[4] Berry's work is particularly interesting since he was the first to use a data base compiled by Fortune to

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[2]Michael Gort, "Diversification, Mergers, and Profits," in William Alberts and Joel Segall, eds., The Corporate Merger, Chicago: University of Chicago Press, 1966, 32.

[3]Michael Gort, Diversification and Integration in American Industry, Princeton: Princeton University Press, 1960.

[4]Charles Berry, Corporate Growth and Diversification, Princeton: Princeton University Press, 1975.

develop additional measures of diversification. He then addressed a number of questions regarding diversification and performance. For example he found the positive relationship between diversification and growth, and he found that diversification tended to decrease concentration.

The modern evidence on diversification certainly should not cause one to abandon the Smithian principle of specialization, it merely forces researchers to look more closely at the nature of the modern corporation. When this is done some logical hypotheses can be introduced to explain the propensity of firms to diversify. Among the many reasons which have been suggested five of the most often heard are the following.[5] First, that firms diversify in response to institutional constraints such as various tax incentives. Second, that firms diversify in order to achieve or extend monopoly power. Third, diversification is merely a means to growth, and growth in and of itself is desired by managers. Fourth, firms diversify in order to reduce the riskiness of the corporation. Fifth, firms diversify in order to generate a net economic gain.

When considering the possible tax incentive toward diversification it is useful to divide them into two general types of incentives. First there are general incentives for firms to diversify, and second there are particular incentives for firms to merge. The general tax

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[5]A more detailed version of this general test is provided by Peter O. Steiner, Mergers: Motives, Effects, Policies, Ann Arbor: University of Michigan Press, 1977, 30-1.

incentives toward diversification center first on the differential treatment of debt and equity capital, and second on the differential treatment of capital gains and dividend income. As Roger Sherman has demonstrated when a potentially profitable new endeavor exists, it may frequently be cheaper for an existing firm to enter, than for a new firm to form.[6] Simply stated, the reasons for this are that if debt were to be used to finance the new activity, it would frequently be the case that the existing corporation would be in the highest marginal tax bracket, hence they will have the greatest cost incentive to enter the new production process. Secondly, when examining a potentially profitable endeavor, firms realize that if they use income, which would have gone to stockholders as dividends, to enter the new profitable endeavor their firm will achieve a capital gain. This process is in the stockholders interest since capital gains are taxed at a lower rate than dividend income.[7] Along with these incentives additional incentives may exist for firms to merge. Among the most important of these is the provision for tax loss carryover.[8]

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[6]Roger Sherman, "How Tax Policy Induces Conglomerate Merger," National Tax Journal, Vol. 25 (December 1972), 521-30.

[7]There is of course a limit to this, since it does not help stockholders of firms enter and are unable to effectively manage the new endeavor, thus causing losses or very small gains. This problem is discussed in Dennis Muellar, "A Life Cycle Theory of the Firm," The Journal of Industrial Economics, Vol. 20 (July 1972), 199-219.

[8]For a full discussion see Peter O. Steiner, Mergers: Motives, Effects, Policies, Chapter 4.

The second frequently argued rationale for diversification is that it allows firms to create or extend monopoly power. One of the arguments which has been suggested was that diversification allows a firm to construct barriers to entry by eliminating the flow of information on profitability to potential entrants.[9] In addition it has been argued that cross subsidization is facilitated by diversification, which in turn allows the firm to engage in anticompetitive activities such as predatory pricing and exclusive dealings. Finally, it has been argued that diversification leads to increased macroconcentration, which facilitates increased payoffs from lobbying efforts.[10]

The next motive for diversification is found in the motives of managers to have their firms grow. The growth motive has been the subject of a considerable amount of discussion. For example one can turn to the work of Robin Marris[11] and Edith Penrose.[12] It will certainly not be denied here that managers may well have incentives which are not strictly alligned with the best interests of their stockholders.

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[9]This argument is made by Stephen Rhoades, "The Effect of Diversification on Industry Profit Performance in 241 Manufacturing Industries: 1963," Review of Economics and Statistics, Vol. 55 (May 1973), 146-54.

[10]An interesting refutation of many of these points is provided by James H. Lorie and Paul Halpern, "Conglomerates: The Rhetoric and the Evidence," Journal of Law and Economics, Vol. 13 (April 1970), 149-67. A more detailed discussion of anticompetitive effects is also presented in Chapter 3.

[11]Robin Marris, The Economic Theory of 'Managerial' Capitalism, New York: The Free Press, 1964.

[12]Edith T. Penrose, The Theory of the Growth of the Firm, New York: John Wiley and Sons, Inc., 1959.

An underlying assumption of this work though, is that managers are constrained by their reward structure to not completely abandon their stockholders. Basically this work accepts the findings of Lewellan and Huntsman,[13] which show that managerial rewards are tied to the basic profit performance of the firm.

Managerial incentives do need to be considered in a study on diversification, since it is the managers who make the diversification decisions. In examining their role it seems more appropriate to see them as entrepreneurs, acting within the environment of a firm, rather than salaried employees. To demonstrate this, consider the meaning of entrepreneurship as stated by Israel Kirzner,

> The key point is that pure entrepreneurship is exercised only in the absence of an initially owned asset. Other market roles invariably involve the search for the best exchange opportunities for translating an initially owned asset into something more eagerly desired.[14]

Assume top managers have their total rewards tied to the performance of the firm as suggested by Lewellan and Huntsman. When they make a diversification decision which leads to a net economic gain then they as well as the stockholders benefit. In generating this benefit they have moved capital, which they did not own, from one place in the corporation to another. The result of their move, if it was a wise one,

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[13]Wilber G. Lewellan and Blaine Huntsman, "Managerial Pay and Corporate Performance," American Economic Review (September 1970), 710-21.

[14]Israel Kirzner, Competition and Entrepreneurship, Chicago: The University of Chicago Press, 1973, 16.

will be to produce a gain, which they will at least in part be able to claim. Hence, they are acting as true entrepreneurs.

The extent of the claim which management is able to make will depend on various market forces. As mentioned earlier it does seem clear that managers will have some incentives which are at odds with stockholders.[15] What one needs to ask though is when managers will have the most freedom to follow these "less desirable" ends. The answer is that they will be able to claim extra rewards when their apparent performance is at least as good as the firm owners or potential owners expect. For example assume the owners of a particular firm required a rule of return on equity of 7 percent. Now suppose earnings are the equivalent of 9 percent. Managers might then claim 1 percent of this return in various perquisities and then return 8 percent to the firm's owners. Thus causing no internal incentives to displace the management, since all parties are gaining. Over time there will, of course, be room for new enterpreneurs to attempt to displace this management.[16] The bottom line here is that managers will be able to gain the most when they pursue policies which are in the interest of their company.

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[15] A number of studies have attempted to assess merger as being in stockholders or managers interest, but the findings are mixed. See, for example, Samuel R. Reid, Mergers, Managers and the Economy, New York: McGraw Hill, 1968.

[16] This point is similar to one made by Henry Manne with regards to horizontal mergers. He argued that other firms similar to one in question would be likely to see when there were potential gains for takeover, and they would eventually take control of these firms whose managements were not performing as well as possible. See Henry Manne, "Mergers and the Market for Corporate Control," Journal of Political Economy, Vol. 73 (April 1965), 110-20.

With respect to diversification policy this means that they will be able to gain the most when they pursue diversifications which produce a net economic gain.

This leads to the question of how diversifications could lead to economic gain. One basic way was discussed by Michael Gort.[17] He argued that merger might be viewed like any other transaction of income earning assets. The reason for the trade is that the buyer and seller have different expectations of the future profitability of the asset. If the managers of the acquiring company are correct, then they can produce a net economic gain. Normally though one would expect the managers of the acquiring firm to initiate some action after takeover which then leads to the higher profitability. They may displace the current inefficient management, or they may be able to transfer resources via internal markets which cannot be as easily transferred through external ones.

This last point is of particular interest, since it will form the core of this research. The goal of this study is to extend the arguments and tests which relate to the efficiency of internal markets. Throughout this study it will be argued that many firms have the ability to generate a type of capital as a joint product, which they are unable to sell via external markets.

The important arguments on the role of internal markets are not new. Edith Penrose first suggested the idea in her pioneering

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[17]Michael Gort, "An Economic Disturbance Theory of Mergers," The Quarterly Journal of Economics, Vol. 83 (November 1967), 624-42.

work.[18] Her arguments with respect to diversification were taken up and refined by Paul Rubin.[19] Rubin's model allowed a firm to simultaneously use the resources which it possessed to produce output and more resources. These additional new resources could then be applied to new production activities in the firm. Sherwin Rosen introduced an important variant of this approach.[20] In his model he suggested learning might be generated as a joint product in production. While he was not particularly interested in diversification it seems his work can be readily extended along those lines.

Finally, it should be noted that the work of Oliver Williamson and David Teece also recognized the importance of internal markets.[21] In addition they have gone on to argue that the potential efficiency of the internal market will depend upon the managerial structure of the corporation. This point was also expounded by Richard Rumelt.[22] His

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[18]Edith Penrose, The Theory of the Growth of the Firm.

[19]Paul H. Rubin, "A Theoretical Model of the Diversification Decision in Firms," Unpublished Ph.D. dissertation, Purdue University, 1971, and Paul H. Rubin, "The Expansion of Firms," Journal of Political Economy, Vol. 81 (July-August 1973), 936-49.

[20]Sherwin Rosen, "Learning by Doing as a Joint Product," The Quarterly Journal of Economics, Vol. 85 (August 1972), 366-82.

[21]Oliver Williamson, Markets and Hierarchies, Analysis and Antitrust Implications, New York: The Free Press, 1975 and David Teece, "Horizontal Integration in the Energy Industries: A Markets and Hierarchies Analysis," Mimeo, 1977.

[22]Richard Rumelt, Strategy, Structure, and Economic Performance, Cambridge, Mass.: Harvard University Press, 1974.

work emphasized the importance of noting both the strategy (style of diversification) and the structure of corporations. Much of his discussion is highly compatible with the earlier work cited above.

A last argument for diversification is that it may lead to a risk reduction for firms. The problem with this argument was first discussed by William Alberts,[23] and later by Haim Levy and Marshall Sarnat.[24] The problem is that in the absence of synergy, the stockholders will in fact gain nothing by a diversification which merely tries to reduce risk. The reason is that the stockholders would have been able to diversify away all unsystematic risk in their portfolios, leaving only systematic risk, and the diversification by a firm would not alter this systematic risk.[25] This is not to say that managers may not want to lower the risk of this corporation, and when given the opportunity they may do so.

It is the contention of this research that risk, performance and managerial motivations need to be considered together. The reason once again is that managers, who make the decisions for the corporation, will want to pursue various of their personal ends through the corporation. One of the things which management may be concerned with is the

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[23]William Alberts, "The Profitability of Growth by Merger," in W. Alberts and J. Segall, eds., The Corporate Merger, Chicago: The University of Chicago Press, 1966.

[24]Haim Levy and Marshall Sarnat, "Diversification, Portfolio Analysis and the Uneasy Case for Conglomerate Mergers," Journal of Finance (September 1970), 793-802.

[25]A discussion of risk is provided in Chapter VI.

riskiness of their corporation. The reason of course is that a large portion of their personal portfolio of total wealth is bound to the corporation. Other investors may not be as concerned with the total risk of the corporation, since the may be more able to diversify their portfolios than the management can. Consequently management, when it is considering a diversification, may have a preference for a certain diversification, over which other investors in a Levy-Sarnat world would be indifferent. But again management will be more able to pursue their own ends when they are also producing economic gains for their stockholders. To the extent that risk reduction is an end of management, it should be more prevalent where management is performing the best for all stockholders.

The remainder of this work will attempt to examine various aspects of the diversification question. First, Chapter II outlines a theory of firm specific capital, since that is seen as a major motive in diversification. In Chapter III, the potential relationships between diversification and monopoly power are reviewed, and some new results regarding the monopolization of related models are derived. Then, Chapter IV provides an industry level empirical examination of the model of firm specific capital and it also provides as test of the structuralist model of monopoly power and diversification. Chapter V begins the movement toward developing a firm level test between diversification and performance. In that chapter the problem of measuring a firm's diversification is examined, and some findings regarding the relative merits of various diversification indices are presented. Then in Chapter VI a

measure of risk is developed drawing on the Capital Asset Pricing Model. Finally in Chapter VII the relationship between diversification and risk is examined. Chapter VIII provides a review of the findings and offers some suggestions for future research.

This study is an effort to link the previous diversification studies of Berry and Rumelt, in that it will attempt to incorporate both measures of the extent of diversification and its diversification. Its first empirical study will extend the methodology of Rhoades to provide an industry level test of the theory of firm specific capital. It then proceeds to develop an examination of diversification at the level of the firm which will attempt to add continuous measures of diversification to refine previous performance studies such as those of Weston, Smith and Shrieves.[26]

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[26] J.F. Weston, K.V. Smith, and R.E. Shrieves, "Conglomerate Performance Using the Capital Asset Pricing Model," Review of Economics and Statistics, Vol. 54 (November 1972), 357-63 and K.V. Smith and J.F. Weston, "Further Evaluation of Conglomerates Performance," Journal of Business Research, Vol. 5 (March 1977), 5-14.

# CHAPTER II

## DIVERSIFICATION AND FIRM SPECIFIC CAPITAL

Each time a major corporation diversifies, interest in diversification is renewed. Has the firm diversified in order to create or extend monopoly power, or was the diversification an attempt to increase efficiency? Could the diversification be causing financial economies for the firm, or would the diversification be a means of exploiting production economies? The purpose of this chapter is to synthesize some of the existing theoretical discussions of diversification. In doing this it is hoped that various potential explanations for synergy will be identified. Once this has been done the relationship between diversification and the firms risk will be examined.

In the discussion which follows certain terms will be used frequently. Consequently it seems appropriate to provide some clarifying definitions. First of all a product line is defined as one particular production activity associated with one particular market demand, and a single product firm is one with only one product line. Under this general definition a firm, which is currently selling in one geographical market, can diversify by moving into another distinct geographical market. A diversified firm is one with more than one product line, and the extent of its diversification depends on the number of product lines and the extent of activity in each of these lines. Diversification can be achieved by adding production activities, by adding

markets, or both. In general diversifications may be vertical, product extension (horizontal), market extension, conglomerate. Vertical diversifications occur when a firm chooses to develop a new production activity, which enables it to either produce an input for itself or further process its current output. Product extension diversifications occur when a firm moves into a line of business which is related in production or distribution. In current policy debates the term horizontal diversification has been used to refer to a particular product extension where products were "potential" competitors. For example, in the case of energy a petroleum company's move into coal has been considered a horizontal diversification. A firm can also diversify by putting its production skills to work serving a second geographical market. Many would not consider this a diversification, but on reflection one realizes that the cross elasticity between the markets could be zero, and that changes in the two demands need not be highly correlated. Because of this market extension does need to be considered a type of diversification. The last form of diversification is conglomerate extension, which occurs when a firm moves into a new product line which is not related to any of its current activities. Since this study will attempt to examine production relationships, purely conglomerate diversifications will not be of particular interest.

When firms diversify in a non-conglomerate manner they are presumably drawing upon special skills and knowledge which they possess. If an external market does not exist for that special skill, then it

will be called firm specific capital. Firm specific capital may be either product specific, or applicable to a wide range of seemingly unrelated production activities. Models of firm specific capital (FSC) have developed along one of two general lines of thought. Some discussions of FSC tended to associate it with a particular input. It followed then that FSC was the discounted difference between the value of the marginal product of the input in its present occupation, and the value of its marginal product, less transfer costs, in its next best employment option. This can be written as

$$FSC_j = \sum_{t=0}^{T} [VMP_{jt} - (VMP_{it} - C_{it})] \, (1/(1+r)^t)$$

where T represents the remaining periods of potential employment, VMP is the value of the marginal product in the current (j) firm and in some new (i) firm, $C_i$ is the cost of transferring the input, and r is the interest rate.[1] Since FSC might be due to the way a collection of inputs is organized in a firm, this definition seems to be too narrow. A second approach is to think of the entire amount of firm specific capital as the difference between the market value of the firm and the market value of its physical capital. The portion of this difference due to any particular skill is the amount of FSC associated with that skill.

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[1]This definition has been employed by Donald O. Parsons, "Specific Human Capital: An Application to Quit Rates and Layoff Rates," Journal of Political Economy, Vol. 80 (November 1972), 1120-43.

One of the earliest discussions of firm specific capital was provided by Adam Smith in his famous discussion of the pin factory.[2] When he suggested that as workers specialized output increased, he might just as well have said that the worker produced a project specific capital as he specialized in an activity. The generation of this capital caused the production function to shift outward and the cost function to shift downward. In terms of the first definition provided above, the specialized input's marginal product is higher in its specialized task than it would be in any other.

A second view of the development of firm specific capital follows from the interpretation of the firm suggested by Alchian and Demsetz.[3] They noted that the contribution of any input to the production process depends upon the inputs ability to combine with others in the production process. The extent of this interaction is not directly observable by agents outside of the firm. Consequently if an input wished to move from one firm to another, the information costs associated with transmitting the marginal productivity information would be high. In terms of the first definition of FSC this represents a higher transfer cost for the input, and hence more FSC.

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[2]Adam Smith, An Inquiry Into the Nature and Causes of the Wealth of Nations, Book I, Chapter I, New York: Random House, 1937.

[3]Armen Alchian and Harold Demsetz, "Production, Information Costs and Economic Organization," American Economic Review, Vol. 62 (December 1972), 777-95.

The Alchian and Demsetz model also helps to explain firm specific capital in a more general way. In any modern firm teams of inputs interact with other teams, making the value of the marginal product of the team difficult to determine. For example, consider the interaction between research and development engineers and production management. In some firm the interactions between these two groups may lead to the successful development and sale of new products. It would be difficult though for the external market to assess the value of the research team in isolation. This would make it difficult for the firm to market the services of that team, for external markets would not be willing to meet the opportunity cost of the team's time. Recognizing this any firm which found that it could bid high enough to acquire the services of another firm's team would be skeptical about the value of that team's services (i.e. how could it afford to meet the team's internal opportunity cost?). Because of this problem one would expect firms with FSC to attempt to exploit it via internal markets.

Firm Specific Capital and Market Extension

As suggested above, firm specific capital may be applicable to the production of many outputs, or it may only be usable in the production of one particular output. If the FSC is only an input into one production process, then it will not provide the firm with the incentive to diversify into different physical product lines. One might expect a firm in this situation to exploit its FSC through growth within its market or to attempt a market extension. This second option is a form of diversification by the broad definition provided earlier. A closer

look at this process will yield some insights which will aid in the more general discussion of diversification.

First consider the generation FSC within the firm. It is a type of commodity, and consequently the firm must be either endowed with it, or it must product it in some way. If it is a type of endowment, then the method of its allocation follows the standard short run cost minimization problem for the firm. It is of course a short run problem since a particular factor is fixed. If, on the other hand, the FSC is produced internally, then the problem becomes more interesting. The FSC production can occur in one of two ways. First of all it could be the result of a planned investment program within the firm. This would occur if the firm effectively lowered current output (raising costs) by devoting resources to develop FSC. This FSC would then enable the firm to raise future output (lower future costs) for the firm. An implication of this approach is that the production of FSC is like the production of any other commodity. For example a firm might hire researchers so that in future periods their output would benefit the firm. A second approach is to consider the production of FSC as a joint product which is coupled with the marketable output of the firm. A common example here is that as the firm produces its managers become more skilled at handling any production problems which might arise. Their skills have been acquired because the firm was producing, yet they might enable the firm to lower its costs in the future.[4]

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[4]Both of these explanations can be found in Edith Penrose, The Theory of the Growth of the Firm, Oxford: Basil Blackwell, 1959. In

Production processes which allow costs to fall over time have been frequently discussed in the literature. The numerous discussions of progress functions provide obvious examples.[5] The notion of a progress function is that as a firm participates in a production activity to greater extent, the cost of subsequent production declines. The reason for the decline is due to the smaller quantity of variable input necessary to produce later output. To be more specific, progress functions imply that the marginal product of inputs in the current period is directly related to the cumulative input of all previous periods.

There are straightforward neoclassical explanations of progress functions. Walter Oi has shown that progress functions can be attributed to intertemporal factor substitutions, or the joint production of firm specific learning.[6] Sherwin Rosen further developed the learning as a joint product model and noted some of its implications for industry structure.[7] One important implication is that when firms generate product specific FSC as a joint product they will in general have

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addition the first form was explicitly discussed by Paul Rubin, "The Expansion of Firms," Journal of Political Economy, Vol. 81 (July-August 1973), 936-49, and the second by Sherwin Rosen, "Learning by Doing as a Joint Product," Quarterly Journal of Economics, Vol. 85 (August 1972), 366-82).

[5]For discussions one should see W.Z. Hirsch, "Firm Progress Ratios," Econometrica, Vol. 24 (April 1956), 136-43, and Armen Alchian, "Reliability of Progress Curves in Airframe Production," Econometrica, Vol. 31 (October 1963), 679-93.

[6]Walter Oi, "The Neoclassical Foundations of Progress Functions," Economic Journal, Vol. 77 (September 1967), 579-94.

[7]Sherwin Rosen, "Learning by Doing as a Joint Product," 378-80.

the incentive to grow over time. It has even been shown by Edward Prescott and Michael Visscher that the existence of product specific FSC can imply that firms will be growing at a rate which is independent of their absolute size, and dependent only on relative amounts of firm specific capital.[8] One will notice that viewed from the production side growth within a market or growth via market extension can be identical, when the firm specific capital can be transferred within the firm to the new market area. Hence a particular type of diversification can be explained by the existence of firm specific capital.

FSC and Wider Diversifications

One can easily visualize how the existence of firm specific capital could lead firm to diversify into products different from their primary one. To demonstrate this assume that the production function of a single product firm in period i is

$$f(X_i, K_i, T_i, T_{i+1}) = 0 \quad K_i = K_{1i} \text{ --- } K_{mi}$$
$$T_i = T_{1i} \text{ --- } T_{ni}$$

where X is the physical output of the firm, K is a vector of purchased inputs and T denotes firm specific capital units. It is assumed here that the firm specific capital units are produced as joint products, so that $\frac{\partial T_{i+1}}{\partial X_i} \geq$ and $\frac{\partial^2 T_{i+1}}{\partial X^2_i} < 0$. Similarly it is assumed that

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[8] Edward Prescott and Michael Visscher, "Organization Capital," Ohio State University Working Paper #41.

$\frac{\partial X_i}{\partial T_i} \geq 0$ and $\frac{\partial^2 X_i}{\partial T_i^2} < 0$, that is to say the currently held firm specific capital enters into the production of X as any normal input would. Notice that it might be the case that the marginal product of the firm specific capital variable could be driven to zero. In other words this model postulates that current production of firm specific capital depends upon the production of the physical output, and this capital can be employed to produce more physical output in the next period. (That is, more output for the same amount of purchased physical inputs.)

The general formulation given above is useful since from it one could capture features of the models of both Sherwin Rosen and Paul Rubin. It captures Rosen's arguments since the FSC is a joint product, and it captures Rubin's work in that the production of physical output and FSC are not in fixed proportions. Hence a firm in some period would choose to produce relatively more FSC and less physical output.

To demonstrate the input characteristics of the FSC, assume that all physical inputs to the firm are fixed, perhaps due to contractural arrangements. (Alternatively one could assume a production function for X which was separable between K and T.) Also, for simplicity, assume that there are only two types of firm specific capital $(T_1, T_2)$. In this case one can depict an isoquant map for this firm allowing only the FSC variables to change, examples of such isoquant maps are given in Figure 1. The mix of firm specific capital generated within firm A is depicted by point A. At point A, output level

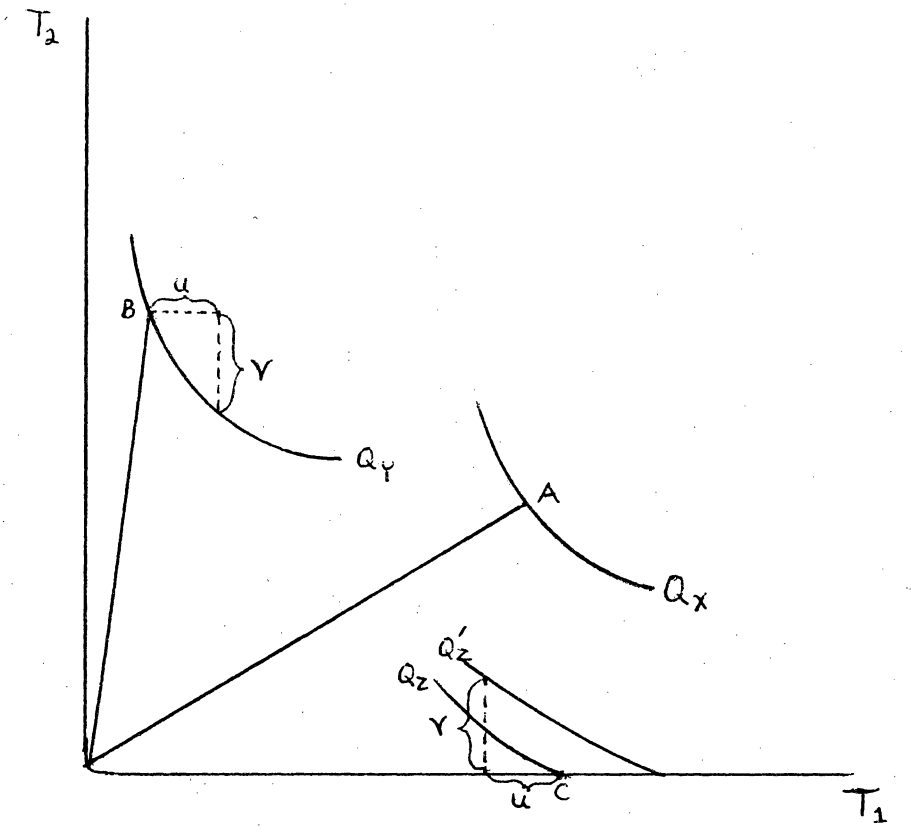


Figure 1
Gains to Diversification

Qx can be attained by the firm. If the firm could employ more of either $T_1$ and $T_2$, it could produce more of output X with the same amount of physical inputs. The length though of vector A (i.e., the amounts of $T_1$ and $T_2$ which the firm has), is dependant upon the production function of the firm.

Even if only two types of FSC exist, firms could be generating FSC at different rates and with different mixes. In addition to the firm which produces X, two other possibilities are depicted in Figure 1. Firm B is engaged in the production of Y. In its production process it generates $T_2$ more quickly than it generates $T_1$. On the other hand, firm C, which produces Z, generates only $T_1$. Notice that although firm C only generates $T_1$, the introduction of $T_2$ into the production process would yield a positive marginal product for $T_2$.[9]

With this simple example, it is clear how diversification can benefit the firm, given the existence of firm specific capital. Again, using the example of Figure 1, if firm B and firm C were to merge, both could gain with the interdivisional transfer of firm specific capital. If firm (division) C could transfer amount U of $T_1$ to firm B (division), it could receive amount V of $T_2$ in return. This transfer would allow the output of Z to increase.[10] Hence a gain from diversification.

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[9] If $T_2$ could not be used in a firm's production process, then the isoquant relating ($T_1$, $T_2$) would be vertical.

[10] This is a simple gains from trade model. Before diversification, trade was precluded by the nature of firm's specific capital.

Some other interesting observations can be made using this model. It may be the case that some forms of firm specific capital possess some qualities of publicness. That is, within the firm, it may be that additional utilization of the input occurs at a zero marginal cost. An example of this may be marketing information, or sales contacts. A firm which has developed extensive marketing expertise, or a network of sales contacts for its product, may be able to distribute a new related product at essentially a zero marginal selling cost. The reason for this is that the new product can draw upon the existing marketing information.

One can display graphically (Figure 2) the situation where one form of firm specific capital has a "public good" quality. Assume, as before that there are only two firm specific inputs, $T_1$ and $T_2$. Also, assume $T_2$ has the public good characteristic discussed above. Finally, assume two production activities can be found which generate and use both $T_1$ and $T_2$. The initial equilibrium in the markets is assumed to occur with $Q_x$, $Q_y$ levels of production. With this level of output, the amount of firm specific capital generated and used is represented by A, B. If a firm were to move into both activities (either through merger or de nova entry) the total amount of available firm specific capital for internal allocation would be (A + B). Since $T_2$ has a publicness characteristic, the total amount of $T_2$ in the firm is available to each division. In general then, one would expect that the same quantities of physical capital could produce higher quantities of output and this will be the case if $T_2$ does not currently have a zero marginal product in the production of X and Y.

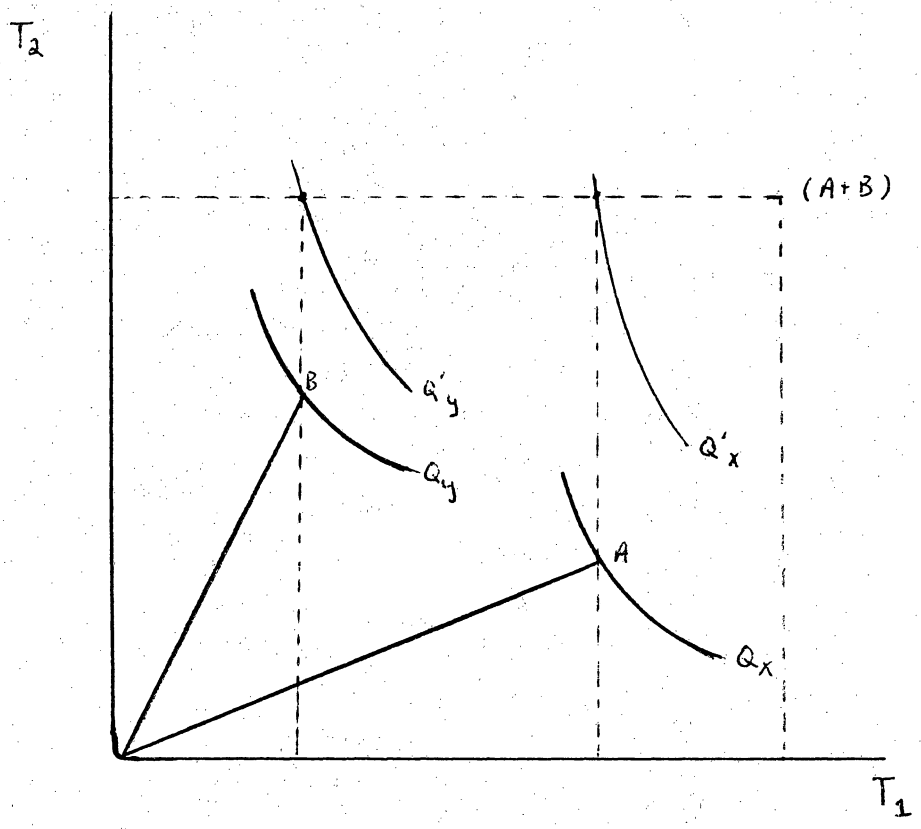


Figure 2
Additional Gains

To extend this model, one need only allow a larger number of firm specific capital units to exist. With a large number of such units, it is likely that some forms of FSC will have a zero marginal product in certain production processes. In this larger model, some diversification will be profitable, and some will not. In addition, for any firm preparing to undergo diversification, there may not be one unique profit maximizing diversification. Hence, the patterns of diversification for firms in an industry need not be identical. In fact, it seems clear that the path which a firm follows will to some extent depend upon its initial diversification choice.

Neoclassical Model of FSC

One can demonstrate some of the important features relating firm specific capital to diversification through the use of a simple, two-period model of the firm. Assume that a firm has a primary line of business $X_1$, and it is considering producing $X_2$. The firm realizes that in its production of $X_1$ it also produces firm specific capital $T^1$ which can subsequently be used to produce more of both $X_1^1$ and $X_2^1$ (the superscript "1" shows that production is one period in the future). It is assumed that the firm, by virtue of its initial managerial staff, has an endowment of FSC (labeled $T^0$) which can be assigned to either the production of $X_1^0$ or $X_2^0$, where $T_1^0$ is assigned to $X_1^0$ and $T_2^0$ is assigned to $X_2^0$ (here the superscript zero shows that the production is in the initial period). For simplicity, assume that $T^1$ is generated only by the production of $X_1^0$, and in particular it is generated at a fixed rate $\beta$.

To be more specific, let the production of physical output be given by

$$X_i^t = f_i(k_i^t, T_i^t) ,$$

where k represents an index of purchased inputs, the superscript t represents the time period (0, 1) and the subscript i is associated with the physical outputs (1, 2). The amount of firm specific capital in period zero is $T^0$ the endowment, and the amount in period one is given by

$$T^1 = T^0 + \beta X_1^0 .^{11}$$

The problem facing the firm is maximizing the present value of its profits, when it faces fixed prices for outputs ($P_1$, $P_2$), purchased inputs (r), and the interest rate i. The present value of profits is:

$$PV = P_1X_1^0 + P_2X_2^1 - r(k_1^0 + k_2^0) + [P_1X_1^1 + P_2X_2^1 - r(k_1^1 + k_2^1)]\delta \quad (1)$$

where $\delta$ is a shorthand for $1/(1 + i)$. The firm will maximize its present value subject to the following constraints:

$$T^0 - T_1^0 - T_2^0 \geq 0 \quad (2a)$$

$$T^0 + X_1^0 - T_1^1 - T_1^2 \geq 0 \quad (2b)$$

---

[11]The form of this production is like that given by Rosen. This specification only allows depreciation of T to be a linear function of $X_1^0$, hence $\beta$ is the net accumulation rate. Other depreciation rates could be introduced, but they are seen to be only an unnecessary complication at this point.

$$X_i^t - f_i(k_i^t, T_i^t) = 0 \qquad i = 1,2 \qquad t = 0,1 \tag{2c}$$

$$X_i^t \geq 0 \ . \tag{2d}$$

In performing the maximization, a new function k is written where constraints (2a) and (2b) will be associated with multiplier $\lambda_1$ and $\lambda_2$, and the constraints in (2c) will be associated with multipliers $\lambda_j$, $j = 3,\ldots,6$.

In solving this problem, the firm must choose levels for 12 variables:

$$V_k = X_1^t,\ X_2^t,\ T_1^t,\ T_2^t,\ k_1^t,\ k_2^t \qquad t = 0,1 \ .$$

The function to be maximized is:

$$k(V_k,\lambda) = PV + \lambda_1(T^0 - T_1^0 - T_2^0) + \lambda_2(T^0 + X_1^0 - T_1^1 - T_1^2) + \lambda[X_i^t - f(k_i^t, T_i^t)] \tag{3}$$

$$i = 3,\ldots,6 \ .$$

The maximization yields the following Kuhn-Tucker first order conditions:

$$P_i + \lambda_2\beta + \lambda_3 \leq 0 \tag{4}$$

$$P_2 + \lambda_4 \leq 0 \tag{5}$$

$$-\lambda_1 - \lambda_3(\partial f_2/\partial T_1^0) \leq 0 \tag{6}$$

$$-\lambda_1 - \lambda_4(\partial f_2/\partial T_2^0) \leq 0 \tag{7}$$

$$-r - \lambda_3(\partial f_1/\partial k_1^0) \leq 0 \tag{8}$$

$$-r - \lambda_4(\partial f_2/\partial k_2^0) \leq 0 \tag{9}$$

$$\delta P_1 + \lambda_5 \leq 0 \tag{10}$$

$$\delta P_2 + \lambda_6 \leq 0 \tag{11}$$

$$-\lambda_2 - \lambda_5(\partial f_1/\partial T_1^1) \leq 0 \tag{12}$$

$$-\lambda_2 - \lambda_6(\partial f_2/\partial T_2^1) \leq 0 \tag{13}$$

$$-\delta r - \lambda_5(\partial f_1/\partial k_1^1) \leq 0 \tag{14}$$

$$-\delta r - \lambda_6(\partial f_2/\partial k_2^1) \leq 0 \tag{15}$$

$$V_k(\partial k/\partial V_k) = 0 \tag{16}$$

$$(\partial k/\partial \lambda) \leq 0 \tag{17}$$

$$\lambda_j(\partial k/\partial \lambda_j) = 0 \tag{18}$$

$$X_i^t \geq 0,\ \lambda_j \geq 0\ . \tag{19}$$

If the firm is producing both commodities, and it is completely using its FSC (T), then the 12 conditions (4-15) will equal zero. When this is happening, one can very easily see how FSC is impacting the firm. Condition (4) is essentially the price equals marginal cost condition for the firm. The reason for this is that $\lambda_3$ is essentially the marginal cost of the firm. Notice that $\lambda_2\beta$ alters the standard form of the expression. To interpret the meaning of this fact, notice that $\lambda_2$ is the shadow price of FSC in the future period. From condition (12)

through condition (15), it is seen that the shadow price of future FSC is

$$\lambda_2 = [\delta r(\partial f_1/\partial T_1^1)/(\partial f_1/\partial k_{11})] = \delta r[\partial f_2/\partial T_2^1)/(\partial f_2/\partial k_2^1)] \ . \qquad (20)$$

This means that for FSC to have a zero shadow price, its marginal product in the future period must be zero. After substitution into condition (4), one obtains

$$P_1 = [r/(\partial f/\partial k_1^0)] - [\delta r(\partial f_2/\partial T_2^1)/((\partial f_2/\partial k_2^1)(\partial f_1/\partial k_1^0))] \ \beta \ . \qquad (21)$$

This result is depicted graphically in Figure 3. In the absence of FSC, the firm would produce $X_1^{0'}$, where price equaled marginal cost. With the introduction of valuable FSC generated as a joint product, firms increase their production to $X_1^{0''}$ . The difference between simple marginal cost and price ($\lambda_2\beta$) depends upon the rate of production of FSC ($\beta$) and upon the future productivity of FSC ($\lambda_2$).

One can use the conditions outlined above to examine the process of diversification. To external observers, the firm would be diversifying if in period zero it did not produce $X_2$, but in period one it did. This would mean that for $X_2^0$ from condition (5) one obtains:

$$P_2 + \lambda_4 < 0 \ ,$$

that is, the marginal cost was greater than the price. This would make $X_2^0$ equal to zero in condition (16). At the same time, for $X_2^1$ one can see from (11) that

$$P_2 + \lambda_6 = 0 \ ,$$

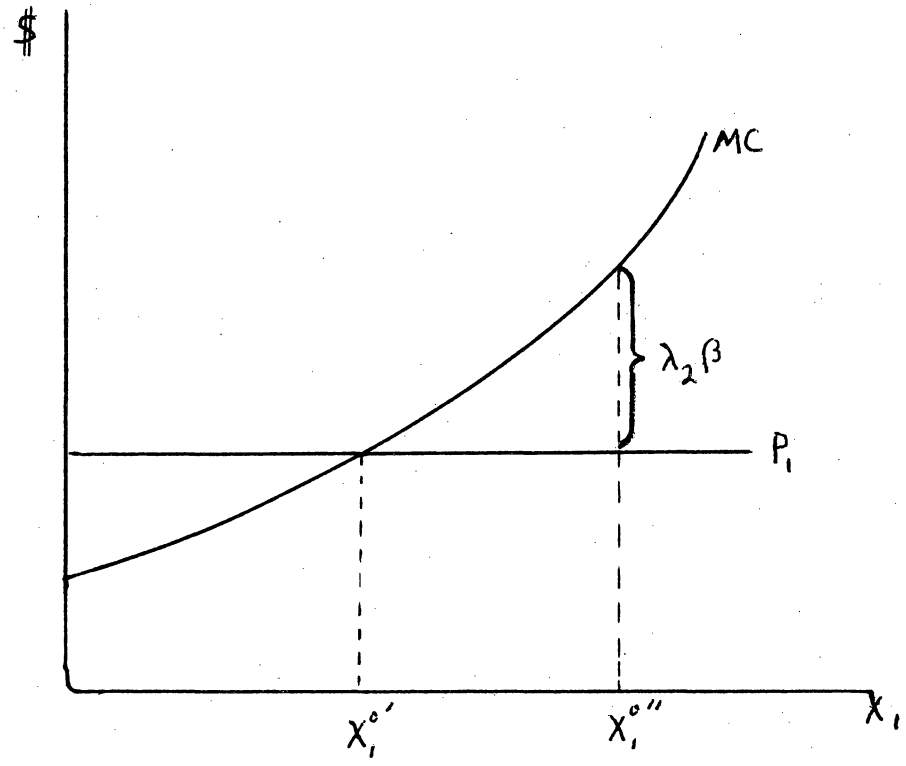


Figure 3
Output and FSC

making $X_2^1$ positive for condition (15). One can see from conditions (7) and (13) that production of $X_2$ could begin in period 1 if the marginal product of FSC was low enough, and that would occur if enough of it were produced in period zero. Hence, diversification has been linked to the production of firm specific capital.

Diversification and Risk

Risk may be introduced into the decision problem of the firm from variations in its demand, variations in cost, or both. To see how a diversification motivated by firm specific capital impacts the risk of the firm, one needs to picture what exactly FSC does to profits. Essentially, FSC allows the firm to produce at a lower cost than it could in the absence of FSC. This situation is depicted in Figure 4. There a marginal cost schedule in the absence of FSC is drawn. A single product firm producing with that cost function would find it maximized profits at point C, producing $X_c$. After the introduction of FSC, the cost schedule would shift down, allowing the profit maximizing manager to choose quantity $X_B$. The introduction of FSC would allow profits to rise by the amount of the area ABC.

When risk is introduced on the demand side, the price the competitive firm faces is no longer some given P, rather it becomes some random $\tilde{P}$, where it is assumed that the mean and variance are known. If capital markets are working, the firm will be able to determine a

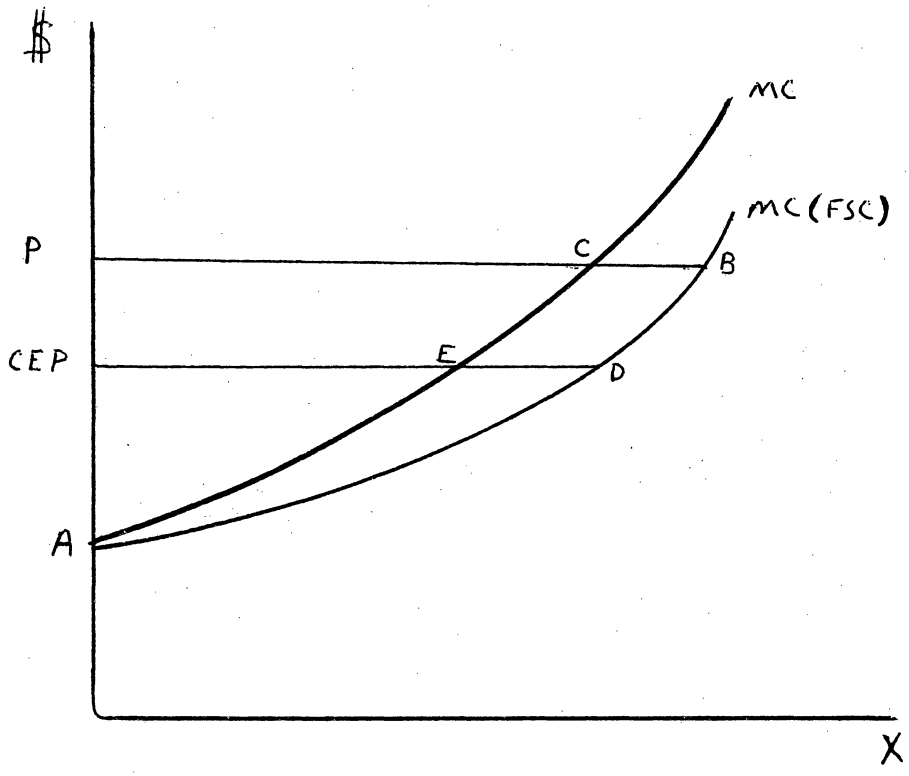


Figure 4
Demand Risk and Output

risk-adjusted price, which will be lower than the mean price.[12] This merely shifts down the price to the firm to a lower certainty equivalent price (CEP). In this case, diversification to exploit FSC would increase profits by an amount equal to the area ADE, but it would not lower risk.

Diversification can lead to lower risk though, when risk enters on the cost side. Assume, for example, that the firm is not certain of the price of the inputs which it will purchase, or it is uncertain about its ability to obtain a particular purchase input. In the absence of firm specific capital, if the worst happens (i.e., high input price, inability to obtain inputs), then the firm has no option but to suffer a loss of profits. If the firm has FSC, and if it is to some extent a substitute for other purchased inputs, then the firm has something it can do to temper its losses. For example, when purchased inputs are not available, then it may be able to substitute FSC for those inputs. It may still suffer a loss, but the loss will not be as great. Hence, it is possible for the generation of FSC, and its transfer via diversification, to alter the risk of the firm.

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[12]The certainty equivalent using the capital asset pricing model would be the mean price minus $\gamma$ cov(P,M) where $\gamma$ is the market price of risk which equals the excess of the market return over the risk-free return divided by the variance of the market, and cov(P,M) is the covariance of the market return and the price.

# CHAPTER III

## MONOPOLY POWER AND DIVERSIFICATION

The central argument of this work is that diversification by firms can, to an extent, be explained by their possession of some firm specific resources. As explained in the previous chapter, if types of firm specific inputs are generated as a joint product in a production process, the profit maximizing firm will seek diversification. In particular they will seek to diversify into an area which can use its firm specific input. There is a second, and very common, explanation for diversification which needs to be considered. This explanation is that firms grow and diversify in order to create or extend market power. An example of this thinking is provided by William G. Shepherd:

> Very broadly speaking, diversification in the United States is associated with concentration . . . . One may first look at the incidence of the very largest firms in markets. In 264 product classes out of a total of 296 in 1950, at least one of the 1000 largest firms was among the leading four producers . . . . In 1958 a majority (550) of all 1014 product classes had a branch of at least one of the 100 largest companies among its four leading firms. But less than one-tenth (86) of the product classes had one or more such branches among the next four firms and at the same time none in its top four. In 1963, the patterns were much the same. Therefore, one may fairly conclude that branching by these firms tends to reinforce market power, rather than to neutralize it.[1]

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[1] William G. Shepherd, Market Power and Economic Welfare, New York: Random House, 1970, pp. 140-41.

Since this philosophy toward diversification seems to be widely held by policymakers and economists, it is important for the completeness of this work to consider the potential for anticompetitive growth through diversification. In this chapter the existing arguments against various types of diversification will be briefly reviewed. The arguments and counterarguments against most types of growth are well defined. One type of diversification, that is, a product extension into a somewhat related market has not had a clear case presented against it. Consequently, the next portion of this chapter will be occupied with explaining the limited conditions under which "horizontal" diversification might be anticompetitive. The main contribution of this chapter is that it derives the conditions which facilitate anticompetitive diversification. Finally, the chapter will conclude with a few words about the relationship between market power and risk.

One of the most widely observed characteristics of firms has been their desire to grow. This growth of course may be either by internal expansion, or by merger. With a close examination one can classify any expansion into one of five categories.[2] The first possibility is for the firm to grow horizontally, which occurs when a firm expands its primary line within its market area. If the firm were to expand its primary line into new geographical markets, then a second type of growth, called market extension, would be occurring. A third

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[2]The categories listed here are taken from the FTC classification of mergers, which was reported in Federal Trade Commission, Bureau of Economics, "Statistical Report on Large Mergers in Manufacturing and Mining: 1948-1967" (1968).

possibility is for the firm to undergo a vertical expansion. Vertical integration as it has generally been called occurs when a firm begins to produce a product which is either an input to or a further processing of its primary product. A fourth type of growth available for the firm is through product extension. This occurs when a firm moves into the production of a good which does not directly compete with its primary line, but is functionally related, either in production or distribution to the firms primary product line.[3] A fifth and final growth possibility for the firm may be called a pure conglomerate expansion. This occurs when a firm begins to produce a product which is not related in any of the above mentioned ways to its primary line.[4]

The history of U.S. antitrust policies reflects a progression of attempts to close various channels of growth to firms. Horizontal mergers have long been outlawed.[5] The economic rationale behind the

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[3]A functional relationship between two commodities is said to exist if the production functions are similar, or if the distribution network is similar. For example, an electronic calculator and an electronic digital watch will have similar aspects in their production yet the two product markets will be quite different. A second type of functional relationship may exist in the distribution of commodities. Some products which may not be similar in their physical production may be marketed through the same network. An example of this might be automobile mufflers and shock absorbers.

[4]For a brief summary of the taxonomy presented by the FTC one should see Lawrence A. Goldberg, "The Effect of Conglomerate Mergers on Competition," Journal of Law and Economics, Vol. 16 (April 1973), 137-58.

[5]Legal action against firms undertaking horizontal mergers could take place under the Sherman Act or Section 7 of the Clayton Act and the Keller-Kefauver Amendment.

statutes which prohibit horizontal merger is based upon the welfare losses associated with monopolies.[6] In general, extensive horizontal expansion is considered harmful when it significantly increases the concentration in an industry. It is argued that with highest concentration the likelihood of collusion, either active or tacit, increases. Since the work of Joe Bain, the concentration-monopoly power hypothesis has gained widespread acceptance.[7]

Expansion via market extension, a type of growth closely related to horizontal expansion, is a type of geographical diversification. This type of activity has, in general, not been subject to policymakers attacks. The rationale here is that if a firm in one competitive market moves into a second geographically distinct competitive market, then there would be no addition to monopoly power in either market. In this situation the profit maximization processes for firms in each market are independent. In practice, however, it is frequently difficult

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[6]The welfare loss of monopolies is a very old and familiar argument. Essentially the argument is that the profit maximizing monopolist will restrict output and raise price. The result is a loss of consumer surplus equal to the area of the welfare loss triangle. Others have argued that due to rent seeking behavior the actual welfare loss will approach the area of the monopoly profit plus the welfare loss triangle. For a discussion of these points one should see Gordon Tullock, "The Welfare Cost of Tariffs, Monopolies, and Theft," Western Economic Journal, Vol. 5 (June 1967), 224-32 and Richard A. Posner, "The Social Costs of Monopoly and Regulation," Journal of Political Economy, Vol. 83 (August 1975), 807-27.

[7]It is argued by Joe S. Bain, Industrial Organization, second edition, New York: John Wiley and Sons, Inc., 1968, that a reasonable probability for collusion exists if the four firm concentration ratio is greater than 51 percent.

to delineate the actual market boundaries of a firm to determine whether a market extension or a horizontal extension has occurred.[8]

The third form of expansion, vertical diversification, has come under repeated attack throughout the years. The antipathy against vertical expansion can be traced as far as 1906, when the Hepburn Act faced a divestiture of coal mines from coal transporting railroads.[9] In recent years the debate over vertical expansion has itensified. It has been argued by some that vertical integration extends market power.[10] One notion has been that if a firm has some market power at one stage of production it can transmit its market power and hence its total monopoly profits to other stages of production. This argument has been forcefully refuted by Robert Bork who concluded:

> It is often asserted that vertical integration causes or permits a firm to behave differently than it would in the absence of integration. But it also seems clear that vertical integration, aside from the case in which it creates new efficiencies, does not affect a firms pricing and output policies. If, for example, a firm operates at both the manufacturing and retail levels, it maximizes overall profit by setting the

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[8]One can examine a sample of FTC cases to see the problems in determining appropriate markets. An overview of merger cases is provided in The Merger Case Digest 1971, American Bar Association.

[9]A historical examination of divestitures, some of which were directed against firms which had undergone vertical expansion, is presented in Mary Brazell, "Previous Cases of Forced Divestiture," Working paper, American Petroleum Institute, March 1977.

[10]The case against vertical integration has been stated by Corwin Edwards, "Vertical Integration and the Monopoly Problem," Journal of Marketing (1953), 404-10 and William S. Comanor, "Vertical Mergers, Market Power, and the Antitrust Laws," American Economic Review, Vol. 57 (May 1967), 254-65.

> output at each level as though the levels were independent. Where both levels are competitive, the firm maximizes by equating marginal cost and price at each level; each level makes the competitive return. Where the firm has a monopoly at the manufacturing level but is competitive in retailing, it will of course exact a monopoly profit at the first level
> . . . .
> The foregoing analysis demonstrates that a vertical acquisition can never create or increase a restriction of output.[11]

Although Bork's analysis was done with a fixed coefficient production model, similar results are reached by John S. McGee and Lowell R. Basset for a variable coefficient case.[12]

Beyond this attack on vertical diversification, others have argued that vertical integration facilitates various types of predatory behavior. Examples of these are cross subsidization, market foreclosure, and increased capital requirements. Cross subsidization refers to one division subsidizing the losses of other divisions in order to drive competitors out of business. Market foreclosure occurs when an integrated firm purchases the customers of a competing firm. Increased capital requirements are said to arise if a new entrant is forced to enter as an integrated firm in order to get inputs and

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[11] Robert H. Bork, "Vertical Integration and Competitive Processes," in J. Fred Weston and Sam Peltzman, ed., Public Policy Toward Mergers, Pacific Palisades, Calif.: Goodyear Publishing Co., 1969. This passage is cited in John S. McGee and Lowell R. Basset, "Vertical Integration Revisited," Journal of Law and Economics, Vol. 19 (April 1976), 20.

[12] John S. McGee and Lowell R. Basset, "Vertical Integration Revisited," 20.

markets. In general, the basic theory behind these arguments has been examined and refuted.[13]

Most recently the remaining types of extensions have come under attack. After the merger wave of the 1960's conglomerates were accused of causing a number of undesirable consequences.[14] Conglomerates are sometimes seen to be anticompetitive, since certain types of anticompetitive conduct such as predatory pricing, cross subsidization, and reciprocal buying are foretold. Apart from theoretical refutations, which can take a form similar to those on vertical diversification, it has been shown, even by the Federal Trade Commission, that there is no real evidence supporting these arguments.[15] A final contention is that conglomerate diversification and, for that matter, diversification in general, causes a barrier to entry by causing a loss of information on

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[13]The necessary conditions for profitable predatory vertical integration have been examined by Michael Canes, "A Theory of Predatory Vertical Integration," Working paper, American Petroleum Institute, 1976, and Robert Spann and Edward Erikson, "An Empirical Test of the Theory of Predatory Vertical Integration," Unpublished paper, 1977.

[14]It has been claimed that conglomerate expansion could cause unsound capital structures, be anticompetitive by facilitating reciprocal trading and increase the share of assets held by the largest firms. In addition to these and other claims, it also has been suggested that concentration in the entered industry would rise. For a refutation of some of these arguments one should see James N. Lorie and Paul Halpern, "Conglomerates: The Rhetoric and the Evidence," Journal of Law and Economics, Vol. 13 (April 1970), 149-67.

[15]H. Michael Mann, Stanley E. Boyle and Philip W. Jaynes, Staff Report to the Federal Trade Commission, Economic Report, Conglomerate Merger Performance, November 1972, pp. 3-5.

potentially profitable activity.[16] Once again, though, the extent and the importance of this argument is not clear.

More recently, criticism has been aimed at expansion by product extension. In particular, the attack has been aimed at large petroleum companies which have expanded into other energy fields. Some policymakers have argued that all energy sources are potential competitors; hence, it is inappropriate to allow oil companies to develop these sources. Those defending the petroleum industry have argued that the inherent similarity in production makes petroleum companies the most logical entrants into this market. This defense then is essentially equivalent to the argument linking the existence of firm specific capital to diversification.

It has been argued, for example, that the production of alternative energy sources (petroleum, coal, uranium, geothermal, etc.) are related. A simple example is that the pipeline technology developed in the petroleum industry is directly applicable to the hydraulic transportation of coal.[17] In addition, the distribution of the alternative energy forms may also be related. Hence, it appears that this is a classic example of product extension. The problem which appears to trouble policymakers is that growth by product extension appears to allow firms to enter areas which are potential competitors with their

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[16] Staff Report to the Federal Trade Commission, Conglomerate Merger Performance, Chapter 5.

[17] This and many other examples are given throughout the work of Jesse Markam, Anthony Hourihan, and Francis Sterling, Horizontal Divestitive and the Petroleum Industry, Cambridge, Mass.: Ballinger Publishing Co., 1977.

primary line. It seems that in their eyes, growth by product extension may become growth by horizontal expansion. Since a case has already been developed against horizontal expansion, it is believed that similar rationale can be applied to "horizontal product extension."

Since this type of diversification seems to be very compatible with the theory of firm specific capital and diversification, it seems important to very clearly understand how this type of diversification might be anticompetitive.[18] But unlike the case of vertical diversification, a theoretical argument against horizontal product extension has not been presented. In the next sections an attempt will be made to fill this gap by presenting a simple model of anticompetitive behavior generated by horizontal product extension (HPE). In addition to presenting the basic model, the conditions for successful anticompetitive behavior will be examined.[19] When this is done one will be able to test (as is done in the next chapter), the relationship between diversification and monopoly power.

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[18]For the example of the energy industries, a summary of the arguments is provided by David Teece, "Horizontal Integration in the Energy Industries: A Markets and Hierarchies Analysis," Mimeo, pp. 45-58.

[19]All firms would like to develop and/or extend their own monopoly power, but the nature of the market economy generally prohibits this. In this paper the conditions of the market which prohibit or allow anticompetitive HPE will be examined.

The Nature of Related Markets

Before explicitly examining the nature of HPE it seems appropriate to review the simple characteristics of the comparative statistics in related markets. Assume that in one sector of the economy there are two products (X, Y) which are substitutes for each other. That is, the cross elasticities between the two products are both positive.[20] Assume also that the cross elasticity of these two goods with respect to any other goods is not significantly different from zero. This means that one could write the demand equations for the two products as:

$$X = f(P_x, P_y) \tag{1}$$

$$Y = g(P_x, P_y) \tag{2}$$

where (X, Y) are the quantities demanded of these goods, and $(P_x, P_y)$ are the respective prices.

If both industries are competitive, then the equilibrium attained by them can be depicted by Figure 5 (A, B). Under the initial demand schedules $(D_x, D_y)$ and the initial supply schedules $(S_x, S_y)$ equilibrium are attained at the price quantity coordinates $(P_x, Q_x)$, $(P_y, Q_y)$. Since

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[20] The cross elasticity of product X with respect to product Y is defined as the percentage change in the quantity demanded of X due to a 1 percent change in the price of Y. Specific reference to elasticities is made since symmetry need not exist in the market. That is, the cross elasticity of X with respect to Y may be significantly different from the cross elasticity of Y with respect to X. For a discussion of this point with regards to the energy industry, one should see Scott E. Atkinson and Robert Halvorsen, "Interfuel Substitution in Steam Electric Power Generation," Journal of Political Economy, Vol. 84 (October 1976), 959-78.

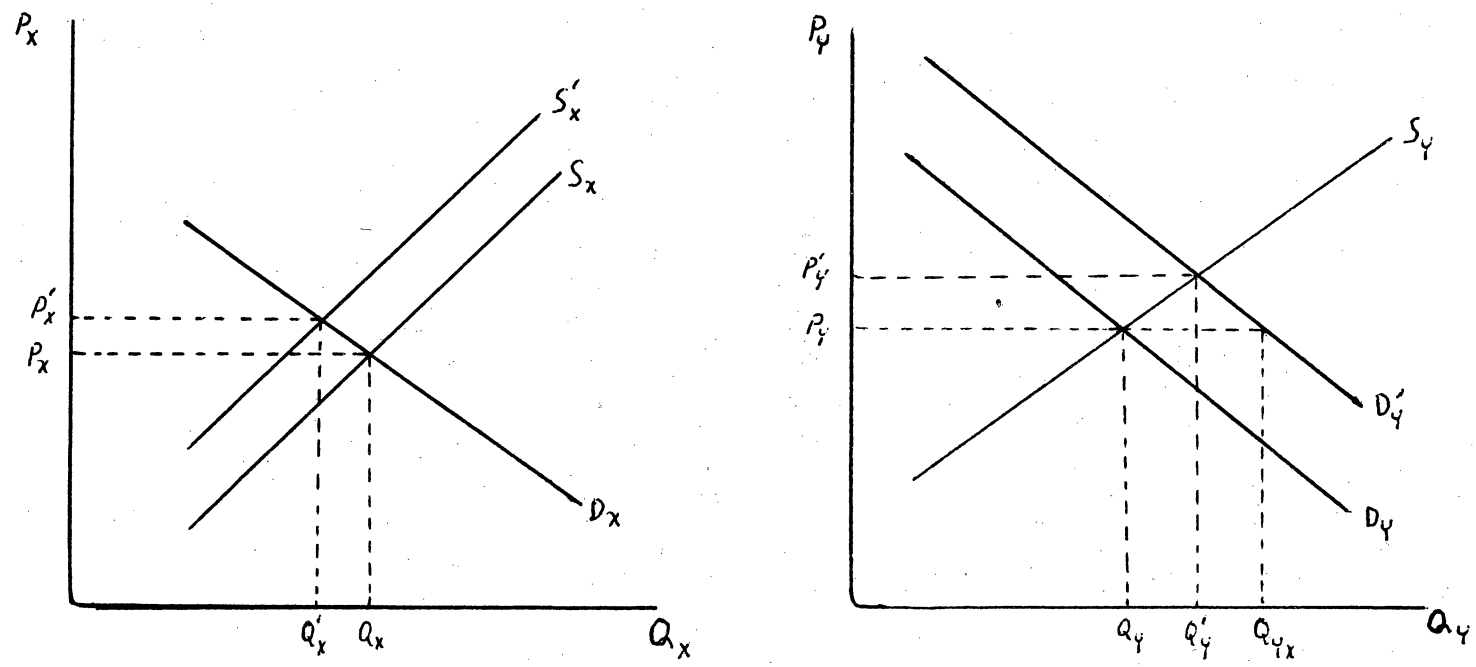


Figure 5
Related Markets

the industries are competitive each equilibrium is characterized by price equal to marginal cost.[21]

Now suppose that the cost of production of good X rises. This is depicted in Figure 5 by the upward shift of the supply schedule (from $S_x$ to $S_x^1$). In the resulting equilibrium the quantity clearing the market is reduced from $Q_x$ to $Q_x^1$, and the price in the market rises from $P_x$ to $P_x^1$. The total expenditure on commodity X will in general also change, but the direction of the change will depend upon the price elasticity of demand. If demand is inelastic over the relevant range an increase in price will increase total expenditure upon X, and if demand is elastic, then the higher price will cause a small total expenditure. Whichever elasticity condition prevails in the market for X, it is clear that a rise in the price of X will cause an increase in the total expenditure on the market for Y. This, of course, follows from the existence of positive cross elasticities. Since the goods are substitutes, an increase in the price of X will cause an outward shift in the demand for Y. The larger the cross elasticities between the two goods, the greater will be the horizontal distance $(Q_{yx} - Q_y)$ between the two demand curves.[22]

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[21] In the absence of pecuniary externalities, the industry supply schedule will equal the sum of the individual firm's marginal cost schedules.

[22] An interesting point here is that if the demand for X had been inelastic, then expenditures would rise both in the market for Y (the substitute for X) and for X. This means that the remaining real income devoted to all other activities falls. Hence, consumption in other markets must fall.

A similar situation occurs if instead of a rise in costs one allowed market X to be monopolized. After monopolization, the equilibrium quantity in market X will no longer be at that point where competitive supply equals demand, but rather at the quantity which equates the monopolists marginal revenue to its marginal cost. This will generally occur at some quantity less than the competitively supplied quantity and hence at a higher price. The resulting higher price will have the same impact in market Y as discussed above.

A Model of the Firm

At this point it is useful to present a simple model of a firm operating in one of the two related markets which have been discussed. The model presented below assumes that firms quantity adjust, and it assumes they take note of the relationship between their market and that of the related market. Finally, it employs the Cournot assumption that firms believe that their actions will not influence the behavior of other firms in the market.

Let X be the total amount of commodity X sold in the market. Also let $X_1$ and $X_2$ represent the amounts sold by firm one and all other firms respectively. In this market the demand function is given by

$$X = h(P_x, P_y).$$

The profits ($\pi_1$) for firm one, which are

$$\pi_1 = P_x[h(P_x,P_y) - X_2] - C(X_1)$$

or

$$\pi_1 = P_xX_1 - C(X_1)$$

where $C(X_1)$ represents the total costs to the firm, will be maximized where

$$P_x + X_1 \frac{dP_x}{dX_1} - C' = 0.$$

From the demand equation one knows that

$$\frac{dX_1}{dP_x} = \frac{\partial h}{\partial P_x} + \frac{\partial h}{\partial P_y} \frac{dP_y}{dP_x}.$$ [23]

Using this one can rewrite the profit maximizing condition

$$P_x + X_1/(\frac{\partial h}{\partial P_x} + \frac{\partial h}{\partial P_y} \frac{dP_y}{dP_x}) - C' = 0.$$

After multiplying the term in parenthesis by X/X, this can be rewritten simply as

$$P_x \left(1 + \frac{s}{\eta + \beta_{yx}\varepsilon_{xy}}\right) = C'$$

where

$$s = \frac{x_1}{X} = \text{the firm's market share}$$

$$n_x = \frac{\partial X}{\partial P_x} \cdot \frac{P_x}{X}$$

$$B_{yx} = \frac{dP_y}{dP_x} \cdot \frac{P_x}{P_y}$$

$$\varepsilon_{xy} = \frac{\partial x}{\partial P_y} \cdot \frac{P_y}{X}$$

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[23] This is true in a Cournot model since $\frac{\partial X}{\partial X_1} = 1$. For a more detailed discussion of models of this nature one should see George Stigler, "Notes on the Theory of Duopoly," Journal of Political Economy, Vol. 48 (August 1940), 521-41.

This is a simple restatement of the Cournot model allowing a clear depiction not only of market share but also of cross elasticity on the equilibrium of the firm. From this one can see that as the firm's market share approaches 0, the situation of a perfectly competitive market, then price approaches marginal cost. (The situation which was stated above.) If the firm is a monopolists and S equals one, then the expression is a straightforward representation of the firm's marginal revenue. Notice that if the cross elasticity is large then the monopolists' ability to charge a price above marginal cost diminishes. Similarly, if the cross elasticity is small (i.e., approaches zero) then the marginal revenue statement approaches the more familiar marginal revenue statement $P(1 + 1/n_x)$.[24]

Anticompetitive HPE

With this background, one can proceed to take a closer look at the nature of HPE. Once again assume that two related products exist as discussed above. Assume that barriers to entry exist in the market for one product. To depict the extreme case allow that industry to be monopolized by firm A. A narrow horizontal diversification would occur if a firm in either market moves into production in the other market. Clearly, if a firm or firms in market Y were able to overcome the

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[24]This can be demonstrated quite easily. Since in equilibrium marginal revenue equals marginal cost one can write

$MC = P_x(1 + \frac{1}{n_x + B_{tx}\varepsilon_{xy}})$. If $\varepsilon_{xy}$ rises, then MC approaches $P_x$, the competitive situation.

barrier to entry in market X they would do so in an effort to capture some of the monopoly profits. Diversification in this direction would decrease the concentration in market X, and make that market more competitive. This would be a desirable diversification. The second possibility is for the monopolist in market X to diversify into the production of Y. If after diversification the firm only has a small share of the market for Y, then by the model developed above the firm will have little impact upon the location of the equilibrium in market Y. But, if the firm can acquire a large share of the market, it can act in an anticompetitive manner, presumably as a price leader.[25]

This situation is depicted in Figure 6. Firm A is assumed to occupy one-half the market in such a way that the supply schedule of the remaining firms is identical to firm A's marginal cost schedule. The profit maximizing behavior for firm A is to compute a residual demand for Y. This is done by determining the quantity demanded of Y at each price once all other firms have supplied all that they choose. This residual demand curve is labeled $DD_y$ in Figure 6. Associated with this demand schedule is a marginal revenue schedule (labeled $MR_A$). Firm A profit maximizes by equating its marginal revenue to its marginal

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[25]The type of situation resembles the model suggested by the proponents of divestiture in the energy industries. They argue that the petroleum firms act as joint monopolists in the petroleum market, and that as they move into new energy fields they develop and exploit additional monopoly power. Since the other energy industries have a large portion of their output provided by firms outside the petroleum industry, then the appropriate model of anticompetitive behavior in those markets is that of price leadership. The key to this model is that there exists a competitive fringe of firms who act to maximize profits, but are not in the price leading cartel.

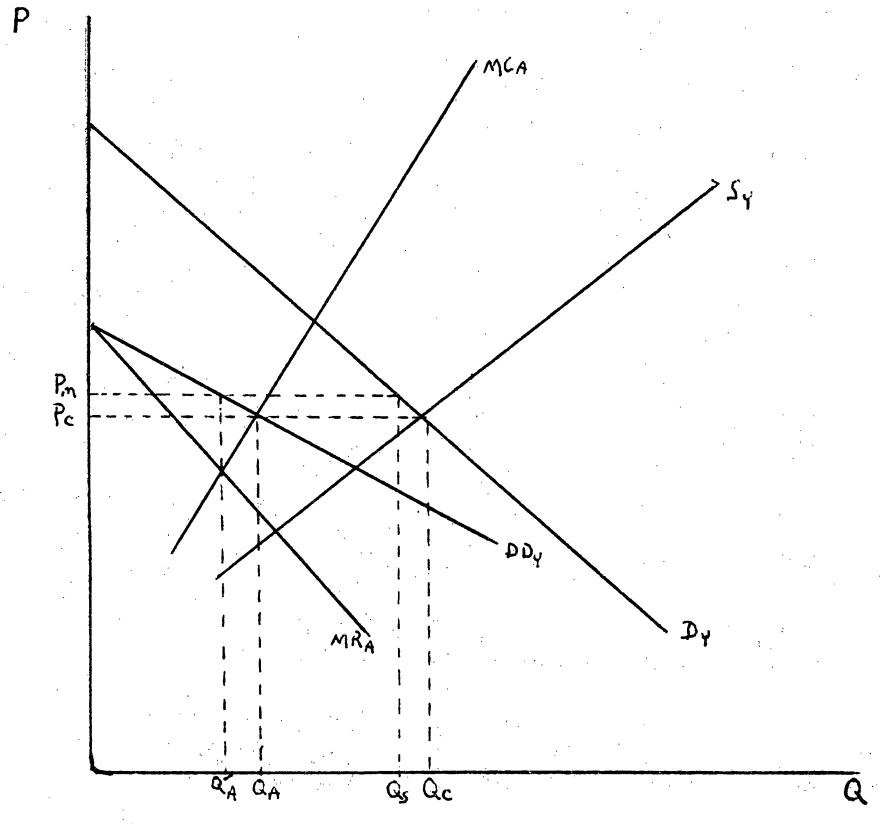


Figure 6
Price Leadership

costs. When this is done price $P_m$ is charged. At that price firm A produces quantity $Q_A'$, and the industry as a whole produces Qs. If firm A had not acted as a price leader, it would have produced $Q_A$ and the industry would have produced Qc. Notice the firm A's cut in output is greater than that made by the industry as a whole. This must be the case of the supply schedule for all remaining firms is positively sloped. In order for this equilibrium to remain over time, there must be barrier to entry in the market for Y.

The impact of firm A's dominance in the market for Y is that it gains higher profits in the production of Y, and it increases the demand for the monopolized product X. This means that the curtailment of output Y simultaneously causes the demand for product X to rise. The final equilibrium result is that more X and less Y will be produced if firm A can successfully "lead" market Y.

As yet the above argument has not provided arguments against HPE. All that has been demonstrated to this point is that a monopolization of a market causes output to decrease, and that this cutback will impact more than the immediate market.[26] It is important to note that the market power was not derived from the process of diversification. In general the ability of a firm to gain monopoly power acting as a price leader will depend directly upon the elasticity of demand in the

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[26]For an interesting discussion of the general equilibrium effects of monopoly, see Jack Stockfish, "Monopoly Theory, General Equilibrium, and Wealth," American Petroleum Institute, Working Paper, 1977.

market, and on the output elasticity of the firms in the competitive fringe.[27]

A potential harm which can be directly attributed to the HPE occurs when firm A begins to jointly maximize profits in both markets. HPE becomes harmful in and of itself only when the output in product market Y is curtailed to a level below that which is profit maximizing for a firm in market Y alone. Referring again to Figure 6, if firm A cut output below Q'A, in order to further increase the demand for product X, then a detrimental effect results.

To look more closely at the situation depicted by Figure 6, assume that the market demand for Y is:

$$Q_y = g(P_y, P_x)$$

where $Q_y$ is the total quantity demanded in market Y and $(P_y, P_x)$ are the prices of Y and its substitute X. If firm A decides to act as a price leader, he must know the supply schedule of the firms on the competitive fringe. Let this schedule for the competitive firms be

$$Q_f = h(P_y).$$

In this situation the residual demand for the price leader is,

$$Q_a = g(P_y, P_x) - h(P_y).$$

From this one can show that the elasticity of the residual demand curve for firm A is,

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[27]This is shown in Appendix 1.

$$\eta_a = \frac{Q_y}{Q_a}(\eta_y + B_{xy}\,\varepsilon_{yx}) - \frac{Q_f}{Q_A}\,\delta_f \qquad 28$$

where

$$\eta_a = \frac{dQ_A}{dP_y} \cdot \frac{P_y}{Q_A} \qquad \varepsilon_{yx} = \frac{\partial Q_y}{\partial P_x} \cdot \frac{P_x}{Q_y}$$

$$B_{xy} = \frac{dP_x}{dP_y} \cdot \frac{P_y}{P_x}$$

$$\eta_y = \frac{\partial Q_y}{\partial P_y} \cdot \frac{P_y}{Q_y} \qquad \delta_f = \frac{\partial Q_f}{\partial P_y} \cdot \frac{P_y}{Q_f} \cdot$$

Given this specification one can write the price leaders marginal revenue as

$$MR = P_y\left(1 + 1/\left[\frac{Q_y}{Q_A}(\eta_y + B_{xy}\varepsilon_{yx}) - \frac{Q_f}{Q_A}\,\delta_f\right]\right) . \qquad (4)$$

Notice that if the output of the competitive fringe is large relative to the output of the price leader, or if the output elasticity of the competitive fringe is large; then the price leaders ability to attain a solution different than the competitive solution diminishes. That is, price will approach marginal cost.

Now consider the situation of firm A attempting to maximize pro profits given his participation in two markets. His profits will be

$$\pi = P_x \cdot f(P_x,P_y) + P_y \cdot [g(P_y,P_x) - h(P_y)] - C(X) - C(Y) \qquad (5)$$

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[28] Discussions of similar models can be found in Thomas R. Saving, "Concentration Ratios and the Degree of Monopoly Power," International Economic Review, Vol. 11 (February 1970), 139-46, and also in George Stigler, "Notes on the Theory of Duopoly."

where the revenue arguments are the same as those discussed above and C(X), C(Y) are the total costs of production.

Consider what happens when the firm, acting as a price leader in market, plans to decrease output by one unit beyond the single market profit maximization level. In this case his total revenue will fall (since he is in the elastic portion of the residual demand curve) and his total profits in that market will also fall. The loss in total revenue will be approximately:

$$P_y \left[1 + 1/\frac{Q_y}{Q_A} (\eta_y + B_{xy}\varepsilon_{yx}) - \frac{Q_f}{Q_A} \delta_f)\right] \tag{6}$$

the marginal revenue in that market. He will be willing to move from the profit maximizing position in market Y if it causes an increase in his total profits due to the interaction with market X. That is, if the increase in total profits in market X, due to the higher price in Y, is greater than the lost profits in market Y, then the firm will cut back its output of Y. The increased total revenue in market X is:

$$\frac{\partial TR_x}{\partial P_y} = P_x \frac{\partial X}{\partial P_y} + X \frac{\partial P_x}{\partial X} \frac{\partial X}{\partial P_y}$$

or

$$= X \frac{P_x}{P_y} [\varepsilon_{xy} + \frac{\varepsilon_{xy}}{x}]. \tag{7}$$

From these equations it can be seen that the more elastic the supply schedule of all other firms in the market for Y (i.e., the greater $\delta_f$) the more difficult it is ceteris paribus for firms to curtail output

in that market. The more difficult it is to restrict output, the more difficult it is to raise the price. Also, the lower the cross elasticity ($\varepsilon_{xy}$) is ceteris paribus, the smaller is the potential increase in profits from the change in the price of Y. Alternatively if the ratio of $P_x/P_y$ is large, ceteris paribus, the greater is the potential increase in profitability.

The importance of the above factors can be easily visualized. First, consider the elasticity of the supply schedule for the competitive firms in market Y. This elasticity ($\delta_f$) directly impacts firm A's potential control over that market. If the elasticity were infinite (i.e., all other had constant costs) then firm A would not affect the quantity clearing the market in that industry. (A similar problem arises if there could be new entry into the industry.) If, on the other hand, all other firms had a perfectly inelastic supply (i.e., a vertical supply schedule), then any decrease in output by firm A would equal the decrease in output for the entire market. As the supply elasticity moves from zero toward infinity, the amount of restriction which firm A must undergo in order to decrease the market clearing output increases. Hence, the conclusion that the more elastic the supply schedule, the lower the likelihood of anticompetitive HPE occurring.

The importance of the cross elasticity is easily visualized. Assume that (X,Y) are defined in similar units, for example, BTUs if X and Y are petroleum and coal. The lower the cross elasticity of X with respect to Y the smaller are the potential profit increases in market X given a price change in market Y. One might add that the more

difficult it is to change the price in market Y (i.e., the more elastic it is) relative to any cross elasticity ($\varepsilon_{xy}$) then the less likely it is that profit can be transmitted from one market to another. These arguments are, of course, tempered by the third consideration, the bases on which the elasticities are calculated. This consideration appears in equation (7) in the price ratio ($P_x/P_y$). If the price of X is high relative to the price of Y, then ceteris paribus the easier it is to transmit profits from market Y to market X.

Using the arguments developed above, one can summarize the conditions necessary for anticompetitive HPE.

1. The ability to capture monopoly profits must be present in the market for the firm's primary product. In general, this entails barriers to entry, and rising costs if more than one firm exists in the market.[29]
2. The firm undergoing anticompetitive HPE must be able to attain a dominant firm position in the market for the secondary product. That is, it must be large or able to form a coalition amenable to the restriction of output beyond the profit maximizing point. (This requires either sidepayments or mutual interests.)

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[29]This chapter has only used the case where market X was monopolized. An oligopoly or dominant firm model could also hold in the market for X. If the latter is the case, then the peripheral firms cannot have constant costs. If they did they would expand output preventing the generation of monopoly rents. A similar situation would occur if new entry were allowed.

3. Barriers to entry and nonconstant costs must exist in the secondary market; otherwise, a dominant firm model cannot be built.

In addition to the above necessary conditions, it is desirable for the following conditions to hold:

4. The supply of "all other firms" in the secondary market is reasonably inelastic.
5. The cross elasticity of the primary to the secondary products is relatively high.
6. The basis upon which the elasticities are calculated (prices on quantities) are high in primary market relative to the secondary market.

With this background, one can proceed to examine whether anticompetitive HPE is likely in any industry.[30] More important, though, to the research here is to examine how the existence of monopoly power might affect risk.

Monopoly and Risk

To this point, various arguments and counter arguments have been presented, discussing how diversification might increase monopoly power. A test of this hypothesis will be conducted in the next chapter. Since a central goal of this research is to examine how

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[30] In this chapter, the diversifying firm was a single firm and not a diversifying cartel. The additional problems of a multiproduct cartel have been discussed by Donald Norman, "Diversification and Competition in the Energy Industry," delivered at the Southwestern Economics Association Meetings, 1977.

diversification might affect risk, it seems appropriate to conclude this chapter with a brief discussion of the relationship between monopoly power and risk.

In considering the riskiness of a particular production activity one is usually concerned with one of two things. First, one may be concerned with the variability of the particular return stream, and second, one may be concerned with the possibility of complete ruin (i.e., bankruptcy) associated with the particular activity. If diversification does lead to monopoly power, it is not clear as yet what will happen to the riskiness of the firm.

First of all, consider the relationship between monopoly power and bankruptcy. In a competitive industry, firms (at least those at the margin) are producing at a point where the long run average cost is at a minimum and price equals marginal cost. If market demand were to "shift" back or if costs were to rise, some firms would be driven out of the market during the process of adjustment to the new equilibrium. By definition, a monopolist will not be driven out of a market by this type of competitive pressure. The monopolist has a buffer over his required (competitive) return on capital, which is equal to his monopoly profits divided by his capital stock. This is not to say that a monopolist cannot be driven out of business. It is, of course, possible for costs to rise or demand to fall to such a level that the resulting profit maximizing price quantity combination still results in a loss. The point here is merely that a monopolist should face lower bankruptcy risk.

The second type of risk facing a firm deals with the variability of a firm's returns. This variability arises from the inherent randomness of costs and demand. This variability can be broken into two components: a portion which is correlated with the overall market return, and a portion which is purely random. A basic tenet of modern portfolio theory is that the purely random component of the return stream need not be considered since its effects can be eliminated through judicious portfolio management. This leaves, then, only the portion of the return stream which is correlated with the market to be considered.[31] How then does monopoly power affect the correlation of the firm's return stream and the market return? There is no unambiguous answer to this question. The existence of monopoly suggests that average returns should be higher, but it is not clear in general how the new series will be correlated with the market. The net effect then seems to be entirely an empirical question.[32]

## Conclusion

In this chapter the ways in which various types of diversification might cause monopoly power have been discussed. It was found necessary to generate a specific model of the conditions for anticompetitive

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[31] This will be discussed in greater detail in Chapter 6.

[32] Timothy G. Sullivan, "Cost of Capital and the Market Power of Firms," Review of Economics and Statistics, Vol. 40 (May 1978), 209-17, examines this relationship and finds that firms in concentrated industries tend to be somewhat less risky.

horizontal product extension, since unlike other types of diversification, no clear theoretical argument had been made here. With the background on how diversification might lead to monopoly power, the relation between monopoly power and risk was briefly discussed. In the next chapter a test will be presented of the diversification-monopoly power hypothesis. Given its findings one will be able to see if the impact of diversification through monopoly power to risk warrants additional examination.

# CHAPTER IV

## FIRM SPECIFIC CAPITAL AND DIVERSIFICATION A TEST

This chapter will attempt to operationalize the work of the previous pages and provide an empirical test of the relationships among firm specific capital, diversification and monopoly power. Chapter II examined the incentive to diversify as it might arise on the production side, and in Chapter III the potential of diversification to cause monopoly power was examined. As discussed in Chapter II, predecessors of the models of Firm Specific Capital can be found in the words of Edith Penrose, Sherwin Rosen, and Paul Rubin.[1] Although this theoretical work is particularly relevant to this research, neither they nor anyone else ever tried to directly test their hypotheses regarding diversification.[2] On the other hand, a number of

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[1]Edith Penrose, The Theory of the Growth of the Firm, New York: John Wiley & Sons, Inc., 1959; Sherwin Rosen, "Learning by Doing as a Joint Product," Quarterly Journal of Economics, Vol. 85 (August 1972), 366-82; and Paul Rubin, "The Expansion of Firms," Journal of Political Economy, Vol. 81 (July-August 1973), 936-49.

[2]It is true, though, that on occasion individuals examining diversification have implicitly relied upon explanations which were in fact quite similar to those of Penrose, Rosen, and Rubin (ibid.). Particularly good examples are provided by the work done on the petroleum industry by David Teece, "'Horizontal' Integration in the Energies: A Markets and Hierarchies Analysis," Mimeo, 1977 and Jesse Markham, Anthony Hourihan and Francis Sterling, Horizontal Divesture and the Petroleum Industry, Cambridge, Mass.: Ballinger Publishing Co., 1977.

individuals have attempted to examine the relationship between monopoly power and diversification. Examples of the mixed results are provided by the Federal Trade Commission in their report on conglomerate merger performance,[3] and by Charles Berry[4] and Stephen Rhoades.[5] Berry in his work with individual firms found some evidence that diversification was procompetitive since it often causes the market shares of existing firms to decline. In speaking of his findings, Berry states:

> Those results are consistent with the hypothesis that where concentration is high, the market position of leading firms tends to be protected from erosion through entry of small firms . . ., but not from entry by firms among the 461 largest . . . . 70 percent of the market share of entering large firms is acquired at the expense of the four leading firms.[6]

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[3]H. Michael Mann, Stanley E. Boyle, and Philip W. Jaynes, Staff Report to the Federal Trade Commission, Economic Report, Conglomerate Merger Performance: An Empirical Analysis of Nine Corporations, Washington: U.S. Government Printing Office, November 1972.

[4]Charles Berry, "Corporate Diversification and Market Structure," Bell Journal of Economics and Management Science, Vol. 5 (Spring 1974), 196-204, and in Corporate Growth and Diversification, Princeton: Princeton University Press, 1975.

[5]Stephen Rhoades, "The Effect of Diversification on Industry Profit Performance in 241 Manufacturing Industries 1963," Review of Economics and Statistics, Vol. 55 (May 1973), 146-54 and "A Further Evaluation of the Effect of Diversification on Industry Profit Performance," Review of Economics and Statistics, Vol. 56 (November 1974), 557-59.

[6]Charles Berry, "Corporate Diversifications and Market Structure," 1974, p. 202.

Stephen Rhoades, using industry data, finds some support for the hypothesis that diversification causes a barrier to entry. As he concludes:

> The results of the analysis provide tentative evidence of a relationship between diversification and industry price cost margins, thus supporting the general hypothesis the diversification may be viewed as a structural variable.[7]

In light of the mixed findings of the existing analyses, clearly more empirical work needs to be done.

The empirical work of this chapter will follow the methodology of Rhoades in that it will examine industrywide trends in diversification. Before a test can be performed, though, the model of firm specific capital will need to be operationalized. Therefore, the following sections will seek to first review and adapt the model of diversification presented in Chapter II, and then to present empirical tests of it and the monopoly power hypothesis using industry level data.

## Firm Specific Capital: A Synthesis

It was argued earlier that one of the inputs into a production process might be some form of firm specific capital.[8] In general, the amount of firm specific capital associated with an input is equal to the difference between the discounted sum of the value of the

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[7]Stephen Rhoades, "The Effect of Diversification on Industry Profit Performance . . .," 1973, 153.

[8]This is the argument presented in Chapter II.

input's marginal product in its present firm, and the greatest discounted value of marginal product, net of transfer cost, in alternative firms.[9] This capital may be generated as a joint product in the firm's production process.

One specification of a production process which reflects the above discussion is:

$$F(X,T,K) = 0 \qquad K = K_1 \ldots, K_m \tag{1}$$

where X is the physical output of the firm, T is an index of firm specific capital, and K is a vector of purchased inputs. As discussed above, T is generally a product which cannot be sold economically. But T is a valuable asset to the firm, and its value lies in its stability to shift the production function for X. To demonstrate this, assume that the following model is an explicit representation of the model in equation 1.

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[9]This definition is employed by Donald Parsons, "Specific Human Capital: An Application to Quit Rates and Layoff Rates," Journal of Political Economy, Vol. 80 (November 1972), 1120-43. Although his work dealt only with firm specific human capital, his definition applies to any firm specific input. The amount (in value units of firm specific capital associated with process j is:

$$FSC_j = \sum_{t=o}^{N} [VMP_{jt} - (VMP_{it} - C_{it})](1/1+r).$$

Where N is the remaining periods of potential employment, $C_i$ is the cost of transfer of the input from firm j to firm i, and r is the interest rate.

$$\text{Log}X_t = a_1 \log K_1 + \ldots + a_m \log K_m + a_{m+1} \log T_t$$

and

$$\Sigma a_i = 1; \frac{\partial X}{\partial T} > 0 \qquad (2a)$$

$$T_t = b_1 x_t + b_2 \bar{T}_t \qquad (2b)$$

$$\bar{T}_t = \bar{T}_{t-1} + T_t - D_{t-1} \qquad (2c)$$

or

$$\bar{T}_t = \sum_{i=1}^{t-1} T_i - \sum_{i=1}^{t-1} D_i \qquad (2d)$$

where $(a_1 \ldots, a_{m+1}: b_1, b_2)$ are technical coefficients

$\bar{T}$ is the stock of firm specific capital at time t,

$D_t$ is the depreciation of firm specific capital in time t.

In the model equation (2a) states that physical output in time period t ($X_t$) is a function of the purchased inputs and of the level of firm specific capital. Equation (2b) says that the production of firm specific capital in the time period t ($T_t$) is a function of the production of physical output in time period t, and the accumulated stock of firm specific capital ($\bar{T}_t$). In equation (2c) the stock of firm specific capital in time t is seen to be the stock which existed at the beginning of the previous period, plus any additions to the stock made in that period, minus the depreciation of the capital. This specification is expanded in (2d). No explicit assumptions are

made about the form of the depreciation function, although this is an important concern.[10]

Within this specification, a firm can accumulate firm specific capital at a rate where its marginal product to the firm approaches zero. This causes the internal price for the factor to fall, yet the value of the factor in activities outside the firm may be significantly high. Unfortunately for the firm, the capital which is firm specific cannot be readily transferred via the market to these higher value uses. When this occurs it will pay the firm to find new internal uses for its firm specific capital. One way for the firm to create new alternatives for investment of its FSC is for the firm to diversify.

One should note that at any point in time a firm might have a number of equally attractive options for the employments of its stock of FSC. Consequently, its initial choice among the options may be essentially random.[11] Hence, the pattern of diversification for firms in an industry need not be identical, since after the firm makes its initial diversification decision, the profitability of subsequent diversifications will depend in part upon the nature of the second

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[10]The production function in (2a) exhibits constant returns, that is if one doubles all inputs, including firm specific capital, then output will be doubled. Notice that if one were to estimate the production function of (2a) but neglected to include firm specific capital, the production function would appear to exhibit decreasing returns to scale.

[11]This point is dealt with explicitly in Paul Rubin, "A Theoretical Model of the Diversification Decision in Firms," Unpublished Ph.D. dissertation, Purdue University, 1971.

production function. So it seems that the diversification path which a firm follows will, to some extent, depend upon its initial diversification decisions.

To demonstrate this, one can consider the case of the petroleum industry's diversification into various energy related endeavors. Initially integrated petroleum firms possess research staffs and technical expertise. These research teams, necessary to the petroleum firms, have a demonstrated capability for applying their expertise to the development of other energy sources. As Markham, Hourihan and Sterling note:

> . . . In the course of our interviews R & D executives identified numerous areas in which oil companies have provided technical expertise to the coal industry and to the mining of oil shale and/or uranium . . . .
>
> Although most of the technology that has been transferred from one energy source to another has generally gone from the petroleum exploration, production, and refining, to coal, uranium, or synthetic fuel development, technology transfer has also gone in the opposite direction; for example, strip mining technology used in coal operations is being adapted for use in uranium and oil shale recovery.[12]

Although the petroleum firms may initially possess a type of firm specific research capital which affords them a capability to move into various other energy fields, their movement into those fields need not be identical. More importantly, once they have chosen a particular secondary field (for example, one firm may choose coal, another uranium, a third geothermal, etc.), their subsequent

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[12]Markham, Hourihan and Sterling (1977), op. cit., p. 77.

generation of firm specific research capital and hence their future diversification plans will differ.[13]

The model presented above has concentrated only upon the potential benefits associated with diversification. Before one leaps to grasp for any implications of this model, something must be said about the costs of diversification. One simple way to delineate the costs of diversification is to assume that associated with each diversification there is a fixed and a variable component. The fixed costs might include such things as legal services, licensing fees, etcetera. The variable component may be viewed as the cost of adopting a new production process into the corporate organization. This cost can be modeled as a positive function of the divergence of the new activity from the firm's primary line. This is merely to say that an activity which is very different from the firm's primary activity is more difficult for the managers to monitor and evaluate, hence the operating costs are likely to rise.

In order to proceed with a basic examination of diversification, it will be assumed that the variable costs of diversification are an inverse function of the amount of firm specific capital in the diversifying industry. A rationale for this is that if a firm recognizes that it can put its firm specific capital to use in some

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[13]A casual demonstration of this is exhibited by the diverse patterns of diversification in the petroleum industry. For an elaboration on the diversity in diversification one can see Donald Norman, "Diversification and Competition in the Energy Industry," Paper presented at the Western Economic Association Meetings, 1977.

second production process, then it must know something about that industry. For example, a research team which knows that its expertise can be used in a certain endeavor, must know something about that endeavor. Hence, the acquiring company should face less trouble and lower costs when moving into that area, as opposed to diversifying into an area which it knew less about.

Using this simplifying cost assumption, together with the model presented above, one can argue that firms which have an abundance of firm specific capital are more likely to diversify. An analogy is that firms undergoing diversification are like individuals trading. Through diversification they are able to trade a commodity internally which could not be traded externally in the market. Extending this analogy, one would expect to observe individuals with larger endowments trading more frequently than individuals with smaller endowments. Similarly, one would expect firms with more firm specific capital to diversify more than firms with less. This hypothesis can be tested if one can obtain a measure of diversification, and a measure for firm specific capital.

Using the models generated above, one can test the various hypotheses concerning the incentives to diversification. The first step is to create a measure of the extent of diversification. Since this study will be performed at the industry, rather than the

individual firm, level one needs a measure compatible with that level of aggregation. A useful approximation is

$$D_{it} = 1 - \frac{V_{it}}{T_{it}} \cdot 100$$

where $D_t$ is the diversification index for industry i at time t; $V_{it}$ is the value added in industry i by companies classified in industry i; $T_i$ is the total value added (in all industries) by those companies.[14] This measure is an industry aggregate version of a measure used by Gort (1963) in his study of diversification. The closer this measure is to zero, the more specialized is the average company in the industry. What this means is that companies who are classified as having their primary activity in industry i, generate very little value added in other industries.[15]

A second similar measure which can be constructed, is one which reflects the degree of penetration into an industry by firms from other industries. This measure is:

$$Pen_{it} = 1 - \frac{E_{it}}{W_{it}} \cdot 100$$

where $Pen_t$ is the penetration index for industry i at time t; $E_{it}$

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[14] Rhoades essentially used this measure, but instead of value added, he used employment. Since many capital-labor ratios are possible, it seems that the value added measure is appropriate, when it is possible to obtain it.

[15] Since the data used to determine diversification and penetration are provided by the census, the standard census definitions of company, establishment, and primary line are all used.

is the value added in industry i by establishments owned by companies in industry i; $W_{it}$ is the total value added in industry i by all establishments. The closer the index is to zero, the more firms classified in the industry control the output of that industry.

The data to generate these measures was taken from the Department of Commerce Enterprise Statistics 1967, and 1972. The industries are classified not by SIC codes but rather by "Enterprise Industry." Since this study required matching a number of data sources, many industries needed to be eliminated due to incomplete data.

The model developed earlier in this section stated that diversification is a function of firm specific capital. The task now is to delineate the components of firm specific capital. Three components which have been suggested are: research and development intensity, brand name and marketing expertise, and firm specific human capital.[16]

As suggested earlier, the stock of firm specific capital of any type, at any point in time, depends not only upon its rate of accumulation, but also upon the depreciation rate associated with it. It was beyond the scope of this study at this time to attempt to estimate the form of the depreciation function of FSC. Consequently, a very strong simplifying assumption was made. That assumption was that for the FSC associated with research and development and advertising, the stock of existing FSC is correlated with the expenditure to sales

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[16]The categories had been suggested by Donald Norman, "Diversification and Competition in the Energy Industry."

ratio. Data to calculate these ratios were obtained from the National Science Foundation, and the Internal Revenue Service, respectively.[17]

To determine the level of firm specific human capital in an industry, one can draw upon the work done by Lester Telser and Donald Parsons.[18] Their works were built upon the notion that firm specific human capital might be either firm financed or worker financed. A conclusion of their work was that layoff rates were related to the level of firm financed human capital while quit rates were related to the degree of worker financed human capital. Drawing on this finding, one can use average industry quit and layoff rates as instrumental variables serving for the unmeasurable firm specific human capital.

The other variables which are necessary to test the model are the rate of return, the capital to labor ratio, and the four firm concentration ratio. The rate of return was calculated using IRS' data.[19] The variable measures profits as a percentage of net work on

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[17]The National Science Foundation, "Research and Development in American Industry 1974," and the Internal Revenue Service, "Source Book for Corporate Income Statistics," were the sources used.

[18]Lester Telser, Competition, Collusion and Game Theory, Chicago: Aldine-Atherton, 1972 and Donald Parsons, "Specific Human Capital: An Application to Quit Rates and Layoff Rates."

[19]Internal Revenue Service, "Source Book for Corporate Income Statistics."

stockholders equity.[20] (Explicitly, it is defined as net income after taxes divided by the value of a firm's equity.) The capital to labor ratio was computed from census data.[21] This variable is necessary in testing the structuralist hypothesis, since it is often contended that capital intensity may cause a barrier to entry. It is also useful in examining penetration into an industry since capital intensity may be related to the ability to obtain financing. The Concentration Ratio is obtained from the Census of Manufacturers data and will be necessary in examining the structuralist model and the relationships among diversification, penetration and concentration.

Using these measures one can test the hypothesis that diversification and penetration are functions of firm specific capital. Essentially, the model can be stated

$$Div = B_0 + B_1RD + B_2AD + B_3Layoff + B_4Quit + B_5CR_4 \qquad (3a)$$

$$Pen = C_0 + C_1RD + C_2AD + C_3Layoff + C_4Quit + C_5CR_4 + C_6CL \qquad (3b)$$

where

Div is the diversification index for an industry in a given year

Pen is the penetration index

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[20]This measure is used since as Scherer puts it "Using profits as a percentage of net worth or stockholders' equity best satisfies the assumptions of economic theory, that firms maximize equity ownership returns, and that equity capital is allocated efficiently only when marginal returns (adjusted for risk differences) are equal in all industries." Fredrick Scherer, Industrial Market Structure and Economic Performance, Chicago: Rand McNally, 1970, 80.

[21]Census of Manufacturers, appropriate years.

Lay is the average annual layoff rate

Quit is the average annual quit rate

RD is the ratio of research and development to total sales

AD is the advertising to sales ratio

$CR_4$ is the four-firm concentration ratio

CL is the capital to labor ratio.

The first equation specifies the diversification model, and the second equation is to examine the penetration model. The model of firm specific capital suggests that the degree of firm specific capital be positively related to the level of diversification. This means that the coefficients on the research and advertising terms should be positive while those on the layoff and quit terms should be negative. This, in general, should be the case in both the diversification and penetration models. One should note though that there is a troublesome ambiguity which is possible with this test. The relationship between firm specific capital and diversification was developed with reference to a simple trade analogy. As with trade, one would expect to witness exchanges (i.e., diversification or penetration in the FSC model), when an economic agent has either an excess supply or an excess demand. The model as it has been discussed portrays the excess supply aspect of the trade, hence the posited positive relationship between FSC and diversification or penetration. If it were the case that firms diversified in order to fill deficiencies, then a negative relation between FSC and diversification could be

seen, but in this case the expected sign would show itself in the penetration equation.

The second goal of this research is to examine the relationship between diversification and concentration. To do this, the data just described will be used to run a standard structuralist paradigm model. In a structuralist model the profitability of an industry (rate of return) is a function of the firm's monopoly power, and the monopoly power is represented by concentration and barriers to entry.[22] The model is given by the equation

$$RI = D_0 + D_1 Div + D_2 Pen + D_3 AD + D_4 CR_4 \qquad (4)$$

where RI is the industry rate of return and the other variables are all as given above. If firms diversify in order to gain monopoly power, then the sign of diversification variable should be positive. If, on the other hand, diversification is a way in which existing firms bid away monopoly power in other industries, then the penetration coefficient should be negative. The concentration and advertising terms, which are generally in structuralist models, are posited to have a positive sign.

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[22] One can find discussions of the structuralist paradigm in the following works: Stanley E. Boyle, Industrial Organization, An Empirical Approach, New York: Holt Reinhart and Winston Inc., 1972 and F.M. Scherer, Industrial Market Structure and Economic Performance, Chicago: Rand McNally College Publishing Co., 1970.

Empirical Findings I: General Data Analysis

As discussed earlier, this study is run using a basic sample of 69 industries on the years 1963, 1967, and 1972. These were the years in which the census data on diversification was collected. In Table 1 the means and standard deviations for the diversification, penetration, and FSC variables are presented. From this table one can see the strong upward trend in diversification and penetration and research. In addition, one can see the downward trend in layoff rates and upward trend in quit rates. An interesting initial observation here is that while diversification and penetration do increase, their standard deviations are not greatly increasing, and in the case of penetration the standard deviation declines. This suggests that the mean is changing due to an upward movement by the entire sample, not just a large increase in the tail of the distribution.

The general trend in diversification and penetration in a sample of 69 industries is shown in Table 2 and Table 3. There the cumulative totals for firms with indices under given levels are displayed. One can readily see, for example, in the case of diversification that there is a steady movement of industries from the low levels of diversification. This movement causes a large growth in the number of firms with indices in the twenty-forty range. In 1963, only, 16 industries fell into this category, while by 1972 31 industries fell into the category. A similar thing occurs with penetration. Consequently, one may conclude, as expected, that diversification and penetration are increasing in American industry.

Table 1

Description of Diversification, Penetration and FSC Variables

| Variable | Pooled Sample Mean | Pooled Sample Std. Dev. | 1963 Mean | 1963 Std. Dev. | 1967 Mean | 1967 Std. Dev. | 1972 Mean | 1972 Std. Dev. |
|---|---|---|---|---|---|---|---|---|
| Div | 20.60 | 12.90 | 15.78 | 10.11 | 21.52 | 11.98 | 26.39 | 13.56 |
| Pen | 28.12 | 18.39 | 24.95 | 18.80 | 28.84 | 18.72 | 32.91 | 16.08 |
| RD | 1.64 | 2.44 | 1.56 | 1.29 | 1.60 | 1.28 | 1.82 | 1.33 |
| AD | 1.79 | 2.65 | 2.08 | 3.53 | 1.70 | 2.10 | 1.32 | 1.68 |
| Lay | 15.59 | 11.46 | 19.09 | 6.95 | 14.20 | 10.71 | 12.58 | 8.47 |
| Quit | 22.30 | 11.79 | 13.42 | 13.01 | 19.59 | 9.65 | 19.94 | 9.36 |

Table 2

Distribution of Diversification Indicies
for a Sample of 69 Industries

| Index Range | 1963 | | 1967 | | 1972 | |
|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage |
| less than 5 | 11 | 16% | 5 | 7% | 2 | 3% |
| less than 10 | 20 | 29 | 13 | 19 | 10 | 14 |
| less than 15 | 38 | 55 | 22 | 32 | 14 | 20 |
| less than 20 | 52 | 75 | 35 | 51 | 24 | 35 |
| less than 30 | 60 | 87 | 54 | 78 | 42 | 61 |
| less than 40 | 68 | 98 | 63 | 91 | 61 | 88 |
| less than 50 | 69 | 100 | 69 | 100 | 65 | 94 |
| Total | 69 | 100% | 69 | 100% | 69 | 100% |

Table 3

Distribution of Penetration Indicies
for a Sample of 69 Industires

| Index Range | 1963 | | 1967 | | 1972 | |
|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage |
| less than 5 | 6 | 9% | 2 | 3% | 2 | 3% |
| less than 10 | 14 | 20 | 8 | 12 | 3 | 4 |
| less than 15 | 21 | 30 | 15 | 22 | 14 | 20 |
| less than 20 | 33 | 48 | 22 | 32 | 20 | 29 |
| less than 30 | 46 | 67 | 41 | 59 | 33 | 48 |
| less than 40 | 56 | 81 | 55 | 80 | 45 | 65 |
| less than 50 | 62 | 90 | 61 | 88 | 57 | 83 |
| Total | 69 | 100% | 69 | 100% | 69 | 100% |

In Table 4 a simple correlation matrix is presented on the pooled sample of data. It is interesting to note that the signs of the correlation coefficients between diversification and the firm specific capital variables, are essentially as the model of FSC predicted. The same thing is true of the correlations between each firm specific capital measure and penetration. One should also notice the low correlation between the diversification and the penetration indices. This low correlation is particularly important since the model postulates both variables to move in the same direction with FSC.[23] With the low correlation one knows that tests of the diversification and the penetration hypotheses are independent.

Before leaving the correlation matrix it should be noted that a relatively high correlation exists between research and concentration and also between concentration and quit rates. This relationship was examined by Telser and Parsons, but one would have expected the relatively higher correlation to be between layoffs and concentration.[24]

Finally, the simple model suggested by equations (3a) and (3b) is run on the pooled sample. The model is run using quit and layoff rates, and using their summation, the separation rate (SEP). The results of this run are given in Table 5. Here it is seen that the coefficient of the research variable always has the appropriate sign,

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[23]The correlations between diversification and penetration in 1963, 1967, and 1972 are 0.17, -0.02, -0.02, respectively.

[24]Their general explanation for this association is that concentrated industries possess more firm specific human capital.

Table 4

Simple Correlations on the Pooled Data Sample

| | Div | Pen | RD | AD | Lay | Quit | RI | CR4 | CL |
|---|---|---|---|---|---|---|---|---|---|
| Div | 1.00 | 0.07 | 0.32 | -0.15 | -0.50 | -0.25 | 0.01 | 0.31 | -0.02 |
| Pen | | 1.00 | 0.14 | -0.19 | -0.23 | -0.15 | 0.07 | -0.03 | 0.004 |
| RD | | | 1.00 | 0.10 | -0.19 | -0.40 | 0.20 | 0.38 | -0.16 |
| AD | | | | 1.00 | 0.08 | -0.03 | 0.17 | 0.13 | 0.44 |
| Lay | | | | | 1.00 | -0.15 | -0.25 | 0.09 | 0.11 |
| Quit | | | | | | 1.00 | -0.18 | -0.36 | -0.15 |
| RI | | | | | | | 1.00 | 0.26 | 0.21 |
| CR4 | | | | | | | | 1.00 | 0.33 |
| CL | | | | | | | | | 1.00 |

Table 5

Regressions on the Pooled Sample

| | Constant | RD | AD | Lay | Quit | Sep | CR4 | CL | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|
| Div | 9.59 | 3.24 | -0.95 | -0.01 | -0.04 | - | 0.17 | - | |
| | (3.25) | (4.83) | (-3.44) | (-0.13) | (-0.42) | | (3.25) | | .26 |
| Div | 11.44 | 3.39 | -0.89 | - | - | -0.001 | 0.20 | - | |
| | (3.69) | (4.94) | (-3.09) | | | (-1.00) | (3.39) | | .26 |
| Pen | 34.67 | 3.08 | -2.48 | -0.30 | -0.19 | - | -0.22 | 6.29 | |
| | (6.59) | (2.46) | (-4.51) | (-2.65) | (-1.33) | | (-2.31) | (4.23) | .19 |
| Pen | 44.84 | 1.42 | -1.12 | - | - | -0.30 | -0.05 | 6.45 | |
| | (8.07) | (1.20) | (-2.20) | | | (-3.20) | (-0.59) | (3.68) | .20 |

and generally it is significant. The advertising term is always negative and significant. This suggests that any firm specific capital associated with advertising, is only applicable within a particular industry. The coefficients on the human capital variables had the appropriate signs, but they were only significant in the penetration model. This suggests that firms are willing to move into industries which possess relatively large amounts of human capital, but the human capital does not lead them to diversify. The next variable in the models is the concentration ratio. Here it was found that the coefficient in this variable was positive and significant in the diversification model. The variable had a negative coefficient in the penetration model. This result seems to suggest that monopoly power does play a role in the diversification decision of firms. Finally, the coefficients in the capital to labor ratio in the penetration model displayed the appropriate sign, and were significant. With these generally favorable results one can proceed to make a closer examination of behavior in individual years.

## Empirical Results II: Individual Years

The results of the regressions for the two models estimated for individual years are given in Tables 6 and 7. In examining the results, one immediately notices the consistent positive relationship between the research and development variable and both diversification and penetration. This is a result which has frequently been observed in the past. The advertising variable, which was to serve as a proxy for marketing expertise, was negative and significant. Even when a

Table 6

FSC and General Diversification*

| | 1963 | | | 1967 | | | 1972 | | |
|---|---|---|---|---|---|---|---|---|---|
| Constant | 11.57 | 9.272 | 8.786 | 11.25 | 10.54 | 10.47 | 18.35 | 14.90 | 14.53 |
| | 2.55 | (2.29) | (2.21) | (2.14) | (2.22) | (2.18) | (1.94) | (1.65) | (1.57) |
| RD | 1.359 | 1.360 | 1.295 | 3.509 | 3.470 | 3.453 | 2.404 | 2.448 | 2.375 |
| | (1.33) | (1.43) | (1.30) | (2.91) | (2.91) | (2.86) | (1.32) | (1.34) | (1.28 |
| AD | -0.561 | -0.570 | -1.628 | -1.436 | -1.403 | -1.461 | -1.904 | -1.978 | -2.375 |
| | (-1.69) | (-1.71) | (-2.54) | (-2.15) | (-2.15) | (-1.93) | (-1.45) | (-1.50) | (-1.31) |
| AD-DUM | - | - | 1.303 | - | - | 0.155 | - | - | 0.639 |
| | - | - | (1.92) | - | - | (0.15) | - | - | (0.32) |
| Quit | -0.179 | - | - | -0.026 | - | - | -0.160 | - | - |
| | (-1.00) | - | - | (-0.17) | - | - | (-0.63) | - | - |
| Layoff | 0.061 | - | - | 0.044 | - | - | 0.268 | - | - |
| | (0.70) | - | - | (0.33) | - | - | (1.03) | - | - |
| Sep | - | -0.030 | -0.025 | - | -0.012 | 0.014 | - | 0.048 | 0.058 |
| | - | (-0.40) | (-0.32) | - | (-0.13) | (0.15) | - | (0.25) | 0.30 |
| CR4 | 0.130 | 0.158 | 0.179 | 0.202 | 0.215 | 0.216 | 0.169 | 0.228 | 0.235 |
| | (1.56) | (1.98) | (2.27) | (2.11) | (2.45) | (2.44) | (1.16) | (1.64) | (1.65) |
| R Square | .17 | .16 | .21 | .28 | .28 | .28 | .18 | .16 | .16 |

*The dependent variables in these regressions were the industry diversification measures for the appropriate years. The t-statistics are given in the parentheses.

Table 7

FSC and Industry Penetration*

| | 1963 | | | 1967 | | | 1972 | |
|---|---|---|---|---|---|---|---|---|
| Constant | 33.63 | 30.95 | 29.58 | 31.92 | 31.94 | 30.80 | 34.65 | 38.43 | 38.14 |
| | (3.81) | (3.98) | (1.01) | (3.97) | (3.96) | (3.40) | (2.95) | (3.43) | (3.59) |
| RD | 2.976 | 3.028 | 2.876 | 4.662 | 4.228 | 4.656 | 2.387 | 2.260 | 1.059 |
| | (1.44) | (1.47) | (1.47) | (2.13) | (1.88) | (2.12) | (1.03) | (1.00) | (0.47) |
| AD | -1.381 | -1.412 | -4.296 | -4.556 | -4.867 | -4.545 | -1.425 | -1.258 | -3.713 |
| | (-1.96) | (-2.02) | (-3.57) | (-3.51) | (-3.59) | (-3.48) | (-0.74) | (-0.66) | (-1.77) |
| Ad Dum | - | - | 3.538 | - | 1.387 | - | - | - | 5.087 |
| | - | - | (2.87) | - | (0.82) | - | - | - | (2.36) |
| Quit | -0.473 | - | - | - | - | -0.137 | 0.198 | - | - |
| | (1.37) | - | - | - | - | (0.55) | (0.66) | - | - |
| Layoff | -0.205 | - | - | - | - | -0.23 | -0.225 | - | - |
| | (-1.16) | - | - | - | - | (-1.08) | (-0.75) | - | - |
| Sep | - | -0.269 | -0.211 | -0.193 | -0.183 | - | - | -0.013 | 0.022 |
| | - | (-1.83) | (-1.50) | (-1.80) | (-1.75) | - | - | (-0.60) | (0.11) |
| CR4 | -0.196 | -0.170 | -0.117 | -0.189 | -0.167 | -0.175 | -0.091 | -0.145 | -0.054 |
| | (-1.15) | (-1.03) | (-0.74) | (-1.23) | (-1.07) | (-1.07) | (-0.53) | (-0.88) | (-0.34) |
| CLRAT | 5.065 | 5.241 | 5.325 | 7.850 | 7.142 | 7.971 | -2.057 | -2.278 | -3.918 |
| | (2.00) | (2.09) | (2.24) | (3.03) | (2.61) | (3.01) | (-0.72) | (-0.80) | (-1.41) |
| R Square | .16 | .15 | .26 | .25 | .26 | .25 | .16 | .26 | .24 |

*The dependent variables in these regressions were the industry penetration measures for the appropriate years. The t-statistics are given in the parentheses.

dummy variable was introduced to separate advertising in producer goods industries (Ad dum) from consumer goods industries, the net effect generally remained negative. The basic explanation is that the marketing expertise associated with advertising are not readily transferable between widely divergent products. If this is the case one will need look at the relationship between diversification and advertising at a much more narrow level of diversification, say the five digit level. Unfortunately this cannot be done with these data.

Moving onward one will notice that the firm specific human capital variables (layoff and quit rates) tended to have the expected signs, but they in general were not significant. When the separation rate was used (a summation of the quit and layoff variables), the expected sign was obtained, and the performance of the model was improved. It should be noted that in general the performance was better in the penetration model. The remaining variables performed as they did in the pooled sample.

Since the model did not perform as well as expected, the data for each year were broken into groups to see if any patterns were discernible. This breakdown is displayed in Tables 8, 9, and 10. In those tables the low and high diversification groups refer to the 20 percent of the industries which had the lowest and the highest levels of diversification. The findings of this breakdown tend to support the firm specific capital hypothesis. In all years, the low diversification group had lower research activity and higher layoff and quit rates than did the intermediate group. The advertising variable, as

Table 8

Grouped Variable Means 1963

| Group Descriptions | Variable | Mean | Standard Deviation |
|---|---|---|---|
| Low diversification 1963 | D63 | 3.39 | 1.28 |
| " | Pen63 | 18.50 | 19.70 |
| " | RD | 1.08 | 1.18 |
| " | AD | 2.37 | 2.54 |
| " | RI | 7.79 | 2.73 |
| " | Lay | 21.46 | 11.75 |
| " | Quit | 14.85 | 10.74 |
| " | CR4 | 30.38 | 18.02 |
| Intermediate Diversification 1963 | D63 | 14.21 | 4.31 |
| " | Pen63 | 25.77 | 20.28 |
| " | RD | 1.49 | 1.26 |
| " | AD | 2.34 | 4.k8 |
| " | RI | 7.46 | 2.87 |
| " | Lay | 18.30 | 13.70 |
| " | Quit | 13.77 | 6.22 |
| " | CR4 | 33.99 | 15.32 |
| High Diversification | D63 | 32.28 | 6.55 |
| " | Pen 63 | 28.26 | 9.11 |
| " | RD | 2.23 | 1.17 |
| " | AD | 1.003 | 0.81 |
| " | RI | 8.65 | 5.69 |
| " | Lay | 19.42 | 11.45 |
| " | Quit | 10.97 | 3.08 |
| " | CR4 | 39.49 | 15.49 |

Table 9

Grouped Variable Means 1967

| Group | Variable | Mean | Standard Deviation |
|---|---|---|---|
| Low Diversification 1967 | D67 | 5.88 | 2.77 |
| " | Pen67 | 30.87 | 26.96 |
| " | RD | 0.88 | 0.44 |
| " | AD | 2.45 | 3.29 |
| " | RI | 10.98 | 3.17 |
| " | Lay | 16.23 | 7.21 |
| " | Quit | 23.22 | 14.85 |
| " | CR4 | 24.90 | 12.13 |
| Intermediate Diversification 1967 | D67 | 20.14 | 6.00 |
| " | Pen67 | 27.92 | 17.01 |
| " | RD | 1.57 | 1.31 |
| " | AD | 1.62 | 1.84 |
| " | RI | 9.80 | 3.71 |
| " | Lay | 13.45 | 11.73 |
| " | Quit | 19.37 | 8.29 |
| " | CR4 | 34.56 | 16.03 |
| High Diversification 1967 | D67 | 40.45 | 5.14 |
| " | Pen67 | 29.95 | 13.86 |
| " | RD | 2.36 | 1.32 |
| " | AD | 1.24 | 1.01 |
| " | RI | 9.41 | 3.92 |
| " | Lay | 14.73 | 9.64 |
| " | Quit | 17.00 | 5.97 |
| " | CR4 | 13.16 | 14.46 |

Table 10

Grouped Variable Means 1972

| Group | Variable | Mean | Standard Deviation |
|---|---|---|---|
| Low Diversification 1972 | D72 | 7.39 | 3.09 |
| " | Pen72 | 37.70 | 19.86 |
| " | RD | 1.56 | 1.02 |
| " | AD | 1.31 | 1.41 |
| " | RI | 21.06 | 12.20 |
| " | Lay | 12.98 | 7.23 |
| " | Quit | 23.04 | 10.82 |
| " | CR4 | 27.20 | 14.81 |
| Intermediate Diversification 1972 | D72 | 24.83 | 6.72 |
| " | Pen72 | 28.47 | 15.19 |
| " | RD | 1.83 | 1.41 |
| " | AD | 1.74 | 1.93 |
| " | RI | 14.60 | 7.37 |
| " | Lay | 11.40 | 6.79 |
| " | Quit | 19.70 | 9.53 |
| " | CR4 | 36.37 | 15.4 |
| High Diversification 1972 | D72 | 49.21 | 11.51 |
| " | Pen72 | 35.73 | 14.08 |
| " | RD | 2.42 | 1.00 |
| " | AD | 1.00 | 0.54 |
| " | RI | 13.67 | 4.67 |
| " | Lay | 16.00 | 12.54 |
| " | Quit | 17.60 | 5.67 |
| " | CR4 | 44.85 | 18.10 |

before, was generally negative, except in 1972 where a positive relationship was observed. For the high diversification group, the FSC model seemed to hold through 1963 and 1967, but in 1972 the nature of the high diversification group seems to change radically.

Finally, one should note that in 1967 and 1972 the industries with the highest (lowest) levels of diversification earned lower (higher) rates of return. This finding is inconsistent with the hypothesis that diversification leads to monopoly power. It is, however, consistent with the view that diversification reduces risk. A further test of the latter hypothesis, though, will be conducted in later chapters.

A final group of specifications are reported in Table 11. Here the basic structuralist model was run on each year of data. The findings for 1963 and 1967 fail to support the contention that diversification causes a barrier to entry. Only the concentration ratio and the advertising to sales ratios are significant. In 1972, though, the data suggest a refutation of the structuralist model as it applies to diversification. In 1972 the relationship between diversification and rate of return is negative and significant. This is contrary to the hypothesis that diversification is a type of anticompetitive behavior. In addition, a significant negative relationship exists between penetration and rate of return. This is consistent with the hypothesis that competition works. That is, if an industry is making high returns, it gets entered by firms from outside the industry.

Table 11

The Structuralist Model

| | RI 1963 | RI 1967 | RI 1972 |
|---|---|---|---|
| Constant | 5.487 | 7.846 | 7.657 |
| | (4.50) | (6.08) | (1.97) |
| Div | -0.003 | -0.025 | -0.230 |
| | (-0.08) | (-0.66) | (-3.13) |
| Pen | -0.021 | -0.011 | 0.146 |
| | (-0.93) | (-0.48) | (2.23) |
| AD | 0.177 | 0.697 | 1.073 |
| | (1.45) | (3.34) | (1.61) |
| CR4 | 0.072 | 0.051 | 0.215 |
| | (2.60) | (1.79) | (3.21) |
| R Square | .15 | .26 | .39 |

## Conclusion

From this examination of diversification, one can make four observations:

1. Diversification appears to be increasing in American industry.

2. The existence of firm specific capital seems, in general, to have significant explanatory power, particularly in the penetration model.

3. The evidence is consistent with the hypothesis that firms diversify in order to reduce risk.

4. Although some evidence was found suggesting that penetration tended to be lower in concentrated industries, tests of the structuralist model do not support the hypothesis that diversification caused a barrier to entry.

# CHAPTER V

## MEASURES OF DIVERSIFICATION: THE FIRST EMPIRICAL PROBLEM

In performing such cross sectional studies of diversification various indices of diversification have been used, but there has been no agreement as to which index is the most appropriate. Since a "best index" has not yet been deduced from economic theory, researchers have been forced to allow their purpose and data availability to guide them in their choice among indices. All of course, recognized that their choice may not be optimal and may lead to distortion of information which might be more accurately conveyed through some other index. Although these costs are recognized their magnitude has never thoroughly been examined.

The purpose here is to examine the differences and similarities which exist among seven popular measures of diversification.[1] Then using simple statistical analysis some conclusions can be drawn concerning the costs of choosing one index over another.[2]

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[1]The discussion which follows attempts to extend the work done by Paul Gorecki, "The Measurement of Enterprise Diversification," Review of Economics and Statistics, Vol. 56 (August 1974), 399-401.

[2]One will notice that there is a distinct similarity between the discussion presented here, and that which characterized the debate over the appropriate measure of concentration. The similarity was

The Calculation of Diversification Indices

When trying to determine the degree of a firm's diversification it is necessary to first distinguish the various lines of business in which that firm participates. It is assumed here that this can readily be done by following a guideline such as the Standard Industrial Classification for some (say 4 digit) level of aggregation. The number of distinct endeavors for firm i are denoted by the variable $N_i$. Next it is necessary to determine the share of the firm's total production activity which it devotes to each of its endeavors. The question of which measure of activity (e.g., value added, employment, etc.) is to be used will not be addressed here. The reason is that simple practicality generally dictates the method of measurement.[3] Consequently, it is assumed that the appropriate data, for example, employment distributions, have been decided upon. The total activity of firm i is given by $T_i$, and the amount of its participation in its

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intended due to the nearly identical nature of the problem. Since much will be borrowed from their analysis, the interested reader may wish to consult Marshall Hall and Nicolaus Tideman, "Measures of Concentration," Journal of the American Statistical Association, Vol. 62 (March 1967), 163-68 and Duncan Bailey and Stanley E. Boyle, "The Optimal Measure of Concentration," Journal of the American Statistical Association, Vol. 66 (December 1971), 702-06.

[3]Theoretical considerations would seem to dictate some form of value added measure, but in general this data is not available for individual firms. Given this problem labor distributions are generally used.

jth endeavor is given as $A_{ij}$. The proportion of its total activity represented by its participation in the jth endeavor can be stated as

$$P_{ij} = A_{ij}/T_i$$

where

$$\sum_{j=1}^{N} P_{ij} = 1.$$

For simplicity, in later calculations it will be assumed that the $P_{ij}$ are in descending order, so that $P_{i1}$ is the largest endeavor of the firm. With this information one could begin to calculate diversification measures.

Before discussing the computation of the various diversification indices it is useful to note three characteristics which diversification indices should have. (1) The measure should be independent of firm size. That is to say that two firms with the same distribution of activities should receive the same index value even if one firm is many times larger than the other. (2) The index should be able to reflect changes in the distribution of $P_{ij}$. This is not to say that two distributions of $P_{ij}$ could not have the same index. For just as two different bundles of commodities can yield the same utility to a consumer, so too can two distributions of endeavor yield the same diversification index. (3) The value of the index should be increasing with diversification, and it should not be **bounded** from above. The reason for this is that while one can easily picture a firm which is

completely specialized in one endeavor, there is no point where a firm reaches maximum diversification.

Turning to the actual computation of diversification indices two simple indices immediately suggest themselves. The first is to merely count the number of endeavors in which a firm participates, this would cause the index to equal N. A second index would be to sum the shares of total activity attributed to all the non-primary activities of the firm. That is,

$$NP_i = \sum_{j=2}^{N} P_{ij}.$$ [4]

The problem with these indices is that they do not have the second desirable characteristic of diversification indices. Very different distributions among a given set of $P_{ij}$ $(j \neq 1)$ would not cause the index to change. This problem is demonstrated in Table 12.[5] In addition, the $NP_i$ index is bounded which in this case means increases in $N_i$ would not be reflected in the value of the index.

By combining these two measures Michael Gort provided a significant improvement. His suggestion was to use

$$G_i = N_i \cdot NP_i$$

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[4] By the convention mentioned above $P_{i1}$ is the largest endeavor of the firm, and it is considered the firm's primary activity. An example of the use of the indices are provided by Stephen A. Rhoades, "The Effect of Diversification on Industry Performance in 241 Manufacturing Industries: 1963," Review of Economics and Statistics, Vol. 55 (May 1973), 146-54.

[5] A similar table is found in Gorecki, "Measure of Enterprise Diversification."

Table 12

Sample Distributions and Indices

| i | $P_{i1}$ | $P_{i2}$ | $P_{i3}$ | $P_{i4}$ | $P_{i5}$ | $P_{i6}$ | N | NP | G | HH1 | HH2 | E | HTU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 1.000 | | | | | | 1.00 | 0.0 | 0.0 | 0.0 | 1.00 | 0.0 | 1.00 |
| 2.000 | 0.900 | 0.100 | | | | | 2.00 | 0.10 | 0.20 | 0.18 | 1.22 | 0.33 | 1.20 |
| 3.000 | 0.900 | 0.050 | 0.050 | | | | 3.00 | 0.10 | 0.30 | 0.19 | 1.23 | 0.39 | 1.30 |
| 4.000 | 0.900 | 0.040 | 0.030 | 0.020 | 0.010 | | 5.00 | 0.10 | 0.50 | 0.19 | 1.23 | 0.45 | 1.40 |
| 5.000 | 0.900 | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 | 6.00 | 0.10 | 0.60 | 0.19 | 1.23 | 0.49 | 1.60 |
| 6.000 | 0.800 | 0.200 | | | | | 2.00 | 0.20 | 0.40 | 0.32 | 1.47 | 0.50 | 1.40 |
| 7.000 | 0.800 | 0.100 | 0.100 | | | | 3.00 | 0.20 | 0.60 | 0.34 | 1.52 | 0.64 | 1.60 |
| 8.000 | 0.800 | 0.100 | 0.050 | 0.050 | | | 4.00 | 0.20 | 0.80 | 0.35 | 1.53 | 0.71 | 1.70 |
| 9.000 | 0.700 | 0.300 | | | | | 2.00 | 0.30 | 0.60 | 0.42 | 1.72 | 0.61 | 1.60 |
| 10.00 | 0.700 | 0.200 | 0.100 | | | | 3.00 | 0.30 | 0.90 | 0.46 | 1.85 | 0.80 | 1.80 |
| 11.00 | 0.700 | 0.100 | 0.100 | 0.100 | | | 4.00 | 0.30 | 1.20 | 0.48 | 1.92 | 0.94 | 2.20 |
| 12.00 | 0.700 | 0.100 | 0.075 | 0.050 | 0.050 | 0.025 | 6.00 | 0.30 | 1.80 | 0.49 | 1.96 | 1.07 | 2.45 |
| 13.00 | 0.600 | 0.400 | | | | | 2.00 | 0.40 | 0.80 | 0.48 | 1.92 | 0.67 | 1.80 |
| 14.00 | 0.600 | 0.300 | 0.100 | | | | 3.00 | 0.40 | 1.20 | 0.54 | 2.17 | 0.90 | 2.00 |
| 15.00 | 0.600 | 0.200 | 0.200 | | | | 3.00 | 0.40 | 1.20 | 0.56 | 2.27 | 0.95 | 2.20 |
| 16.00 | 0.600 | 0.200 | 0.100 | 0.100 | | | 4.00 | 0.40 | 1.60 | 0.58 | 2.38 | 1.09 | 2.40 |
| 17.00 | 0.600 | 0.100 | 0.100 | 0.100 | 0.100 | | 5.00 | 0.40 | 2.00 | 0.60 | 2.50 | 1.23 | 3.00 |
| 18.00 | 0.500 | 0.500 | | | | | 2.00 | 0.50 | 1.00 | 0.50 | 2.00 | 0.69 | 2.00 |
| 19.00 | 0.500 | 0.400 | 0.100 | | | | 3.00 | 0.50 | 1.50 | 0.58 | 2.38 | 0.94 | 2.20 |
| 20.00 | 0.500 | 0.300 | 0.200 | | | | 3.00 | 0.50 | 1.50 | 0.62 | 2.63 | 1.03 | 2.40 |
| 21.00 | 0.500 | 0.200 | 0.200 | 0.100 | | | 4.00 | 0.50 | 2.00 | 0.66 | 2.94 | 1.22 | 2.80 |
| 22.00 | 0.500 | 0.480 | 0.010 | 0.010 | | | 4.00 | 0.50 | 2.00 | 0.52 | 2.08 | 0.79 | 2.06 |
| 23.00 | 0.500 | 0.400 | 0.040 | 0.020 | 0.020 | 0.010 | 6.00 | 0.50 | 3.00 | 0.59 | 2.42 | 1.04 | 2.32 |
| 24.00 | 0.300 | 0.300 | 0.300 | 0.100 | | | 4.00 | 0.70 | 2.80 | 0.72 | 3.57 | 1.31 | 3.40 |
| 25.00 | 0.300 | 0.200 | 0.200 | 0.200 | 0.100 | | 5.00 | 0.70 | 3.50 | 0.78 | 4.55 | 1.56 | 4.20 |

or

$$G_i = N_i\left(\sum_{j=2}^{N} P_{ij}\right).^{6}$$

The range of this index is from zero to N-1 if all N activities have equal $P_{ij}$. This measure overcomes some of the problems of the first two, but for any given $N_i$, changes in the distribution of $P_{ij}(j \neq 1)$ cannot impact the index.

A method of overcoming this problem, which is very familiar to industrial organization economists, is to use a variation of the Herfindahl-Hirschman index. This index, which was developed to measure concentration, is equal to the sum of the squared shares. That is

$$HH_i = \sum_{j=1}^{N} P_{ij}^2.$$

Since this measure would decrease with diversification, some transformation is used which forces a positive relationship between diversification and the magnitude of the index. One possibility is to compute

$$HH1_i = 1 - \sum_{j=1}^{N} P_{ij}^2.^{7}$$

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[6] This index was developed in Michael Gort, Diversification and Integration in American Industry, Princeton: Princeton University Press, 1962.

[7] This index was used by Charles Berry, Corporate Growth and Diversification, Princeton: Princeton University Press, 1975.

This index will equal zero if the firm is completely specialized, and it will equal (N-1)/N if the firm has equal shares in its N endeavors. A problem with this measure is that the artificial boundary ($HH1 \leq 1$) making increases in the index of diversification more difficult once the firm is already highly diversified. A second variation is to generate a "number equivalent" as suggested by Morris Adelman.[8] This measure is

$$HH2_i = 1/\left(\sum_{j=1}^{N} P_{ij}^2\right).$$

This index then displays all of the desirable properties of a diversification index. This measure ranges from one for the completely specialized firm to N if all activities are of equal size.

Another index which displays desirable properties comes to economics via information theory.[9] This measure, frequently referred to as an entropy index, is

$$E_i = \sum_{j=1}^{N} P_{ij} \cdot \text{Ln}\,(1/P_{ij}).$$

This index although not frequently used in economics was presented by Berry.[10] An interesting property of this measure is that while it

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[8]Morris A. Adelman, "Comment on the 'H' Concentration Measure as a Numbers Equivalent," Review of Economics and Statistics, Vol. 51 (February 1969), 99-101.

[9]For a discussion one should see Robert Ash, Information Theory, New York: Interscience Publishers, 1967, Chapter 1.

[10]Charles Berry, Corporate Growth and Diversification, Chapter 5.

does not have an upper bound it does give less weight to incremental diversification by the already diversified firm. This is shown by the range of this index, which is equal to 0 for the specialized firm and LN(N) for the firm with N equal sized activities. One can see that changes in the extreme of the index are nonlinear in N (as shown in Table 13). This change is linear for most of the other indices. With more research it may be determined that this weighting scheme is desirable, but at this point that is not clear.[11]

The last index to be discussed here is one which has a great deal of intuitive appeal in the study of diversification. An early variant of this index was presented in the concentration measure literature by Marshall Hall and Nicolaus Tideman,[12] and its use in diversification is highlighted by the work of M.A. Utton.[13] The index is

$$HTU_i = 2\left(\sum_{j=1}^{N} j\, P_{ij}\right) - 1 .$$

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[11]For example, it has been shown in portfolio theory that "complete" diversification can be achieved by a relatively small number of assets. This was shown by J.C. Evans and S.H. Archer, "Diversification and the Reduction of Dispersion: An Empirical Analysis," Journal of Finance, Vol. 23 (December 1968), 761-68. If we chose to view the firm as a portfolio of activities then the entropy measure of diversification would be useful.

[12]Marshall Hall and Nicolaus Tideman, "Measures of Concentration."

[13]M.A. Utton, "Large Firm Diversification in British Manufacturing Industry," The Economic Journal, Vol. 87 (March 1977), 96-111. The description of the index follows the one presented there.

Table 13

Summary of Indices

| Index | Formulation | Range | |
|---|---|---|---|
| | | Low | High* |
| N | $N$ | 1 | N |
| NP | $\sum_{j=2}^{N} P_j$ | 0 | $\frac{N-1}{N}$ |
| G | $N(\sum_{J=2}^{N} P_J)$ | 0 | N-1 |
| HH1 | $1-\sum_{J=1}^{N} P_J^2$ | 0 | $\frac{N-1}{N}$ |
| HH2 | $1/\sum_{J=1}^{N} P_J^2$ | 1 | N |
| E | $\sum_{J=1}^{N} P_J \cdot LN(1/P_J)$ | 0 | ln(N) |
| HTU | $2(\sum_{J=1}^{N} JP_J) - 1$ | 1 | N |

*The high range refers to the value of the index if the firm participated equally in each of its N activities.

The appeal of this index can be explained with reference to Figure 7. In the figure the horizontal axis represents activities in which the firm engages, ordered from highest to lowest, and the vertical axis represents the cumulative proportion of the firm's total activity. The area under the "diversification" curve is:

$$\text{AREA} = P_1/2 + [(N-1)P_1 + P_2/2] + [(N-2)P_2 + P_3/2] + \ldots$$

or

$$\text{AREA} = 1/2 + N - \sum_{j=1}^{N} jP_j \ .$$

Because the cumulative height of the curve must equal one, and the width equal N, obviously a measure based on the area under the curve will obviously be highly sensitive to changes in N. To remedy this one can look at the area of the bounded region above the curve. This is

$$\text{AREA} = N - \text{AREA} = \sum_{j=1}^{N} jP_j - 1/2$$

and twice this measure gives the HTU index.

$$\text{HTU}_i = 2\sum_{j=1}^{N} jP_{ij} - 1.$$

This measure will not be so sensitive to changes in $N_i$. Because of its appealing derivation, this index will be used as a benchmark for the remainder of this study.

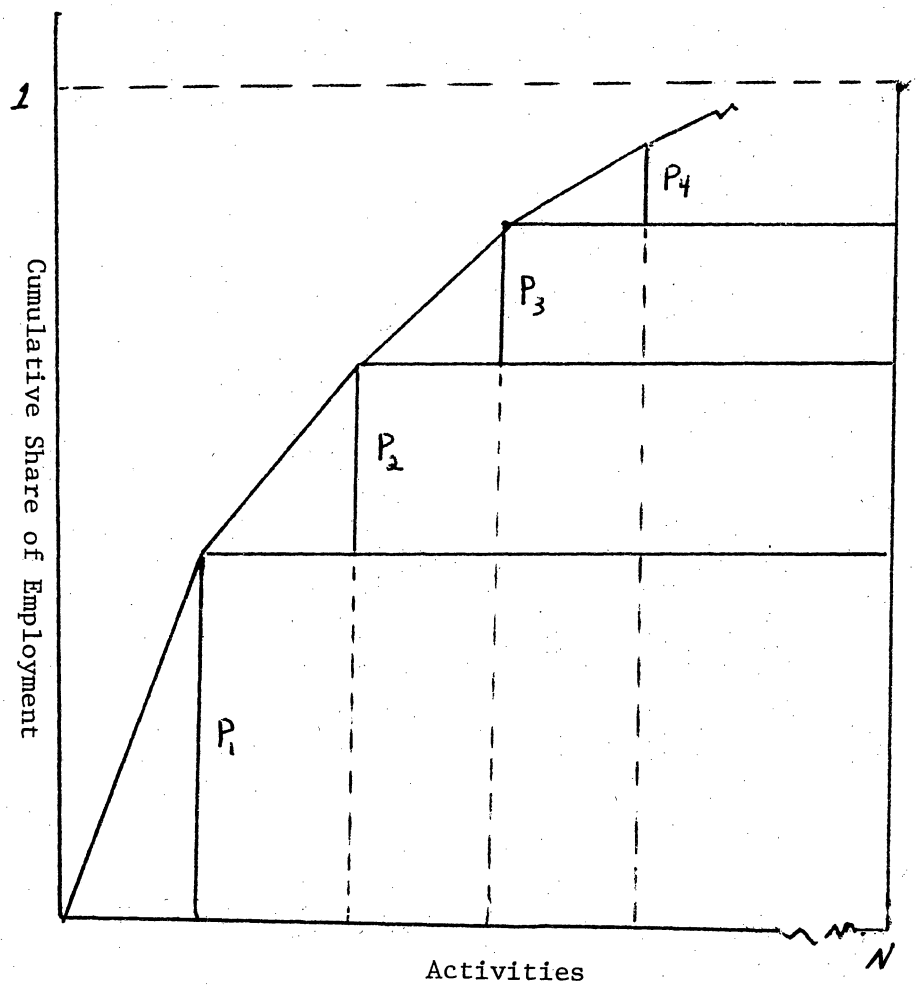


Figure 7
The Diversification Curve

Information Content of Indices

The characteristics (T, N, $P_j$) of any firm are drawn from some underlying distribution. In general, one would like variations in the sample distribution to be reflected in the index of diversification. The nature of the underlying distribution has not been deduced from economic theory, and its characteristics are in general a part of diversification studies. It would be nice to know the relationship between the characteristics of the distribution of $A_{ij}$ and the diversification index, but the relationship is more of an empirical question than a theoretical one. To demonstrate this one can consider the relationship between the skewness of the distribution of $A_{ij}$ and the magnitude of the diversification index. Skewness is defined as

$$SK_i = \sum_{j=1}^{N} [A_{ij} - \bar{A}_{ij})^3/S_i]/N ,$$

where $\bar{A}_i$ is the mean participation by firm i in its endeavors, and $S_i$ is the standard deviation of $A_{ij}$. One who has observed the data might argue that the degree of skewness should be positively related to the value of the diversification index. The rationale is that as a firm with a given distribution of $A_{ij}$ increases the number of its relatively small activities the distribution of $A_{ij}$ becomes more positively skewed. Since the addition of activities is making the firm more diversified the positive skewness should be associated with higher diversification. Although this particular story may be characteristic of the real world, the relationship between skewness and

the index value need not hold. For example, if new activities were added at the mean level of $A_{ij}$ the skewness would not change, but the level of diversification, and hence its index, should change. So to find the relationship between this moment of the distribution and the level of diversification one must conduct an empirical analysis.[14]

Empirical Analysis

In order to examine the relationship which exists among the seven diversification indices and between the skewness coefficient and each various index a simple correlation study has been performed on actual firm data for 1960 and 1965. The indices were constructed using estimated employment distributions across four and five digit SIC groups. The data used were initially compiled in the Fortune Plant and Product directory, and are the same as used by Charles Berry.[15] The method of assigning the employment distribution to the various SIC codes is the same as that used and described by Berry.[16] The diversification indices discussed above as well as the skewness

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[14]The relationship between diversification and any other moments of the distribution of $A_{ij}$ is even more ambiguous.

[15]The data were initially reported in Fortune, Market Research Department, 1961; Plant and Product Directory, Time, Inc.,1966 and 1966 Plant and Product Directory, Time, Inc., 1966. Summaries of the data are provided in Charles Berry, Corporate Growth and Diversification. The version of the data used here was obtained through the National Bureau of Economic Research.

[16]Charles Berry, Corporate Growth and Diversification, 52-7.

coefficient were computed initially at the five digit SIC level of aggregation. For two samples (1960, 1965) simple correlations were computed.[17] These correlations are reported in Table 14 and Table 15.

The examination of the correlations among indices immediately shows some rather interesting points. First, an inspection of the underlying distribution of $A_{ij}$ shows, as one might have guessed, that skewness varied considerably across firms.[18] Also, as seen in Table 14 and Table 15 this variation is positively correlated with the various measures of diversification. The magnitude of the correlation between skewness and NP, HH1 and HH2, although positive, was relatively low, while it was higher for the other indices. A second, and far more important finding, is seen in the pairwise correlation coefficients. If as a benchmark one chooses the HTU index as "the best," he will find that it is highly correlated with the entropy index (E), the Herfindahl numbers equivalent (HH2), and the Gort index (G). The interesting point here is that the Gort measure requires the smallest amount of information of the four, yet apparently the information loss is minimal. A surprising finding is that the correlation between the often used HH1 and various other indices is relatively low, suggesting that if one has the needed

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[17]The sample includes 490 firms for 1960 and 890 firms in 1965.

[18]This was found by computing the mean skewness coefficient, which was 1.18 with a standard deviation of 1.24.

Table 14

Correlation Matrix for 1960

| | N | NP | G | HH1 | HH2 | E | HTU | SK |
|---|---|---|---|---|---|---|---|---|
| N | 1.00 | | | | | | | |
| NP | 0.52 | 1.00 | | | | | | |
| G | 0.96 | 0.64 | 1.00 | | | | | |
| HH1 | 0.60 | 0.96 | 0.67 | 1.00 | | | | |
| HH2 | 0.71 | 0.77 | 0.85 | 0.71 | 1.00 | | | |
| E | 0.82 | 0.88 | 0.88 | 0.92 | 0.88 | 1.00 | | |
| HTU | 0.84 | 0.72 | 0.92 | 0.71 | 0.96 | 0.92 | 1.00 | |
| SK | 0.62 | 0.06 | 0.42 | 0.16 | 0.05 | 0.31 | 0.28 | 1.00 |

Table 15

Correlation Matrix for 1965

| | N | NP | N | HH1 | HH2 | E | HTU | SK |
|---|---|---|---|---|---|---|---|---|
| N | 1.00 | | | | | | | |
| NP | 0.55 | 1.00 | | | | | | |
| G | 0.96 | 0.66 | 1.00 | | | | | |
| HH1 | 0.62 | 0.96 | 0.67 | 1.00 | | | | |
| HH2 | 0.74 | 0.77 | 0.87 | 0.72 | 1.00 | | | |
| E | 0.82 | 0.89 | 0.88 | 0.92 | 0.88 | 1.00 | | |
| HTU | 0.86 | 0.74 | 0.94 | 0.73 | 0.96 | 0.92 | 1.00 | |
| SK | 0.64 | 0.04 | 0.45 | 0.25 | 0.12 | 0.38 | 0.33 | 1.00 |

information it would seem appropriate to use HH2 (or E or HTU) rather than the HH1 index.

The similarity between the findings in 1960 and 1965 is important to note since it need not occur. To demonstrate this, an artificial sample of 200 firms was generated where the $A_{ij}$ were drawn from a positively skewed distribution. The sample was constructed to show that in certain cases the indices need not be as highly correlated. The correlation matrix for the artificial sample is reported in Table 16. Fortunately, the findings of Tables 14 and Table 15 suggest that one need not worry about the causes of changes in the correlations, since in actual data rather high correlations exist. The implication is that the underlying structure is stable. Consequently, the cost of using one index rather than another, even one of the most simple indices is rather low.

Improving the Diversification Measure

The discussion above has shown some a priori reasons for preferring some measures of diversification over others, but the empirical findings show that not much is lost no matter which measure is chosen. This suggests that if one were interested in refining the measure of diversification it would be more fruitful to learn to incorporate additional information into the index rather than try and improve the index using the same basic data. Two major suggestions for improvement have been forwarded in the literature. The first is to include a weighting scheme in the diversification measures, which capture some information on the "distance" a new activity is from the

Table 16

Correlation Matrix for Artificial Sample

| | N | NP | G | HH1 | HH2 | E | HTU |
|---|---|---|---|---|---|---|---|
| N | 1.00 | | | | | | |
| NP | 0.31 | 1.00 | | | | | |
| G | 0.78 | 0.76 | 1.00 | | | | |
| HH1 | 0.28 | 0.94 | 0.74 | 1.00 | | | |
| HH2 | 0.36 | 0.71 | 0.81 | 0.61 | 1.00 | | |
| E | 0.49 | 0.92 | 0.84 | 0.91 | 0.83 | 1.00 | |
| HTU | 0.87 | 0.51 | 0.89 | 0.56 | 0.75 | 0.72 | 1.00 |

primary one. The second approach is to classify firms, in a discrete instead of a continuous manner, by the firm's diversification strategy.

The first approach has been analyzed by Honeycutt and Zimmerman.[19] Their basic suggestion was to include the index construction a weight which in some way captures the distance two corporate activities. Their suggestion was to let the weight equal 0 if the activities were the same at the five digit SIC level. The weight would then equal 1 if the activities differed any at the five digit level, it would equal 2 if they differed at the four digit level, and so on. Although this index seems to be an improvement it is in fact only adding misinformation. The reason is that distance cannot be taken from the SIC classification alone.

A second approach is to attempt to classify the direction of a firm's diversification. An interesting approach to dealing with this problem has been provided by Richard Rumelt.[20] He classified a sample of firms by their strategy into one of eight categories. These strategies were: single business (S), dominant vertical (DV), dominant constrained (DC), dominant linked (DL), related constrained

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[19] T. Crawford Honeycutt and Donald L. Zimmerman, "Measurement of Corporate Diversification: 1950-1967," Antitrust Bulletin, Vol. 21 (Fall 1976), 509-35.

[20] Richard Rumelt, Strategy, Structure, and Economic Performance, Cambridge, Mass.: Harvard University Press, 1974. In this study the actual classifications made by Rumelt for a sample of firms is used.

(RC), related linked (RL), unrelated passive (UP), and acquisitive conglomerate (AC). In order to classify firms in this way three ratios were computed for each firm. The first was the specialization ratio, which was defined as the portion of the firm's revenues which were attributed to its primary line of business. The second was the related ratio, which was the proportion of the firm's revenues attributed to all vertically related activities. An outline of how these ratios are used in the classification of diversification strategies is given in Figure 8.

A first taxonomy included four groups of firms. Single product firms were those with specialization ratios greater than 0.95. Dominant type firms were firms which had diversified to some extent, but they were still getting a large portion of their revenues from one line of business. They had specialization ratios greater than or equal to 0.7 but less than 0.95, or firms with vertical ratios of at least 0.7. Related type firms were diversified businesses which were not vertically integrated. That is they had a specialization and vertical ratios which were less than 0.7. These firms were diversifying into related activities, as displayed in a related ratio which was greater than or equal to 0.7. If this condition was not fulfilled the firm was classified as an unrelated product firm (i.e. conglomerate).

Since further clarification was possible the broad categories were divided further. First, dominant businesses were divided into four groups. A dominant vertical business was one with a vertical

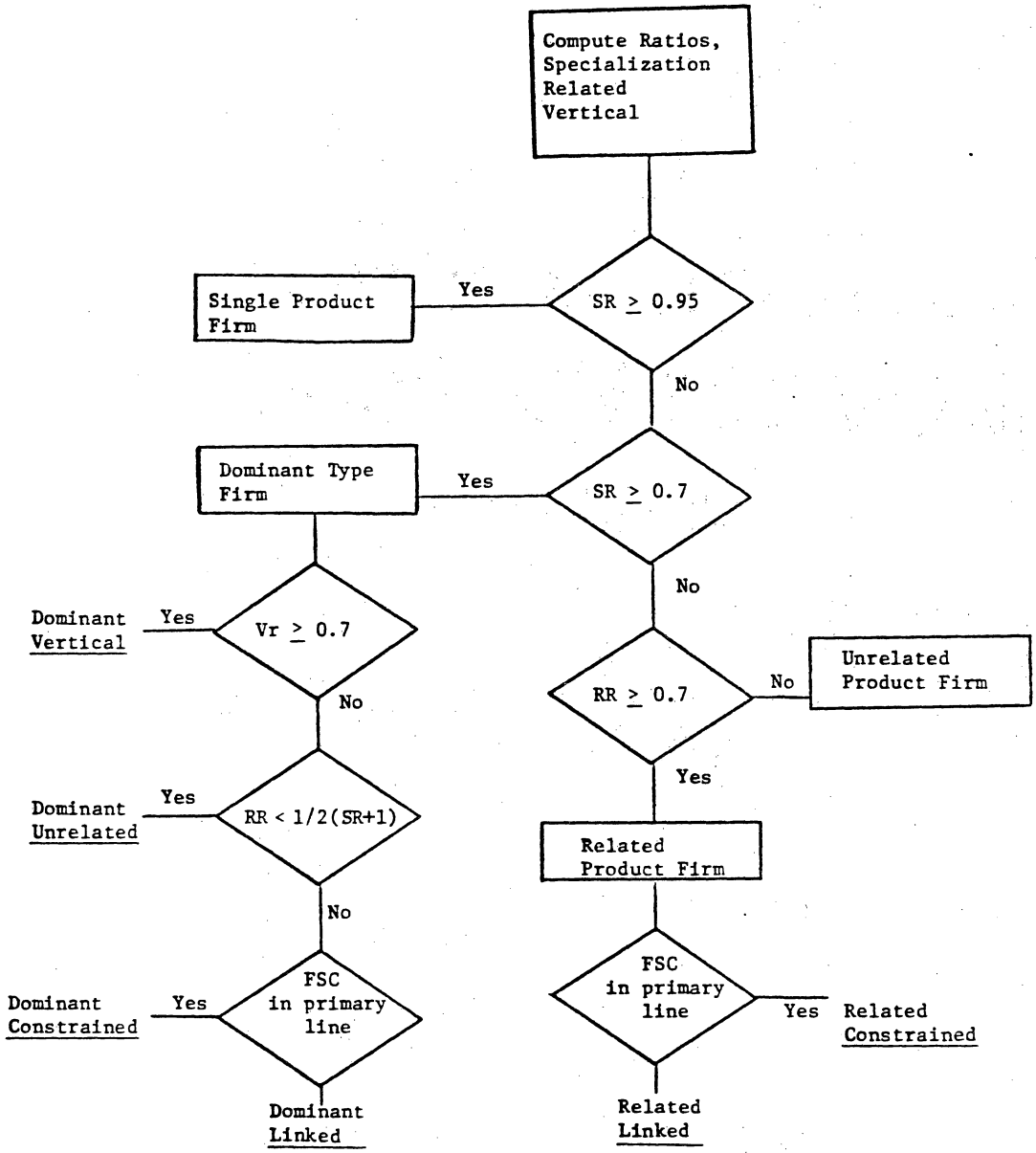


Figure 8
Rumelt's Strategy Classification

ratio of at least 0.7. If the diversification in the dominant business was not related to the primary activity then the firm was classified as dominant unrelated. If the related diversification in the dominant firm drew on a strength or skill developed in the primary activity then the firm was classified as a dominant constrained type. (In other words this classification says that the firm specific capital was being generated in the initial primary activity.) If the diversification drew upon particular strengths or skills in the firm, but not necessarily strengths developed in the primary activity, then the firm was classified as dominant linked. This distinction between constrained and linked diversification activities was extended to related type firms yielding related constrained and related linked business categories.

One can now see the source of some of the ambiguity in diversification levels for firms in various strategies is shown in Table 17. One sees that firms in the related linked strategy tended to be the most diversified, and they were followed closely by unrelated and dominant unrelated firms. One will notice though that vertically integrated firms tended to have high diversification levels. For this one can immediately see the relevance of considering the diversification strategy in addition to diversification alone. The reasons is that firms with certain "dominant" strategies can be expected to have diversification indicies which are as high as firms with "related" strategies. Intuitively, though one would have expected firms with dominant strategies to be less diversified. The

Table 17

Mean Diversification Measures by Corporate Strategies, 1960

| | Strategy* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| INDEX | S | DV | DC | DL | DU | RC | RL | UP |
| N | 3.64 | 10.81 | 6.71 | 11.00 | 17.50 | 12.25 | 24.78 | 20.17 |
| NP | 0.19 | 0.43 | 0.36 | 0.56 | 0.63 | 0.57 | 0.77 | 0.74 |
| G | 1.25 | 5.90 | 2.72 | 6.17 | 10.99 | 7.72 | 19.32 | 16.16 |
| HH1 | 0.28 | 0.55 | 0.49 | 0.73 | 0.76 | 0.70 | 0.88 | 0.85 |
| HH2 | 1.76 | 3.36 | 2.61 | 4.17 | 5.91 | 4.75 | 9.50 | 10.06 |
| E | 0.59 | 1.30 | 1.06 | 1.70 | 1.97 | 1.70 | 2.55 | 2.39 |
| HTU | 1.88 | 3.80 | 2.85 | 4.61 | 6.57 | 5.08 | 10.47 | 10.25 |

*In this study, unrelated positive and acquisitive conglomerates are taken together.

fact that this result does not necessarily follow can, in part, be blamed upon the ambiguity of the Standard Industrial Classification scheme. The conclusion then is that in testing hypothesis on diversified firms one should, if possible, explicitly consider both the level of diversification as reflected in a diversification index, and also the strategy of the firm.

CHAPTER VI

# EXAMINING RISK: A SECOND EMPIRICAL PROBLEM

A primary goal of this work is the examination of the empirical relationship between the extent of diversification of a firm and its degree of riskiness. To facilitate this end it seems appropriate to carefully examine the measure of corporate riskiness which will be used. In doing this one must answer two questions: First, exactly what is the measure, and how is it generated? Second, why is the chosen measure appropriate? This chapter will provide the answer to these questions by first reviewing the capital asset pricing model (CAPM), which yields the "beta coefficient" as a measure of risk. After presenting the model the relationship of the beta coefficient to other accounting measures of risk will be discussed. Then in section two, the specific method of computation for the beta coefficient is discussed. Finally, in section three the way in which diversification might effect beta will be examined and a review and critique of previous research which has employed this methodology.

## Generating a Measure of Risk

Obtaining a useful proxy for corporate risk has been a topic of concern to both academicians and corporate management. In the past many have relied upon accounting data generated by firms to provide

necessary proxies.[1] But the relatively recent research in financial theory has provided an appealing alternative to the collection of accounting data. The basic work by Tobin and Markowitz introduced the concept of portfolio theory.[2] In portfolio theory, risk is defined as the variance of a portfolio's return. From this work it follows that the risk associated with any individual asset will be its contribution to the variance of the portfolio and not its variance per se.

This can be easily shown by an examination of the variance of the portfolio's return.[3] The variance of a portfolio containing N assets is

$$\sigma^2(P) = \sigma_1^2 + \sigma_2^2 + \text{---} + \sigma_N^2 + 2\sigma_{12} + 2\sigma_{13} + \text{---} + 2\sigma_{1N} + 2\sigma_{23} + \text{---} + 2\sigma_{2N}$$

or

$$^2(P) = \sum_{i=1}^{N} \sum_{j=1}^{N} \sigma_{ij}$$

where $\sigma^2(P)$ = the variance of the portfolio's return

$\sigma_i^2$ = the variance of the ith component

$\sigma_{ij}$ = the covariance of the ith and jth components.

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[1] For a discussion of some accounting measures of risk, one should see William Beaver, Paul Kettler and Myron Scholes, "The Association Between Market Determined and Accounting Determined Risk Measures," Accounting Review (October 1970), 654-82.

[2] James Tobin, "Liquidity Preference as Behavior Toward Risk," The Review of Economic Studies, Vol. 25 (February 1958), 66-86 and Harry Markowitz, Portfolio Selection: Efficient Diversification of Investment, New York: John Wiley and Sons, 1959.

In other words, the variance of the portfolio is equal to the sum of the variances of the components, plus twice the sum of all the distinct covariances. Since the average of the first N variables has a variance ($\sigma^2(w)$) given by

$$\sigma^2(w) = \left(\frac{1}{N}\right)^2 \quad \sigma^2(P)$$

$$\sigma^2(w) = \left(\frac{1}{N}\right)^2 \quad \sigma^2(P)$$

or

$$\sigma^2(w) = \frac{\text{(Sum of the variances)}}{N^2} + \frac{2\text{(Sum of the distinct covariances)}}{N^2}.$$

But the sum of the distinct covariances is equal to N(N-1)/2 times the average covariance. Consequently, one can rewrite the variance of the portfolio as

$$\sigma^2(P) = \frac{\bar{\sigma}_i^2}{N} + \left(\frac{N-1}{N}\right) \bar{\sigma}_{ij} \qquad (1)$$

where $\bar{\sigma}_i^2$ = average component variance

$\bar{\sigma}_{ij}$ = average covariance.

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[3]This discussion closely follows that of Markowitz, Portfolio Selection: Efficient Diversification of Investment, Chapter 5 and that of Beaver, Kettler, and Scholes, "Association Between Market Determined and Accounting Determined Risk Measures."

The importance of this derivation is that it shows that as N increases the importance of the variance term decreases, leaving only the covariance term to be considered.[4]

Since the Markowitz model required enormous amounts of calculations, a simplification has been developed by Sharpe, Lintner, Mossin, Fama, and Jensen.[5] The new approach is referred to as the diagonal model or the capital asset pricing model.

In essence the capital asset pricing model (CAPM) asserts that in equilibrium the capital market can be described by the following simple linear equation:

$$E(Rj) = R_f + \beta_j[E(Rm) - R_f] \qquad (2)$$

where $E(Rj)$ = expected return on the jth security

$R_f$ = the risk free rate of interest

$B_j$ = slope of the securities characteristic line.

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[4]An assumption being made here is that the individual variances are bounded. This assumption may cause some consternation though since some empirical work has shown that the distributions of returns are symmetric, but appear to have an infinite variance. The intuitive explanation of the importance of the covariance is simple to see. The variability of a portfolio is the sum of the variance and the covariance terms. As one new item is added to the portfolio, the variability of the portfolio goes up by one variance term and 2N-1 covariance terms. If N is large the covariance terms should be more important.

[5]William F. Sharpe, "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk," Journal of Finance, Vol. 19 (September 1964), 425-42; John Lintner, "The Valuation of Risk Assets and the Selection of Risk Investments," Review of Economics and Statistics, Vol. 47 (February 1965), 13-37; Jan Mossin, "Equilibrium in a Capital Assets Market," Econometrica, Vol. 34 (October 1966), 768-84; Eugene Fama, "Risk, Return and Equilibrium: Some Clarifying Comments," Journal of Finance, Vol. 23 (March 1968), 29-40; Michael C. Jensen, Studies in the Theory of Capital Markets, New York: Praeger Publishing Co, 1972.

The slope term $\beta_j$ is commonly called the securities beta coefficient, and it refers to the systematic component of the security's risk. The other component of the security's risk, the "unsystematic" portion, is not of primary concern, since its effects can be eliminated through careful portfolio construction.

It can be shown that the beta coefficient is equal to the covariance of the securities return with the return on the market portfolio. That is:

$$\beta_j = \frac{COV(Rj,Rm)}{Var(Rm)} .$$

Empirically, the CAPM is estimated from the simple linear equation

$$R_j = \alpha_j + \beta_j \, Rm + \varepsilon_j$$

where $E(\varepsilon_j) = 0$

$\sigma(Rm,\varepsilon_j) = 0$

$\sigma(\varepsilon_i,\varepsilon_j) = 0$

$R_j$ = the actual return on security j

Rm = the return on the market portfolio

$\varepsilon_j$ = portion of the security's return which is not a function of Rm

$\alpha_j,\beta_j$ = parameters of the model.[6]

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[6]The parameter $\beta_j$ has already been discussed, and it equals $\sigma(R_j,Rm)/\sigma^2(Rm)$. The intercept parameter $\alpha_j$ has been given two interpretations. The first follows from equation (2) where $\alpha_j = R_f - \beta_j R_f$. But objections to the reliance on a risk free rate

In the CAPM the variance of an investor's portfolio is given by

$$\sigma^2(P) = (\frac{1}{N})\ \bar{\sigma}^2(\varepsilon_j) + \bar{\beta}^2\sigma^2(Rm)$$

where $\sigma^2(P)$ = variance of the portfolio

$\bar{\sigma}^2(\varepsilon_j)$ = mean of the unsystematic components

$\bar{\beta}$ = mean $\beta_j$

$\sigma^2(Rm)$ = variance of the market return.

As in the basic Markowitz model the individualistic components decline in importance as N grows and it is the covariance terms which play the important role. In practice it has been shown by Evans and Archer that complete diversification can be achieved with a relatively small number of assets in the portfolio.[7] This leaves the beta coefficient as a well defined measure of a security's riskiness.

The risk measure provided by portfolio theory is derived from the interactions among variables whose values are determined in the market. It is clear that if $E(R_j) < R_f + \beta_j(E(Rm) - R_f)$ the price of security would fall, driving the return up to its necessary equilibrium level. That is, if the expected return was less than the risk

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of interest caused subsequent research to develop a new interpretation, where $\alpha_j$ equaled the mean return on zero beta portfolio. For a discussion one should see Fischer Black, "Capital Market Equilibrium with Restricted Borrowing," Journal of Business, Vol. 45 (July 1972), 444-54.

[7] J.C. Evans and S.H. Archer, "Diversification and the Reduction of Dispersion: An Empirical Analysis," Journal of Finance, Vol. 23 (December 1968), 761-68.

free return plus the necessary risk premium, individuals would want to sell the security causing downward pressure on the price. With this understanding of the securities market it is necessary to ask how the activity of the security market relates to the activity of the corporation.

Fortunately one does not need to look very long to find a justification for the use of security market data. A substantial body of literature has emerged which demonstrates that current security's prices reflect all relevant information on expected return or price distribution.[8] In other words, they act as unbiased estimates of a firm's intrinsic value. Consequently, the previous preoccupation of searching accounting data to locate market miscalculations should prove to be an unnecessary expenditure of effort.

In addition to the basic literature on efficient markets, research has been conducted which examines the relationship between accounting determined risk measures and the beta coefficient measure of work obtained from the CAPM. An excellent example of this type of research is provided in the work of Beaver, Kettler and Scholes.[9] In

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[8]The literature on Efficient Markets is massive, but the point can be made by examining the work of Eugene Fama, "Efficient Capital Markets, A Review of Theory and Empirical Work," Journal of Finance, Vol. 25 (May 1970), 383-417, or Eugene Fama, Lawrence Fisher, Michael Jensen and Richard Roll, "The Adjustment of Stock Prices to New Information," International Economic Review, Vol. 10 (February 1969), 1-21. As Fama concludes, "In short, the evidence in support of efficient market models is extensive, and somewhat uniquely in economics) contradictory evidence is sparse."

[9]Beaver, Kettler and Scholes, "The Association Between Market Determined and Accounting Determined Measures of Risk."

their study, various accounting measures of risk are examined and their relationship to the CAPM beta is examined. The measures used were: payout, leverage, liquidity, asset size, growth, variability of earnings, and covariability of earnings, where the last measure is essentially an "accounting beta." This list, while it does not include all possible risk measures, does seem to contain important and frequently used risk proxies from both the industrial organization and the finance literature.[10] Their findings are clearly stated in their concluding remarks.

> The evidence supports the contention that accounting measures of risk are impounded in the market-price based risk measure. There is a high degree of contemporaneous association between the accounting and the market risk measures. More precisely, a strategy of selecting and ranking portfolios according to accounting risk measures is essentially equivalent to a strategy of ranking those same portfolios according to the market-determined risk measure. This finding is consistent with the joint hypothesis that accounting data do reflect the underlying events that determine differential riskiness among securities and that such events are also reflected in the market prices of securities.[11]

This finding is consistent with other well known work on this subject. For example, Hamada found that the risk associated with leverage explained a significant portion of the CAPM beta. Similarly, the work of Rosenberg and McKibben found that various measures of a

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[10] In the industrial organization literature one frequently sees earnings variability, growth, or asset size used as proxies for a company's risk.

[11] Beaver, Kettler and Scholes, "The Association Between Market Determined and Accounting Determined Measures of Risk," p. 679.

firm's riskiness were functually related to the firm's CAPM beta.[12] It is important to note, that while evidence supports the contention that various accounting risk measures are considered in the market calculation of beta, this is not equivalent to saying that beta is highly correlated with any one measure of risk. Consequently, if one expects a change in the nature of the firm (such as a change in the level of diversification) to effect the riskiness of the firm, an empirical test based upon the CAPM beta should be more than adequate.

The Computation of Beta

As discussed above the Capital Asset Pricing model postulates that the rate of return to an asset can be represented by the simple linear model:

$$R_{jt} = \alpha_{jt} + \beta_{jt} Rm_t + \varepsilon_{jt}$$

where $R_{jt}$ is the rate of return on asset j during time period t. $R_{mt}$ is the rate of return on a market index, $\beta_{jt}$ is a parameter which measures the riskiness of asset j, $\alpha_{jt}$ is the rate of return on a portfolio orthogonal to the market portfolio, and $\varepsilon_{jt}$ is an error term. Theoretically, the notion of this model is that it holds at each equilibrium point in time. In practice, individuals who use the

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[12] Robert S. Hamada, "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks," Journal of Finance, Vol. 27 (May 1972), 435-52 and Barr Rosenberg and Walt McKibben, "The Prediction of Systematic and Specific Risk in Common Stock," Journal of Financial and Quantitative Analysis, Vol. 8 (March 1973), 317-33.

model typically assume that the parameters of the model are stationary through time, and they estimate the parameters using time series data. Recent research though has demonstrated that this is not in general the case.[13] Although there is no theoretical reason for the parameters to be stationary it has been found that for many securities the stationarity assumption may be reasonable.[14] When it exists the nonstationarity may be attributed to various changes internal to the firm. One such change may be the level of diversification.

In the work of Hinich and Roll,[15] a method for tracking the nonstationary parameter of a linear model is presented. The method is quite simple and direct, and merely requires making the parameters a function of time. In their work legendre polynomials (a class of orthogonal polynomials) were used to develop a tracking over time. One can estimate the movement of the $\beta_{jt}$ parameter (assuming now for simplicity that one knows $\alpha_{jt}$ is stationary)[16] by estimating

$$R_{jt} = \alpha_{jt} + b_{oj}Rm_t + b_{1j}tR_{mt} + b_{2j}[(3t^2 - 1)/2]Rm_t + ---$$

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[13]Examples of this research are provided by: Marshall Blume, "On the Assessment of Risk," Journal of Finance (March 1971), 1-10 and Melvin Hinich and Richard Roll, "Measuring Nonstationarity in a Linear Model with Applications to Asset Returns," Virginia Polytechnic Institute and State University Working Paper, No. E77-4-4.

[14]Hinich and Roll, "Measuring Nonstationarity in a Linear Model with Applications to Asset Returns."

[15]Hinich and Roll, "Measuring Nonstationarity in a Linear Model with Applications to Asset Returns."

[16]The estimation process did not force the constants to be stationary, and some nonstationarity was detected.

Using this estimation procedure, one can determine if and how the risk parameter moves through time, and its location relative to other firms at any given point in time.

In this study the risk measure is computed using data from the CRSP (Center for Research in Stock Prices) tapes. The model was calculated using monthly stock return data over the period 1954-1975. This placed the observation period of interest (1960's) toward the center of the computation. Both the constant and the beta coefficient were allowed to move through time, although in general there was less movement in the constant. The program used to compute the parameters used a stepwise algorithm,[17] and it allowed the parameters to be up to sixth degree legendre polynomials.[18] A function was included in the model if it was at least significant at the 0.10 level, although in general included functions were significant at the .05 level or better.

Once a continuously moving beta has been estimated, one can obtain the appropriate annual average by merely averaging the twelve appropriate observations. In order to compare the results of the

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[17] The program used was from the IMSL (International Mathematical Statistical Library).

[18] Trigonometric functions were also tested. The polynomial used in the trigonometric estimation was

$$y = \text{Sin}(\frac{2\pi Jt}{T}) + \text{Cos}(\frac{2\pi Jt}{T})$$

where t is the time period, T is the total number of periods, and j is the degree.

different estimation techniques, annual average betas were estimated for 100 firms using legendre polynomials, trigonometric polynomials, and in a stationary manner. The stationary beta was computed for two three year periods (1960-1961, 1965-1966). In Table 18 the means and standard deviations for the betas are given, and in Table 19 the correlations are given. It is striking how low these correlations are. From this information one cannot choose the best technique, but it does suggest that analysis conducted with the various measures could produce different results.

The CAPM Beta and Diversification

Before proceeding any further in discussions on tests of the effect of diversification on risk, it is necessary to outline how diversification might impact risk. The reason that point must be explicitly considered is that under many conditions a firm's diversification could not reduce the risk to the stockholders. It had been noted by Alberts[19] and later argued by Levy and Sarnat[20] that simple portfolios style diversification by firms cannot accomplish anything that individual investors could not have done for themselves. On the other hand, it has been noted by Lewellen that diversification can

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[19]William W. Alberts, "The Profitability of Growth by Merger," in William Alberts and Joel Segall, ed., The Corporate Merger, Chicago: University of Chicago Press, 1966.

[20]Haim Levy and Marshall Sarnat, "Diversification Portfolio Analysis and the Uneasy Case for Conglomerate Merger," Journal of Finance (September 1970), 795-802.

Table 18

Mean Betas and Standard Deviations for Select Years

| | Mean | Standard Deviation |
|---|---|---|
| Stationary Beta 1960-61 | 1.089 | 0.324 |
| Legendre Type Beta 1960 | 1.073 | 0.273 |
| Legendre Type Beta 1961 | 1.087 | 0.257 |
| Trigonometric Type Beta 1960 | 1.082 | 0.331 |
| Trigonometric Type Beta 1961 | 1.112 | 0.369 |
| Stationary Beta | 1.103 | 0.301 |
| Legendre Type Beta 1965 | 1.098 | 0.273 |
| Legendre Type Beta 1966 | 1.091 | 0.289 |
| Trigonometric Type Beta 1965 | 1.147 | 0.433 |
| Trigonometric Type Beta 1966 | 1.105 | 0.433 |

Table 19

Correlation Matrix of Beta Measures*

| | SB 1960 | BL 1960 | BL 1961 | T 1960 | BT 1961 | SB 1965 | BL 1965 | BL 1966 | BT 1965 | BT 1966 |
|---|---|---|---|---|---|---|---|---|---|---|
| SB | 1.00 | | | | | | | | | |
| BL 1960 | 0.59 | 1.00 | | | | | | | | |
| BL 1961 | 0.56 | 0.97 | 1.00 | | | | | | | |
| BT 1960 | 0.58 | 0.69 | 0.67 | 1.00 | | | | | | |
| BT 1961 | 0.35 | 0.67 | 0.70 | 0.73 | 1.00 | | | | | |
| SB 1965 | 0.16 | 0.33 | 0.69 | 0.41 | 0.52 | 1.00 | | | | |
| BL 1965 | 0.30 | 0.39 | 0.50 | 0.34 | 0.38 | 0.55 | 1.00 | | | |
| BL 1966 | 0.28 | 0.33 | 0.40 | 0.27 | 0.29 | 0.46 | 0.97 | 1.00 | | |
| BT 1965 | 0.33 | 0.49 | 0.52 | 0.22 | 0.34 | 0.33 | 0.59 | 0.57 | 1.00 | |
| BT 1966 | 0.21 | 0.39 | 0.43 | 0.21 | 0.19 | 0.38 | 0.72 | 0.74 | 0.72 | 1.00 |

*Abbreviations are (SB) for stationary beta, (BL) for Legendre type beta, and (BT) for trigonometric type beta.

lower bankruptcy risk and certain situations.[21] But, in general, it is concluded that without synergy, individual investors will be able to diversify at least as well as firms.

The theory of firm specific capital provides an explanation for the existence of synergy. Clearly if a firm diversifies in order to create an internal market for its firm specific capital, the result of diversification will appear as a type of synergy. The way in which diversification due to FSC might effect risk can be easily visualized. Assume for simplicity that a corporate center exists; which charges the various production units for the use of firm specific capital. An example is depicted by Figure 9. Assume C(Q) is the total cost function in the absence of any firm specific capital, and C(Q,FSC) is the total cost function after the application of firm specific capital. Assume the corporate center charges the production unit for the firm specific capital an amount equal to:

$$P_c = \int_0^{Q_1} [C(Q) - C(Q,FSC)2 \; d \; Q + \int_{Q_1}^{Q_2} [MR - C(Q,FSC)]dQ.$$

This merely shifts the additional profits which might have been accrued by the production unit to the corporate center. When this is done, a firm with X productive streams (X equals the return streams associated with productive units and the last return stream is generated by the managements sale of FSC). Notice that if the

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[21] W.G. Lewellen, "A Pure Financial Rationale for Conglomerate Merger," Journal of Finance, Vol. 26 (May 1971), 521-37.

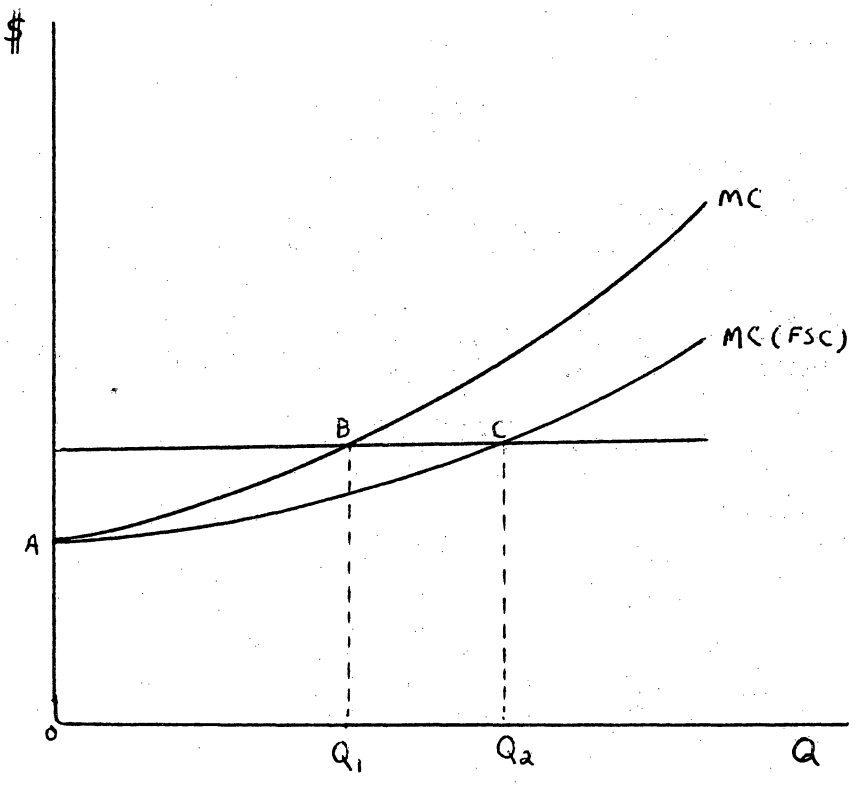


Figure 9
Firm Specific Capital and Marginal Cost

management has no input to sell then its return stream is zero. Given the existence of this return stream, the corporation can no longer be viewed as a portfolio of X production return streams, where each X return stream could have existed just as profitably outside of the diversified firm.[22]

The effect of this new return stream upon the total risk of the firm is clear. The total beta for the firm is the weighted average of all its component betas. The beta for the corporate center is equal to the covariance of its return with the market return, divided by the variance of the market. The net effect of FSC on the firm's beta will be equal to the corporate centers beta times its proportional contribution to the firm's total income.[23]

A number of studies have attempted to use the beta coefficient to examine various aspects of the firm. For the purposes here the most notable are the studies by Weston, Smith, Shrieves, and Weston and Smith.[24] Their work, building upon earlier studies[25] attempted

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[22]Discussing the problem in terms of the corporate center is meant as a simplification not a restriction, clearly one could view FSC as altering each return stream and its covariance with the market. But it seems easier to speak of one additional return stream occurring to the corporate center.

[23]Since this would tend to be a small change, one would not expect firms to diversify only to reduce capital market risk.

[24]J.F. Weston, K.V. Smith, and R.E. Shrieves, "Conglomerate Performance Using the Capital Asset Pricing Model," Review of Economics and Statistics, Vol. 54 (November 1972), 357-63.

[25]For example, R. Westerfield, "A Note on the Measurement of Conglomerate Diversification," Journal of Finance, Vol. 25 (September 1970), 909-14.

to examine the portfolio performance of conglomerates. The major problem with these studies was that none really attempted to assess the role of diversification levels or strategies to the portfolio performance. The test which will be conducted subsequently will use their general methodology, but attempt to overcome the primary shortcomings by incorporating measures of the extent of diversification, and of diversification strategies.

# CHAPTER VII

# DIVERSIFICATION AND RISK: THE EMPIRICAL ANALYSIS

Whether or not corporations can reduce their riskiness in a meaningful way through line of business diversification has long been a subject for debate. It is known that asset holders can lower their risk through diversification, but it is not clear how or when this argument can be applied to line of business diversification by firms. Here an empirical examination will be conducted, which will attempt to ascertain if and when line of business diversification can lead to lower riskiness for the corporation. In addressing this basic question some testable hypotheses concerning diversification and risk will be developed, and then the empirical tests will be conducted using the capital asset pricing model to derive measures of risk.

## A View of the Firm

It has been argued that diversification by any firm will enable that firm to lower its risk. As Richard Rumelt has said:

> One of the simplest and most often used arguments in favor of diversification is that it reduces the total risk or variability in earnings that comes from spreading investment funds and effort among several businesses. Just as a mutual fund reduces the risk inherent in purchasing a single security

> by holding many, management can employ diversification to reduce the total risk borne by the corporation.[1]

Although it is intuitively appealing, the defense of diversification through the application of simple portfolio theory is not strictly correct. For example, it has been argued by Haim Levy and Marshall Sarnat that without synergy (and, of course, some explanation for it) economic advantages cannot be achieved by purely conglomerate mergers.[2]

The argument developed by Levy and Sarnat is a very important one, and consequently it merits some elaboration. Their point is that different production activities will be associated with different return streams. Each of these return streams will be associated with a different level of riskiness. At one time the riskiness of the return was seen as the variability of that return stream. Modern portfolio theory leads one to question this view of risk. Since the owners of the company are the stockholders of the corporation, the relevant variability is that of the stockholders portfolio. In constructing his portfolio the stockholder recognizes that associated with each asset there are two types of risk. The first is unsystematic risk, which the stockholder can diversify away through careful portfolio construction. The second type of risk is the systematic risk which cannot be

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[1]Richard Rumelt, Strategy, Structure and Economic Performance, Cambridge, Mass.: Harvard University Press, 1974, 80.

[2]Haim Levy and Marshall Sarnat, "Diversification, Portfolio Analysis and the Uneasy Case for Conglomerate Merger," Journal of Finance (September 1970), 795.

diversified away. The total risk associated with a stockholders well diversified portfolio will be the weighted average of the systematic risk of the individual assets.[3] Now one can easily see the point made by Levy and Sarnat. If the market portfolio is an efficient portfolio,[4] then the systematic risk of any corporation is a function of the covariance of the company's return stream with the market's return stream. A merger then will cause the resulting company to have a systematic risk equal to the weighted average of each of the two pre-merger companies. Hence, this type of behavior provides no economic gain. Another way to view this situation is that a less (more) risky asset will, ceteris paribus, have a higher (lower) value. Consequently if markets are efficient a company cannot buy up less risky companies in order to lower total company risk, and obtain the commensurate capital gain.

At this point one must recognize that there are ways in which firms can and will alter their riskiness through diversification. This will occur first of all if a diversified firm can effectively utilize its internal markets to move some type of firm specific capital. A second possibility is that managers of firms have access to different information than do ordinary investors. Since the riskiness of an asset depends upon expectations, managers may be able to alter the net

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[3]The weights in the average process will be the percentages of the total portfolio made up by the individual assets.

[4]In using the capital asset pricing model the market portfolio is seen as an efficient portfolio.

riskiness of the corporation by exploiting their special information. A third possibility is that for some reason investors may be constrained to construct portfolios which are largely composed of one particular asset. In this case it might be wise to alter the portfolio by altering the nature of the primary asset holding. (This case seems to apply to managers who hold a large portion of their total portfolio in their own company.) In any of the above cases one would expect to see enterprising managers attempting to diversify and lower their corporations riskiness.

In any examination of the firm it is important to recognize the role played by the managers of the firm. The point has often been made that hired managers, and not the actual owners of the firm make the decisions for the firm. Consequently, the motivations for their decisions need to be considered, and it should be noted to what extent they deviate from the stockholders' interests. Robin Marris in his classic study on corporate capitalism has argued that although managers do have some incentives which may be in some ways at odds with the stockholder, they are still constrained to not totally neglect stockholders.[5] Similarly a study by Lewellan and Huntsman has shown that the vested interest which managers have in their own companies keeps them from acting to exploit the stockholders.[6]

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[5]Robin Marris, The Economic Theory of "Managerial" Capitalism, New York: The Free Press, 1964.

[6]W.G. Lewellen and B. Huntsman, "Managerial Pay and Corporate Performance," American Economic Review, Vol. 55 (September 1970), 710-710-21.

The fortunes of management are tied to corporate performance in two ways. First of all, salaries may depend upon such things as corporate growth and corporate profitability. Secondly, it is not uncommon for managers to have a large portion of their portfolio in stock options and in the stock of their company. To the extent that the variability of their future income stream is tied to the variability of the performance of their company, they would have the incentive to reduce the variability in their company's performance. Consequently management may view themselves as being unable to fully diversify their portfolio, since so much of their portfolio is tied to their own company. This may cause them to prefer certain diversifications which leave other investors in a Levy and Sarnat world indifferent. Yet to the extent that all stockholders are served, the management would not want to undertake diversifications which lower the market value of the firm.

It should be noted though that managers will have the most freedom to pursue their own ends when they are keeping stockholders happy. In diversification policy, managers should seek those alternatives which they expect will yield economic gains, then they will be able at the same time to seek other diversifications which will lower their own perceived riskiness. As mentioned earlier, real economic gains can be captured either if managers have better information than other investors, or if managers can make the corporation more profitable after diversification by exploiting some sort of firm specific capital.

On some occasions it may be that investors are unable to get full accurate information on a corporation, or for some reason they lose faith in the current management causing the value of the corporation to fall. In this case the management of a second corporation may see the potential for a profitable takeover. The increase in value may result without the new management instituting any real changes. For example, consider the recent case of UV Industries. This Fortune 500 firm appeared to be worth more to investors after liquidation than it was if it were operating. When the management decided to divest itself of all its holdings the value of the corporation rose.[7] Since all operating divisions are expected to remain intact, this suggests that the investors had for some reason lost faith in the ability of the present management to operate effectively. It provides a large scale example of how smart managers can obtain economic gains through a wise diversification and divestiture policy.

The second way in which a management might produce a real economic gain is through the exploitation of some form of firm specific capital. When a firm diversifies creating an internal market for firm specific capital, it achieves an economic gain by lowering its production costs. In addition it will cause the resulting risk of the firm to be different from the mere weighted average of the pre-diversification endeavors.[8]

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[7]Peter W. Burnstein, "A Company That's Worth More Dead Than Alive," Fortune (February 26, 1979), 42-44.

[8]For an example see the discussion in Chapter VI.

One is now faced with the problem of quantifying corporate risk. There are two ways in which this can be done. The first method is to follow in the lead of other studies in industrial organization and use the variability of corporate earnings. A second method is to use the capital asset pricing model (CAPM), as developed by Sharpe, Lintner, et al.[9] In essence the CAPM asserts that the equilibrium rate of return to an asset can be represented by the simple linear model

$$R_{jt} = \alpha_{jt} + \beta_{jt} R_{mt} + \varepsilon_{jt}$$

when $R_{jt}$ is the rate of return on asset j during time period t. $R_{mt}$ is the rate of return on a market index, $\beta_{jt}$ is a parameter which measures the riskiness of asset j, $\alpha_{jt}$ is the rate of return on a portfolio orthogonal to the market portfolio, and $\varepsilon_{jt}$ is an error term. Theoretically, the notion of this model is that it holds at each equilibrium point in time. In practice, individuals who use the model typically assume that the parameters of the model are stationary through time, and they estimate the parameters using time series data. Recent research though has demonstrated that this is not in general the case. Although there is no theoretical reason for the parameters to be stationary it has been found that for many securities the

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[9]William F. Sharpe, "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk," Journal of Finance, Vol. 19 (September 1964), 425-42 and John Lintner, "The Valuation of Risk Assets and the Selection of Risk Investments," Review of Economics and Statistics, Vol. 47 (February 1965), 13-37. See the discussion of Chapter VI for further references.

stationarity assumption may be reasonable.[10] When it exists the non-stationarity may be attributed to various changes internal to the firm. One such change may be the level of diversification.

With these two basic risk measures (earnings variability and Beta) defined, one can set out two basic hypotheses regarding diversification and risk. First of all additional diversification should enable a firm to lower the variability of its earnings. This follows from the simple application of portfolio theory. One must remember that lower variability of earnings does not necessarily yield an economic gain to the stockholders, but one would expect it to be beneficial to managers. Consequently, one would expect that manager who could produce the greatest real economic gains through diversification, to be the most successful at seeking lower earnings variability as an additional perquisite.

The impact of diversification on the systematic risk of the firm is not quite as straightforward. Diversification can cause the systematic risk of a corporation to rise or fall, depending upon the relative systematic risk of the new activity. The results of this study will show that in general, firms diversify into higher beta activities, causing their Betas to rise. But if a firm is exploiting firm specific capital in its diversification, then the rise in Beta should not be as

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[10]Examples of this research are provided by Marshall Blume, "On the Assessment of Risk," Journal of Finance (March 1971), 1-10 and Melvin Hinich and Richard Roll, "Measuring Non-Stationarity in the Parameters of a Linear Model with Applications to Asset Returns," Virginia Polytechnic Institute and State University Working Paper, 1977.

great (i.e., the resulting Beta is less than the weighted average Beta of the two endeavors).

Empirical Considerations

To examine diversification and risk one needs three empirical measures. These are a measure for risk, a measure for diversifications, and a means of judging the extent of firm specific capital. For risk measures earnings variability and the CAPM Beta will be used. The Beta for firms in this study was calculated in three different ways. The first method was to assume stationarity of the Beta and to calculate it over a 24 month period. Since this study will center on the years 1960 and 1965, the stationary Betas (labeled B0 and B5) were calculated over the 1960-61 and 1965-66 periods. The two other calculations of Beta allowed the parameter to move through time. Beta was allowed to be a function of time (as was the intercept term). In the estimation of Beta, two types of time functions were used, Legendre and Trigonometric. The resulting Betas were an average of the moving Beta for the appropriate year. (They are labeled BL for Legendre type and BT for trigonometric type.) In this study the Betas were calculated for a sample of 97 firms from the CRSP (Center for Research on Security Prices) tapes.

The relationship which exists among the various computations of Beta for this sample of firms is shown in Table 20 and Table 21. It can be seen in Table 20 that on average the firms in this sample had Betas which were greater than one. From Table 21 one can see that the results of the various estimations are not that highly correlated.

Table 20

Beta Means and Standard Deviations

| | Mean | Standard Deviation |
|---|---|---|
| Stationary Beta 1960 | 1.089 | 0.324 |
| Stationary Beta 1965 | 1.031 | 0.301 |
| Legendre Type Beta 1960 | 1.071 | 0.273 |
| Legendre Type Beta 1965 | 1.097 | 2.273 |
| Trigonometric Type Beta 1960 | 1.08 | 0.331 |
| Trigonometric Type Beta 1965 | 1.147 | 0.188 |

Table 21

Correlation Among Beta Estimates

| | S. Beta 1960 | L. Beta 1960 | T. Beta 1960 | S. Beta 1965 | L. Beta 1965 | T. Beta 1965 |
|---|---|---|---|---|---|---|
| S. Beta 1960 | 1.00 | | | | | |
| L. Beta 1960 | 0.59 | 1.00 | | | | |
| T. Beta 1960 | 0.58 | 0.69 | 1.00 | | | |
| S. Beta 1965 | 0.16 | 0.63 | 0.41 | 1.00 | | |
| L. Beta 1965 | 0.30 | 0.39 | 0.34 | 0.55 | 1.00 | |
| T. Beta 1965 | 0.32 | 0.49 | 0.22 | 0.33 | 0.59 | 1.00 |

Since this study is not designed to choose among the various methods of estimation it will examine the sensitivity of the findings to the various estimation techniques.

In models of firm specific capital, as discussed earlier, it is argued that firms diversify in particular ways in order to expand internal markets for their firm specific resource. Consequently, not all diversifications will be equivalent. One would expect different impacts upon profitability under different diversification strategies.[11] For example, a completely specialized firm which diversifies into a completely unrelated product line would be effected in a different way than a firm which diversifies into a product which is related in production or distribution. Therefore, one needs to consider the type of diversification as well as its extent. For the purpose of empirical analysis this means that one needs measures of the degree of a firm's diversification and a method to classify its direction.

To measure the degree of diversification data reported in the Fortune Plant and Product Directory were used.[12] Following the lead

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[11]The concept of corporate strategy is discussed in Alfred D. Chandler, Strategy and Structure, Garden City, New York: Doubleday & Co., 1942. For a more recent discussion one should see Richard Rumelt, Strategy, Structure and Economic Performance, Cambridge, Mass.: Harvard University Press.

[12]Fortune, Market Research Department, 1961 Plant and Product Directory. Time Inc., 1961 and 1966 Plant and Product Directory, Time Inc., 1966. Indices developed from this data are found in Charles Berry, Corporate Growth and Diversification, Princeton, New Jersey: Princeton University Press, 1975.

of Charles Berry diversification measures based upon employment distributions were computed.[13] The particular diversification measure (D) used in this study is:

$$D = 1/(\sum_{i=1}^{n} p_i^2)$$

where $P_i$ is the share of the firm's total employment devoted to a particular SIC category.

Now that a measure of the extent of diversification has been defined, a proxy for the relative amounts of firm specific capital must be found. To fill this need the direction of diversification in the firm will be determined using the work of Richard Rumelt.[14] Rumelt had classified a sample of firms by their strategy into one of eight categories. These strategies were: single business, dominant vertical, dominant constrained, dominant linked, related constrained, related linked, unrelated passive and acquisitive conglomerate. For the purposes of this study, Rumelt's classifications of individual firms were reordered into the following five groups: single businesses, vertically integrated businesses, constrained type businesses, linked type businesses, and unrelated businesses. Basically, this classification system eliminated the "dominant" and related distinctions, since a continuous measure of diversification was also being used.

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[13] Charles Berry, Corporate Growth and Diversification.

[14] For a more complete discussion of Rumelt's methodology see the discussion in Chapter V. Due to the inherent difficulties in subjectively classifying the firms this study uses data on the classification of firms presented by Rumelt.

Accounting Measures and Risk

In addition to diversification it is known that risk, as measured by the CAPM beta, may also be effected by changes in other variables under the control of the firm. Five of these variables are leverage, liquidity, payout, absolute firms size and growth. Consequently, when examining changes in corporate risk it will be necessary to control for the influence of these factors. These variables are of additional interest in a diversification study since it is frequently alleged that they are effected by diversification themselves.

Consider first the role of leverage.[15] It has long been known that the earning stream of stockholders becomes more volatile as the ratio of total senior securities to total assets increases.[16] In addition, it has been argued that the degree of leverage would vary systematically with diversification.

A second factor to consider is liquidity. It has been argued that a lack of liquid assets may make a firm more risky. The notion here is that current assets are less volatile than noncurrent assets. In addition, it has been argued that changes in diversification levels impact the liquidity of a firm. For example, a firm choosing to be

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[15]The discussion here follows that of William Beaver, Paul Kettler, and Myron Scholes, "The Association Between Market Determined and Accounting Determined Risk Measures," Accounting Review (October 1970), 654-81.

[16]See Franco Modigliani and Merton Miller, "The Cost of Capital Corporation Finance and the Theory of Investment," American Economic Review, Vol. 48 (June 1958), 261-97.

more liquid could diversify into an endeavor which tened to be highly liquid.

In the security valuation literature it has been argued that firms with lower ratios of dividends to income available for common stockholders (the payout ratio) will be more risky. The basic rationalization of this argument is that payout is a proxy for management's perception of the firm's riskiness.

The last two control variables are growth and absolute size. The popular linkages between size, growth and risk are well known. In addition some believe that there is a relationship between these two variables and diversification. This belief is displayed in statements such as "Diversification is the way to corporate growth" and "Large firms tend to be highly diversified."

Empirical Findings

From the above discussion one is left with the following simple empirical model:

Risk = f(Diversification levels, diversification strategy, financial variables).

If one were to ignore diversification strategies, he would find that diversification had either a positive or no effect on the systematic risk of the firm, depending upon what year and what level of diversification (two-three or four SIC Digit) was considered. Table 22 reports the results of a regression of systematic risk on the financial variables and diversification for 1960. It was found that the only important financial variables were leverage and payout which had

Table 22
The Effect of Financial Variable and Diversification
on the Beta Coefficient 1960*

| | 2 Digit Diversification | | | 3 Digit Diversification | | | 4 Digit Diversification | | |
|---|---|---|---|---|---|---|---|---|---|
| | B60** | BL60 | BT60 | B60 | BL60 | BT60 | B60 | BL60 | BT60 |
| Constant | 0.93 | 0.96 | 1.11 | 0.96 | 1.04 | 1.17 | 0.98 | 1.06 | 1.19 |
| | (4.57) | (5.90) | (5.22) | (4.88) | (6.45) | (5.61) | (4.94) | (6.50) | (5.66) |
| Div | 0.02 | 0.05 | -0.05 | 0.02 | 0.02 | 0.01 | 0.97 | 0.01 | 0.01 |
| | (0.74) | (2.50) | (1.47) | (1.73) | (1.78) | (1.03) | (1.42) | (1.48) | (0.96) |
| Leverage | 0.78 | 0.49 | 0.79 | 0.74 | 0.49 | 0.18 | 0.75 | 0.50 | 0.19 |
| | (2.63) | (2.08) | (0.61) | (2.52) | (2.03) | (0.61) | (2.55) | (2.05) | (0.61) |
| Liquidity | -0.01 | 0.02 | 0.01 | -0.01 | 0.02 | 0.01 | -0.01 | 0.02 | 0.01 |
| | (-0.21) | (0.76) | (0.17) | (-0.43) | (0.55) | (0.05) | (-0.37) | (0.58) | (0.02) |
| Payout | -0.22 | -0.35 | -0.40 | -0.25 | -0.35 | -0.40 | -0.26 | -0.36 | -0.41 |
| | (-1.43) | (-2.82) | (-2.47) | (-1.61) | (-2.81) | (-2.47) | (-1.64) | (-2.83) | (-2.49) |
| Size | 0.38 | 0.06 | 0.35 | 0.29 | -0.03 | 0.28 | 0.27 | -0.05 | 0.25 |
| | (1.02) | (0.22) | (0.90) | (0.79) | (-0.86) | (0.70) | (0.71) | (-0.16) | (0.64) |
| Growth | -0.46 | -0.81 | 0.11 | -0.49 | -0.84 | 0.90 | -0.47 | -0.83 | 0.10 |
| | (-1.04) | (-2.27) | (0.24) | (-1.11) | (-2.33) | (0.20) | (-1.07) | (-2.28) | (0.22) |
| R Square | .15 | .23 | .11 | .17 | .20 | .10 | .16 | .19 | .10 |

*T statistics are in parentheis.

**The dependent variables are listed at the column tops. See Appendix 4 for a discussion of variables.

the expected signs. The other financial variables were not significant. The diversification level seemed to have a slightly positive effect. Suggesting that in general firms diversified into higher Beta activities. Similar results are shown in Table 23 for 1965. The primary difference is that the relative importance of diversification rose, while that of leverage fell. The payout ratio was once again found to be the most important financial variable.

At this point, one can begin to test the first of the hypotheses regarding diversification and FSC. It was found that in general firms were diversifying into higher Beta activities. It was hypothesized earlier that if diversification were going to cause the Beta of the firm to rise, it would tend to rise less if the firm could exploit some of its FSC. Hence, in the strategy where the most FSC is expected one would expect the marginal impact of diversification on Beta to be lower.

To test the hypothesis, the basic model of Tables 23 and 24 was estimated again incorporating the strategy variables as slope change dummy variables. In addition, the coefficients on the insignificant financial variables were constrained to zero.[17] The results were basically consistent with the hypothesis. The financial variables had the expected signs though only payout remained significant. More importantly it was found that the marginal effect of diversification in the linked strategy group was consistently lower than in the other

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[17] These constraints could not be rejected at any reasonable level with an F test.

Table 23
The Effect of Financial Variables and Diversification
on the Beta Coefficient 1965*

| | 2 Digit Diversification | | | 3 Digit Diversification | | | 4 Digit Diversification | | |
|---|---|---|---|---|---|---|---|---|---|
| | B60 | BL60 | BT60 | B60 | BL60 | BT60 | B60 | BL60 | BT60 |
| Constant | 1.23 | 0.76 | 1.02 | 1.26 | 0.85 | 1.19 | 1.30 | 0.90 | 1.26 |
| | ( 4.29) | (3.13) | (2.65) | (4.70) | (3.70) | (3.27) | (4.84) | (3.94) | (3.49) |
| Div | 0.02 | 0.03 | 0.06 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 |
| | (0.62) | (1.42) | (1.70) | (1.05) | (1.91) | (1.72) | (1.14) | (1.94) | (1.90) |
| Leverage | 0.01 | 0.51 | 0.51 | -0.03 | 0.44 | 0.37 | -0.05 | 0.04 | 0.32 |
| | (0.04) | (1.71) | (1.08) | (-0.08) | (1.47) | (0.80) | (-0.15) | (1.34) | (0.67) |
| Liquidity | -0.02 | 0.07 | 0.06 | -0.02 | 0.06 | 0.04 | -0.02 | 0.06 | 0.03 |
| | (-0.31) | (1.92) | (0.92) | (-0.44) | (1.68) | (0.65) | (-0.50) | (1.60) | (0.56) |
| Payout | -0.39 | -0.34 | -0.68 | -0.41 | -0.37 | -0.74 | -0.43 | -0.41 | -0.79 |
| | (-2.09) | (-2.15) | (-2.71) | (-2.21) | (-2.38) | (-2.96) | (-2.32) | (-2.58) | (-3.16) |
| Size | 0.11 | 0.13 | -0.25 | 0.08 | 0.08 | -0.33 | 0.06 | 0.05 | -0.38 |
| | (0.41) | (0.55) | (-0.69) | (0.29) | (0.33) | (-0.89) | (0.21) | (0.22) | (-1.02) |
| Growth | -0.16 | 0.24 | 0.64 | -0.21 | 0.17 | -0.03 | -0.21 | 0.17 | -0.04 |
| | (-0.38) | (0.66) | (0.11) | (-0.50) | (0.47) | (-0.05) | (-0.51) | (0.46) | (-0.07) |
| R Square | .07 | .17 | .18 | .08 | .18 | .18 | .08 | .18 | .19 |

*T statistics are in parenthesis.

Table 24

Diversification, Strategies and Risk*

| | 2 Digit Diversification | | 3 Digit Diversification | | 4 Digit Diversification | |
|---|---|---|---|---|---|---|
| | BL60 | BL65 | BL60 | BL65 | BL60 | BL65 |
| Constant | 1.056 | 1.154 | 1.106 | 1.104 | 1.100 | 1.127 |
| | (7.78) | (6.77) | (8.29) | (7.09) | (8.36) | (7.55) |
| Div | -0.092 | -0.250 | -0.072 | -0.109 | -0.038 | -0.088 |
| | (-1.32) | (-2.24) | (-1.63) | (-1.75) | (-1.17) | (-1.68) |
| DVD | 0.223 | 0.243 | 0.130 | 0.127 | 0.088 | 0.103 |
| | (3.69) | (2.30) | (3.09) | (2.10) | (2.72) | (2.04) |
| CD | 0.147 | 0.264 | 0.093 | 0.140 | 0.055 | 0.112 |
| | (2.51) | (2.54) | (2.30) | (2.36) | (1.81) | (2.24) |
| LD | 0.127 | 0.256 | 0.080 | 0.120 | 0.043 | 0.094 |
| | (2.03) | (2.43) | (1.90) | (1.99) | (1.38) | (1.85) |
| UD | 0.132 | 0.290 | 0.091 | 0.137 | 0.054 | 0.109 |
| | (2.01) | (2.70) | (2.10) | (2.23) | (1.68) | (2.14) |
| Leverage | 0.274 | 0.273 | 0.030 | 0.273 | 0.036 | 0.240 |
| | (1.18) | (1.01) | (1.26) | (1.04) | (1.32) | (0.92) |
| Payout | -0.312 | -0.343 | -0.346 | -0.378 | -0.366 | -0.414 |
| | (-2.66) | (-2.20) | (-2.82) | (-2.52) | (-2.90) | (-2.78) |
| R Square | .31 | .21 | .25 | .23 | .23 | .24 |

*T statistics are in parenthesis.

diversified strategies. The end result was that firms in the linked strategy group tended to have Betas which were the closest to unity, meaning their riskiness was the closest to the risk of holding the entire market portfolio. (This is shown in Table 25.) Hence, one can conclude that firms are able to effect their systematic risk through diversification, and the nature of the effect depends on the type of diversification which was undertaken.

The second thing to consider is what the impact of diversification is upon the variability of earnings in the firm. In his study Rumelt concluded that, "Diversification in itself has not served to reduce the variability of the firm's earning stream."[18] This result seems contrary to simple portfolio theory. In his study Rumelt did not use a continuous measure of diversification. When one does examine earnings variability as a function of the extent of diversification he will find a negative relationship. This is demonstrated in Table 26. The marginal effect of diversification on earnings variability does not differ among the various diversification strategies.[19]

Although the marginal effect of diversification did not differ among strategies the average earnings variability did differ to some extent among strategies. In particular, single product firms and

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[18]Rumelt, Strategy, Structure, and Economic Performance, p. 103.

[19]This was found by running a model with strategy slope variables, and then running a constrained model where the coefficient on the dummy slope variables were constrained to zero. One could not reject the restrictions with an F test.

Table 25

Mean Beta Measures by Strategy Types

| | 1960 | | | 1965 | | |
|---|---|---|---|---|---|---|
| | B60 | BL60 | BT60 | B60 | BL60 | BT60 |
| Single | 0.90 | 0.87 | 0.91 | 0.90 | 0.73 | 0.88 |
| Vertical | 1.20 | 1.23 | 1.21 | 1.05 | 1.06 | 1.05 |
| Constrained | 1.13 | 1.10 | 1.13 | 1.05 | 1.13 | 1.15 |
| Linked | 1.10 | 1.06 | 1.06 | 1.01 | 1.10 | 1.17 |
| Unrelated | 0.98 | 1.04 | 0.96 | 1.05 | 1.22 | 1.41 |
| F Statistic | 2.31 | 3.83 | 2.31 | 0.30 | 3.20 | 1.66 |

Table 26

Earnings Variability and Diversification

| | 2 Digit Diversification | | 3 Digit Diversification | | 4 Digit Diversification | |
|---|---|---|---|---|---|---|
| | EV60 | EV65* | EV60 | EV65 | EV60 | EV65 |
| Constant | 0.021 | 0.020 | 0.022 | 0.020 | 0.021 | 0.020 |
| | (7.12) | (6.76) | (8.93) | (8.56) | (9.56) | (9.52) |
| Diversification | -0.002 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 |
| | (-1.43) | (-1.322) | (-1.90) | (-1.80) | (-1.99) | (-1.90) |

*The dependent variables are earnings variability for 1960 and 1965. The T statistic are in parentheses.

unrelated product firms tended to have the highest earning variability. This result can be seen in Table 27.

Two other results of interest are also shown in Table 27. First of all it was seen that earning differed significantly among strategies, with unrelated firms and vertically integrated firms doing surprisingly well.[20] Finally, it was found that total stock price variability was not related to diversification or diversification strategy. This is particularly interesting since it was previously found that the systematic component of the risk was related to diversification. This once again suggests that the relevant component of risk is the systematic not the total risk, a well known result from portfolio theory.

Conclusions

While this study does have a number of empirical problems, in that various measures may be only crude approximations of the actual desired variables, it does seem to produce some rather interesting insights. It has shown that a firm when diversifying does not appear to be able to use diversification alone to impact risk, although diversification alone does decrease the variability of earnings. It has shown that diversification needs to be considered in conjunction with the firm's diversification strategy. When strategies

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[20] For a further discussion of the performance of these firms, see Appendix 5. There it is shown that if portfolio performance measures are used, linked-type firms do very well, as one would expect.

Table 27

Mean Performance and Risk Measures by Strategy Types

| | Earnings | | Earning Variability | | Total Stock Price Variability | |
|---|---|---|---|---|---|---|
| | 1960 | 1965 | 1960 | 1965 | 1960 | 1965 |
| Single | 0.074 | 0.018 | 0.029 | 0.025 | 0.064 | 0.071 |
| Vertical | 0.060 | 0.084 | 0.013 | 0.012 | 0.070 | 0.064 |
| Constrained | 0.054 | 0.074 | 0.017 | 0.017 | 0.069 | 0.073 |
| Linked | 0.051 | 0.076 | 0.014 | 0.017 | 0.067 | 0.067 |
| Unrelated | 0.062 | 0.085 | 0.023 | 0.022 | 0.066 | 0.071 |
| F Statistic | 2.15 | 3.17 | 3.15 | 1.34 | 0.31 | 1.25 |

are taken into account it appears that diversification into linked lines does enable the firm to obtain a lower CAPM Beta. Additionally this study does seem to suggest that the general methodology of linking financial studies (CAPM) with industrial organization research seems to be quite promising.

# CHAPTER VIII

## SUMMARY AND EXTENSIONS

This work has examined various aspects of corporate diversification. The central theme of this work was that much diversification was the result of an effort to develop an internal market for a resource which would not trade well via external markets. This resource was given the general name of firm specific capital; and in the previous chapters its implications have been discussed, its existence has been tested, and its impact on the risk of the firm has been examined.

This study showed in Chapter II how the firm specific capital could arise either as a result of a conscious production decision in the firm, or as a joint product developed in the manufacturing process in the firm. It was shown in that chapter how the existence of firm specific capital could lead the firm to profitably diversify. The potential impact of diversification motivated by firm specific capital, on the riskiness of the firm was also examined.

In Chapter III a popular alternative argument for diversification was discussed. In that chapter the various explanations for anticompetitive diversification were examined. After examining the many traditional discussions, the chapter examined the potential for anticompetitive horizontal product extension, a type of diversification where

clear economic arguments have not been presented. On net the findings of that chapter showed that monopoly power was not likely to arise from the diversification strategy of the firm.

The discussions of Chapter II and Chapter III led to the first empirical test of this work. Drawing on industry level data, Chapter IV provided an empirical examination of the link between firm specific capital and diversification. In addition, it provided a test of the diversification for monopoly power hypothesis. The findings of that chapter generally supported the hypothesis that diversification was linked to firm specific capital. In addition, some evidence was found to show that diversification did not lead to monopoly power.

After the general industry level test provided in Chapter IV, the study shifted to an examination of the effect of diversification on individual firms. After addressing the important empirical problems of measuring diversification, and quantifying risk, an empirical study was conducted on a sample of 97 individual firms. This study uses a relatively new methodology for the field of industrial organization. The methodology is new in that it attempts to draw on the findings of modern finance theory to test hypotheses in industrial organization. The study found that firms could not use diversification alone to impact the riskiness of the firm in any meaningful way, but diversification which seemed to draw on firm specific capital (as reflected in the diversification strategy) seemed to be able to effect the net riskiness of the firm. Also, it was found that diversification did

impact the variability of earnings for firms, but the impact did not appear to vary by diversification strategy.

These findings do have some interesting policy implications. They seem to suggest that an active anti-diversification or divestiture policy is not necessary. The reason for this is that there seems to be more evidence to support the argument that diversification is motivated by a desire to exploit internal markets and resources, rather than desire to achieve a monopoly power. This is not to say that the antitrust authorities should not keep a watchful eye aimed toward certain potentially anticompetitive diversifications, rather it suggests a general anti-diversification policy would be undesirable. In fact, it suggests that such a policy would be quite harmful.

In generating the results of this study existing data have been used. The empirical problems which they presented were handled as well as was possible. More work though clearly needs to be done along these lines. Two promising directions for future work seem to be obvious. The first would be to begin to develop a micro data base on a sample of firms through time, tracking their changes in diversification and performance. The second direction is to examine the effect of diversification by carefully examining the net effect of forced divestiture. In both cases studies which draw on finance as well as basic economic theory, would seem to be the most promising.

LITERATURE CITED


Adelman, Morris A. "Comment on the 'H' Concentration Measure as a Numbers Equivalent," Review of Economics and Statistics, 51 (February 1969), 99-101.

Alberts, William W. and Segall, Joel E., ed. The Corporate Merger, Chicago: University of Chicago Press, 1966.

_____. "The Profitability of Growth by Merger," in William Alberts and Joel Segall, eds., The Corporate Merger, Chicago: University of Chicago Press, 1966.

Alchian, Armen. "Reliability of Progress Curves in Airframe Production," Econometrica, 31 (October 1963), 679-93.

_____ and Demsetz, Harold. "Production, Information Costs, and Economic Organization," American Economic Review, 62 (December 1972), 777-95.

American Bar Association. Merger Case Digest, Chicago: American Bar Association, 1972.

Arrow, Kenneth J. "The Economic Implications of Learning by Doing," Review of Economic Studies, 29 (June 1962), 155-73.

Ash, Robert. Information Theory, New York: Interscience Publishers, 1967.

Askari, Hossein, Ruefli, Timothy W., and Kennedy, Michael P. Horizontal Divestiture of Energy Companies and Alternative Policies, Austin, Texas: Graduate School of Business, The University of Texas at Austin.

Atkinson, Scott E. and Halvorsen, Robert. "Interfuel Substitution in Steam Electric Power Generation," Journal of Political Economy, 84 (October 1976), 959-78.

Bailey, Duncan and Boyle, Stanley E. "The Optimal Measure of Concentration," Journal of the American Statistical Association, 66 (December 1971), 702-06.

Bain, Joe S. Industrial Organization, New York: John Wiley and Sons, Inc., 1968.

Baumol, William J. "On the Theory of the Expansion of the Firm," American Economic Review, 52 (December 1962), 1078-87.

Beaver, William, Kettler, Paul, and Scholes, Myron. "The Association Between Market Determined and Accounting Determined Risk Measures," Accounting Review (October 1970), 654-82.

Berry, Charles H. "Corporate Growth and Diversification," Journal of Law and Economics, 14 (October 1971), 371-83.

_____. "Corporate Diversification and Market Structure," The Bell Journal of Economics and Management Science, 5 (Apring 1974), 196-204.

_____. Corporate Growth and Diversification, Princeton: Princeton University Press, 1975.

Black, Fischer. "Capital Market Equilibrium with Restricted Borrowing," Journal of Business, 45 (July 1972), 444-54.

Blume, Marshall E. "On the Assessment of Risk," Journal of Finance, 26 (March 1971), 1-10.

_____. "Betas and Their Regression Tendancies," Journal of Finance, 30 (June 1975), 785-95.

_____. "Portfolio Theory: A Step Toward its Practical Application," Journal of Business, 43 (April 1970), 152-73.

Bork, Robert H. "Vertical Integration and Competitive Processes," in J.F. Weston and Sam Peltzman, eds., Public Policy Towards Mergers, Pacific Palisades, California: Goodyear Publishing Co., 1969.

Boyle, Stanley E. Industrial Organization: An Empirical Approach, New York: Holt Rinehart and Winston, Inc., 1972.

Brazell, Mary. "Previous Cases of Forced Divestiture," Working Paper, American Petroleum Institute, 1977.

Burnstein, Peter W. "A Company That's Worth More Dead Than Alive," Fortune, February 26, 1979, pp. 42-4.

Canes, Michael. "A Theory of Prevatory Vertical Integration," Working Paper, American Petroleum Institute, 1976.

Chandler, Alfred D. Strategy and Structure, Garden City, New York: Doubleday and Co., 1942.

Comanor, William S. "Vertical Mergers, Market Power, and the Antitrust Laws," American Economic Review, 57 (May 1967), 254-65.

_____ and Wilson, Thomas A. Advertising and Market Power, Cambridge, Massachusetts: Harvard University Press, 1974.

Edwards, Corwin. "Vertical Integration and the Monopoly Problem," Journal of Marketing (1953), 404-10.

Evans, J.E. and Archer, J.H. "Diversification and the Reduction in Dispersion: An Empirical Analysis," Journal of Finance, 23 (December 1968), 761-68.

Fama, Eugene. "Efficient Capital Markets, A Review of Theory and Empirical Work," Journal of Finance, 25 (May 1970), 383-417.

_____. "Risk, Return and Equilibrium: Some Clarifying Comments," Journal of Finance, 23 (March 1968), 29-40.

_____, Fisher, Lawrence, Jensen, Michael, and Roll, Richard. "The Adjustment of Stock Prices to New Information," International Economic Review, 10 (February 1969), 1-21.

Federal Trade Commission, Bureau of Economics. "Statistical Report on Large Mergers in Manufacturing and Mining: 1948-1967," 1968.

Frish, Ragnar. Theory of Production, Chicago: Rand McNally & Company, 1965.

Goldberg, Lawrence A. "The Effect of Conglomerate Mergers on Competition," Journal of Law and Economics, 16 (April 1973), 137-58.

Gorecki, Paul. "Measures of Enterprise Diversification," Review of Economic and Statistics, 56 (August 1974), 399-401.

Gort, Michael. Diversification and Integration in American Industry, Princeton, N.J.: Princeton University Press, 1960.

_____. "Diversification, Mergers, and Profits," in William Alberts and Joel Segall, eds., The Corporate Merger, Chicago: University of Chicago Press, 1966.

_____. "An Economic Disturbance Theory of Mergers," The Quarterly Journal of Economics, 83 (November 1967), 624-42.

Hall, Marshall and Tideman, Nicolaus. "Measures of Concentration," Journal of the American Statistical Association, 62 (March 1967), 162-68.

Hamada, Robert S. "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks," Journal of Finance, 27 (May 1972), 435-52.

Hinich, Melvin J. and Roll, Richard. "Measuring Non-Stationarity in the Parameters of a Linear Model with Applications to Asset Returns," Virginia Polytechnic Institute Working Paper #E77-4-4, 1977.

Hirsch, W.Z. "Firm Progress Ratios," Econometrica, 24 (April 1956), 136-43.

_____. "Manufacturing Progress Functions," Review of Economics and Statistics, 34 (May 1952), 144-55.

Hogarty, Thomas F. "The Profitability of Corporate Mergers," Journal of Business, 43 (July 1970), 317-27.

Honeycutt, T. Crawford and Zimmerman, Donald L. "Measurement of Corporate Diversification: 1950-1967," Antitrust Bulletin, 21 (Fall 1976), 509-35.

Jensen, Michael C. Studies in the Theory of Capital Markets. New York: Praeger Publishing Co., 1972.

Kirzner, Israel. Competition and Entrepreneurship, Chicago: University of Chicago Press, 1973.

Levy, Haim and Sarnat, Marshall. "Diversification Portfolio Analysis and the Uneasy Case for Conglomerate Merger," Journal of Finance, 25 (September 1970), 795-802.

Lewellen, W.G. "A Pure Financial Rationale for Conglomerate Merger," Journal of Finance, 26 (May 1971), 521-37.

_____ and Huntsman, Blaine. "Managerial Pay and Corporate Performance," American Economic Review, 55 (September 1970), 710-21.

Lintner, John. "The Valuation of Risk Assets and the Selection of Risk Investments," Review of Economics and Statistics, 47 (February 1965), 13-37.

Lorie, James H. and Halpern, Paul. "Conglomerates: The Rhetoric and the Evidence," Journal of Law and Economics, 13 (April 1970), 149-67.

Magnusson, G. Production Under Risk: A Theoretical Study, Uppsala, Sweden: Almquist & Wiksells Boktryckeri AB, 1967.

Mann, H. Michael, Boyle, Stanley E., and Jaynes, Philip W. Staff Report to the Federal Trade Commission, Economic Report, Conglomerate Merger Performance, 1972.

Manne, Henry. "Mergers and the Market for Corporate Control," Journal of Political Economy, 73 (April 1965), 110-20.

Markam, Jesse, Hourihan, Anthony, and Sterling, Francis. Horizontal Divestiture and the Petroleum Industry, Cambridge, Massachusetts: Ballinger Publishing Co., 1977.

Markowitz, Harry. Portfolio Selection: Efficient Diversification of Investment, New York: John Wiley and Sons, 1959.

Marris, Robin. The Economic Theory of Managerial Capitalism, New York: The Free Press, 1964.

McGee, John S. and Basset, Lowell R. "Vertical Integration Revisited," Journal of Law and Economics, 19 (April 1976), 17-38.

Modigliani, Franco and Miller, Merton. "The Cost of Capital, Corporation Finance, and the Theory of Investment," American Economic Review, 48 (June 1958), 261-97.

Mossin, Jan. "Equilibrium in a Capital Assets Market," Econometrica, 34 (October 1966), 768-84.

Muellar, Dennis. "A Theory of Conglomerate Mergers: Reply," Quarterly Journal of Economics, 83 (November 1969), 675-79.

_____. "A Theory of Conglomerate Mergers," Quarterly Journal of Economics, 83 (November 1969), 643-69.

_____. "A Theory of Conglomerate Mergers: Comments and Extensions," Quarterly Journal of Economics, 84 (November 1970), 663-66.

_____. "A Life Cycle Theory of the Firm," Journal of Industrial Economics, 20 (July 1972), 199-219.

Norman, Donald. "Diversification and Competition in the Energy Industry," Paper Presented at Southwestern Economic Association Meetings, April, 1977.

_____. "Diversification Into Product Related Lines," Paper Presented at Western Economic Association Meetings, April, 1977.

Oi, Walter. "The Neoclassical Foundations of Progress Functions," Economic Journal, 77 (September 1967), 579-94.

Parsons, Donald O. "Specific Human Capital: An Application to Quit Rates and Layoff Rates," Journal of Political Economy, 80 (November 1972), 1120-43.

Penrose, Edith. The Theory of the Growth of the Firm, New York: John Wiley and Sons, Inc., 1959.

Posner, Richard A. "The Social Costs of Monopoly and Regulation," Journal of Political Economy, 83 (August 1975), 807-27.

Prescott, Edward and Visscher, Michael. "Organization Capital," Ohio State University Working Paper #41, 1979.

Reid, Samuel R. Mergers, Managers, and the Economy, New York: McGraw Hill Book Co., 1968.

Rhoades, Stephen. "The Effect of Diversification on Industry Profit Performance in 241 Manufacturing Industries: 1963," Review of Economics and Statistics, 55 (May 1973), 146-54.

_____. "A Further Examination of Diversification on Industry Profit Performance," Review of Economics and Statistics, 56 (November 1974), 557-59.

Rosen, Sherwin. "Learning by Doing as a Joint Product," The Quarterly Journal of Economics, 85 (August 1972), 366-82.

Rosenberg, Barr and McKibben, Walt. "The Prediction of Systematic and Specific Risk in Common Stock," Journal of Financial and Quantitative Analysis, 8 (March 1973), 317-33.

Rubin, Paul H. "A Theoretical Model of the Diversification Decision on Firms," Unpublished Ph.D. dissertation, Purdue University, 1971.

_____. "The Expansion of Firms," Journal of Political Economy, 81 (July-August 1973), 936-49.

Rumelt, Richard. Strategy, Structure, and Economic Performance, Cambridge, Massachusetts: Harvard University Press, 1974.

Saving, Thomas. "Concentration Ratios and the Degree of Monopoly Power," International Economics Review (February 1970), 139-145.

Sharpe, William F. "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk," Journal of Finance, 19 (September 1964), 425-42.

Shepard, William G. Market Power and Economic Welfare, New York: Random House, 1970.

Sherer, F.M. Industrial Market Structure and Economic Performance, Chicago: Rand McNally College Publishing Co., 1970.

Sherman, Roger. "How Tax Policy Induces Conglomerate Merger," National Tax Journal, 25 (December 1972), 521-30.

_____ and Tollison, Robert. "Public Policy Toward Oligopoly: Dissolution and Scale Economies," Antitrust Law and Economics Review, 4 (Summer 1971), 77-90.

Siemon, Donna. "Public Financing by the Petroleum Industry: Method and Costs of Raising Capital," Working Paper, American Petroleum Institute, 1977.

Smith, Adam. An Inquiry Into the Nature and Causes of the Wealth of Nations, New York: Random House, 1937.

Smith, K.V. and Schreiner, J.C. "A Portfolio Analysis of Conglomerate Diversification," Journal of Finance, 25 (June 1969), 413-28.

_____ and Weston, J.F. "Further Evaluation of Conglomerate Performance," Journal of Business Research, 5 (March 1977), 5-14.

Spann, Robert M. and Erickson, Edward. "An Empirical Test of the Theory of Predatory Vertical Integration," Unpublished paper, 1977.

Steiner, Peter O. Mergers: Motives, Effects, Policies, Ann Arbor: University of Michigan Press, 1977.

Stigler, George. "Notes on the Theory of Duopoly," Journal of Political Economy, 48 (August 1940), 521-41.

Stockfish, Jack. "Monopoly Theory, General Equilibrium, and Wealth," Working paper, American Petroleum Institute, 1977.

Sullivan, Timothy G. "Cost of Capital and the Market Power of Firms," Review of Economics and Statistics, 40 (May 1978), 209-17.

Teece, David. "Horizontal Integration in the Energy Industries: A Markets and Hierarchies Analysis," Mimeo, 1977.

Telser, Lester G. Competition, Collusion, and Game Theory. Chicago: Aldine-Atherton, Inc., 1972.

Thomadakis, S.B. "A Model of Market Power, Valuation and the Firms Returns," The Bell Journal of Economics, 7 (Spring 1976), 150-62.

Tobin, James. "Liquidity Preference as Behavior Toward Risk," The Review of Economic Studies, 25 (February 1958), 66-86.

Tullock, Gordon. "The Welfare Costs of Tariffs, Monopoly and Theft," Western Economic Journal, 5 (June 1967), 224-32.

Utton, M.A. "Large Firm Diversification in British Manufacturing," Economic Journal, 87 (March 1977), 96-113.

Westerfield, Randolf. "A Note on the Measurement of Conglomerate Diversification," Journal of Finance, 25 (September 1970), 909-14.

Weston, J. Fred. "Comment" on Lintner, American Economic Review (May 1971), Papers and Proceedings, 125-27.

_____ and Mansingka, S.K. "Tests of the Efficiency Performance of Conglomerate Firms," Journal of Finance, 26 (September 1971), 919-36.

_____ and Peltzman, Sam, eds. Public Policy Towards Mergers, Pacific Palisades, California: Goodyear Publishing Co., 1969.

_____, Smith, K.V., and Shrieves, R.E. "Conglomerate Performance Using the Capital Asset Pricing Model," Review of Economics and Statistics, 54 (November 1972), 357-63.

Williamson, Oliver. Markets and Hierarchies, Analysis and Antitrust Implications, New York: The Free Press, 1975.

DATA SOURCES

Fortune, Market Research Department, 1961 Plant and Product Directory, New York: Time Inc., 1961.

Fortune, Market Research Department, 1966 Plant and Product Directory, New York: Time Inc., 1966.

National Science Foundation, Research and Development in Industry, 1974, Washington, D.C.: Government Printing Office, 1975.

United States Bureau of the Census, 1972 Census of Manufactures, Concentration Ratios in Manufacturing, Washington, D.C.: Government Printing Office, 1975.

_____, 1972 Enterprise Statistics, Part I, Washington, D.C.: Government Printing Office, 1977.

_____, 1967 Enterprise Statistics, Part I, Washington, D.C.: Government Printing Office, 1972.

United States Internal Revenue Service, Source Book for Corporate Income Statistics: 1963, Washington, D.C.: Internal Revenue Service Photocopy, 1964.

_____, Source Book for Corporate Income Statistics: 1967, Washington, D.C.: Internal Revenue Service Photocopy, 1968.

_____, Source Book for Corporate Income Statistics: 1972, Washington, D.C.: Internal Revenue Service Photocopy, 1968.

## APPENDIX 1

## THE ROLE OF DEMAND ELASTICITY IN A PRICE LEADERSHIP MODEL

In a price leadership model either one large firm or a cartel of smaller firms are able to set price above marginal cost in a way which maximizes profits given the existence of the competitive fringe, and assuming barriers to new entry exist.

Following the notation of Saving,[1] assume that an industry of n firms faces a market demand function

$$Q_m^d = f(P) \qquad f'(P) < 0$$

where $Q_m^d$ is the quantity demanded in the market and P is the price. Assume that the k largest firms form a cartel. The quantity supplied by the remaining n-k firms can be written

$$Q_r^s = g(P) \qquad g'(P) > 0.$$

In this situation the residual demand curve for the price leaders is

$$Q_k^d = f(P) - g(P).$$

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[1] One should consult Thomas R. Saving, "Concentration Ratios and the Degree of Monopoly," International Economic Review (February 1970), 139-45. One will also find useful discussions in George Stigler, "Notes on the Theory of Duopoly," Journal of Political Economy (1940), 521, 541.

Using this notation one can derive the elasticity of demand for the price leaders. This elasticity is defined as

$$\eta_k = \frac{\partial Q_k^d}{\partial P} \cdot \frac{P}{Q_k^d} .$$

One can rewrite the elasticity of demand for the k largest firms as

$$\eta_k = \frac{f(P)}{Q_k^D} \eta_m - \frac{g(P)}{Q_k^D} \delta_r$$

where $\eta_k$ and $\eta_m$ are the elasticities of demand for the k largest firms and the market respectively, and $\delta_r$ is the supply elasticity for the firms representing the competitive fringe.

The impact of monopolization on a market can be defined by the divergence of price from marginal cost in that market. If the cartel is profit maximizing then it will set marginal revenue equal to marginal cost. In this case the divergence of price from marginal cost may be written

$$D = P - P(1 + 1/\eta_k)$$

and substitution for $\eta_k$ this can be written

$$D = -p \frac{1}{[(\frac{Q_m}{Q_k}) \eta_m - (\frac{Q_r}{Q_k}) \delta_r]} .$$

Differentiating D with respect to $\eta_m$ and $\delta_r$ yields:

$$\frac{\partial D}{\partial \eta_M} = \frac{-P\left(\frac{Q_m}{Q_k}\right)}{\left[\left(\frac{Q_m}{Q_k}\right)\eta_m - \left(\frac{Q_r}{Q_k}\right)\delta_r\right]^2} > 0$$

and

$$\frac{\partial D}{\partial \delta_r} = \frac{-P\left(\frac{Q_r}{Q_k}\right)}{\left[\left(\frac{Q_m}{Q_k}\right)\eta_m - \left(\frac{Q_r}{Q_k}\right)\delta_r\right]^2} < 0 .$$

That is, the change in the divergence is positively related to the market demand elasticity and negatively related to the supply elasticity.

From this simple analysis it is clear that the monopolistic capabilities of the cartel (i.e., its ability to maintain price above marginal cost) will diminish as the market demand becomes more elastic, and as the supply elasticity of the competition fringe increases.

## APPENDIX 2

## ENTERPRISE INDUSTRIES

| Code | Title |
|---|---|
| 10A | Metal Mining |
| 12A | Coal Mining |
| 13A | Crude Petroleum Extraction (No Refining), Natural Gas |
| 20A | Meat Packing |
| 20B | Prepared Meats and Dressed Poultry |
| 20G | Prepared Feeds for Animals and Fowls |
| 20I | Bread, Cake and Related Products |
| 20J | Cookies and Crackers |
| 20L | Confectionary and Related Products |
| 20M | Malt Liquors |
| 20P | Bottled Soft Drinks and Flavorings |
| 21A | Tobacco Products |
| 22E | Floor Covering Mills |
| 22F | Yarn and Thread Mills |
| 23A | Men's and Boy's Suits and Coats |
| 23C | Separate Trousers |
| 23D | Work Clothes |
| 23I | Women's and Children's Underwear |
| 26B | Paperboard Containers and Boxes |
| 26C | Other Paper Products |
| 27B | Periodicals |
| 28B | Drugs |
| 28E | Paints and Varnishes |
| 29A | Integrated Petroleum Extraction, Refining |
| 29B | Other Petroleum and Coal Products |
| 30A | Rubber Products |
| 31A | Footwear |
| 32B | Hydraulic Cement |
| 33A | Blast Furnaces and Steel Mi-ls |
| 33B | Gray Iron Foundries |
| 33C | Malleable Iron and Steel Foundries |
| 33F | Nonferrous Foundries |
| 34A | Metal Cans |
| 34B | Cutlery, Hand Tools, Hardware |
| 34C | Plumbing and Nonelectric Heating |
| 34D | Fabricated Structural Steel |

| Code | Title |
|---|---|
| 34E | Metal Doors, Sash, and Trim |
| 34G | Screw Machine Products, Bolts |
| 34H | Metal Stampings |
| 34I | Metal Services, N.E.C. |
| 34J | Fabricated Wire Products |
| 35A | Engines and Turbines |
| 35B | Farm Machinery and Equipment |
| 35E | Machine Tools |
| 35G | Special Industry Machinery |
| 35H | Pumps and Compressors |
| 35J | Computers and Other Office Machines |
| 35K | Service Industry Machines |
| 36C | Household Appliances |
| 36D | Lighting and Wiring Devices |
| 36B | Electronic Components and Accessories |
| 37A | Motor Vehicles and Equipment |
| 37C | Aircraft and Guided Missile Parts |
| 37D | Ships and Boats |
| 36A | Radio, TV, and Communication Equipment |
| 38A | Scientific Instruments and Mechanical Measuring Devices |
| 38B | Optical and Ophthalmic Goods |
| 38C | Medical Instruments and Supplies |
| 38D | Photographic Equipment |
| 38E | Watches and Clocks |
| 39A | Jewelry and Silverware |
| 39B | Toys and Sporting Goods |

## APPENDIX 3

## FIRMS USED IN THE STUDY

Abbott Laboratories
ACF Inds
Addressograph-Multigraph
Airco Inc
Allis-Chalmers Corp
American Motors Corp
American Standard Inc
Armstrong Cork Co
Ashland Oil Inc
Atlantic Richfield Co
Borden Inc
Borg-Warner Corp
Bristol-Myers Co
Bucyrus-Erie Co
Carrier Corp
Caterpillar Tractor Co
Chrysler Corp
Cincinnati Milacron Inc
Clark Equipment Co
Cluett, Peabody & Co
Coca-Cola Co
Continental Oil Co
Crown Cork & Seal Co Inc
Curtiss-Wright Corp
Deere & Co
Dow Chemical
Dresser Industries Inc
Du Pont (E.I.) De Nemours
Eastman Kodak Co
Eaton Corp
Ex-Cello-O Corp
Fibreboard Corp
Flintkote Co
FMC Corp
Foster Wheeler Corp
General Cable Corp
General Electric Co
General Foods Corp

General Mills Inc
Genesco Inc
Gillette Co
Goodrich (B.F.) Co
Goodyear Tire & Rubber Co
Gulf Oil Corp
Hart Schaffner & Marx Co
Hershey Foods Corp
Ingersoll-Rand Co
Intl Business Machines Corp
Johnson & Johnson
Keystone Cons Industries Inc
Kimberly-Clark Corp
Koppers Co
Lehigh Portland Cement Co.
Libbey-Owens-Ford Co
Lockheed Corp
Lukens Steel Co
Marathon Oil Co
Maytag Co
McGraw-Edison Co
Midland-Ross Corp
Minnesota Mining & Mfg Co
Mobil Corp
Mohasco Corp
Monsanto Co
Nabisco Inc
National Steel Corp
NCR Corp
Outboard Marine Corp
Owens-Illinois Inc
Pennwalt Corp
Pet Inc
Pfizer Inc
Philip Morris Inc
Phillips Petroleum Co
Pillsbury Co
Proctor & Gamble Co
Pullman Inc
Republic Steel Corp
Reynolds Metals Co
Rockwell Intl Corp
Sperry Rand Corp
Standard Brands Inc
Standard Oil Co (Ohio)
Sterling Drug Inc
Stevens (J.P.) & Co
Stewart-Warner Corp
Stokely-Van Camp Inc

Texaco Inc
Texas Instruments Inc
Trans Union Corp
U S Steel Corp
Uniroyal Inc
Ward Foods Inc
Westinghouse Electric Corp
Westvaco Corp
White Motor Corp
Wrigley (Wm.) Jr Co

## APPENDIX 4

## DEFINITION OF VARIABLES FOR CHAPTER VII

The dependent variable in this study is the Capital Asset Pricing Model (CAPM) beta coefficient. It was estimated using monthly CRSP data allowing the parameters to move. Then a twelve month average was calculated. The diversification measure (DIV) was calculated from employment distributions initially found in the Fortune Plant and Product Directory. These data were organized on a tape and were obtained from the National Bureau of Economic Research. The index used was $DIV = 1/(\Sigma P_i^2)$, where $P_i$ represents fraction of total activity represented by the ith activity.

The financial variables are all computed from data on the Compustat tapes. When leverage and liquidity were computed, the three year average of the past two years and the year in question was used. When growth was computed it was growth over the three year period. The size variable reflected the current asset size. In computing the variables the following definitions were used:

$$\text{leverage} = \frac{1}{3} \cdot \sum_{t=1}^{3} \frac{\text{total senior securities}_t}{\text{total assets}_t}$$

$$\text{liquidity} = \frac{1}{3} \cdot \sum_{t=1}^{3} \frac{\text{current assets}_t}{\text{current liabilities}_t}$$

$$\text{payout} = \frac{\sum_{t=1}^{3} \text{cash dividends}}{\sum_{t=1}^{3} \text{income available for common stockholders}}$$

$$\text{growth} = \left(\frac{\text{Total Assets}_3}{\text{Total Assets}_1}\right)^{\frac{1}{2}} - 1$$

$$\text{size} = \sum_{i=1}^{3} \frac{(\text{Asset Size})}{3}$$

where

Total Senior Securities = Current Liabilities + long term debt + preferred stock.

In order to incorporate diversification strategies dummy variables were used. The dummy equaled the diversification level if the term was classified in the particular strategy, and zero otherwise. The following abbreviations were used.

DIV was the general diversification level.

DVD was diversification in vertically integrated firms.

CD was diversification in constrained type firms.

LD was diversification in linked type firms.

UD was diversification in unrelated firms.

## APPENDIX 5

## PORTFOLIO MEASURES OF PERFORMANCE

If capital markets are efficient, then once information is introduced into the market asset prices will adjust to reflect that information. This suggests that relevant performance characteristics of diversified firms will be reflected in financial performance measures, derived from the behavior of the firm's stock price. The capital asset pricing model provides a statement of the equilibrium returns to an asset. It states the equilibrium returns can be given by

$$E(R_j) = R_f + \beta[E(R_m) - R_f]$$

where

$R_j$ is the return to the individual asset

$R_m$ is the return of the market portfolio

$R_f$ is the risk free rate of return

$E(\ )$ is the expectation operator

$\beta$ is a parameter which measures systematic risk.

Recognizing how the capital market operates, one can use information derived from the capital asset pricing model to compare various performance measures. All of the performance measures which are used here were also used in the work of Weston, Smith and Shrieves.[1]

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[1] J.F. Weston, K.V. Smith and R.E. Schrieves, "Conglomerate Performance Using the Capital Asset Pricing Model," Review of Economics and Statistics, Vol. 54 (November 1972), 357-63 and K.V. Smith and J.F. Weston, "Further Evaluation of Conglomerate Performance," Journal of Business Research, Vol. 5 (March 1977), 5-14.

A first measure which has been suggested is the ratio of excess returns to the total risk of the asset. This measure, generally called the Sharpe measure is

$$\text{Sharpe} = (E(R_i) - R_f) / \sigma_i$$

where $\sigma_i$ is the standard deviation of the assets returns, and all other variables are as defined earlier. A measure similar to this has the systematic component of risk in the denominator, rather than total risk. This measure, referred to as the Treynor index can be written as

$$\text{Treynor} = (E(R_i) - R_f) / \beta$$

where $\beta$ is taken from the assets characteristic line. In addition, both the CAPM Beta ($\beta$) and the standard deviations of the assets return ($\sigma$) can in some sense be viewed as performance measures. In particular, the $\beta$ is important, since it measures the systematic or nondiversifiable risk. The $\sigma$ measure on the other hand contains both diversifiable and nondiversifiable risk.

Another portfolio measure which has been suggested also comes from the capital asset pricing model. In estimating a securities characteristic line, one obtains both a slope term ($\beta$) and an intercept term $\alpha$. It has been suggested that this intercept is a measure of performance since it signifies the return over the market on asset generates when the market return is zero. It has also been suggested

that this performance measure be adjusted by risk. This would yield $\alpha/\sigma$ if total risk was used, or $\alpha/\beta$ if systematic risk was used.[2]

Two last measures which have been suggested relate to the correlation of an asset return to the market portfolios returns. If for a security systematic risk equaled total risk, the correlation (r) of the assets returns with the market would equal one. Hence, the higher the correlation the better the firms "diversification in a financial sense" is. Westerfield suggested that an alternative measure would be the correlation divided by the Beta coefficient ($r/\beta$).[3]

Empirical Findings

A sample of one hundred Fortune 500 firms was chosen so that stock price and diversification data could be obtained. Then the relevant financial variables were calculated. In estimating the CAPM the parameters ($\alpha,\beta$) were allowed to move through time. The technique allowed the parameters to be Legendre polynomials of time.[4] Then the estimated parameters were averaged for the appropriate year in question (1960 or 1965). A measure of diversification and diversification strategy was obtained as before.

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[2]It has been shown by Weston, Smith and Shrieves, "Conglomerate Performance Using the Capital Asset Pricing Model," that $\alpha/\beta$ were is equivalent to the Treynor Measure. In this study they are different due to slightly different averaging techniques used to calculate the measures.

[3]R. Westerfield, "A Note on the Measurement of Conglomerate Diversification," Journal of Finance, Vol. 25 (September 1970), 909-14.

[4]This follows Melvin Henich and Richard Roll, "Measuring Non-Stationarity in the Parameters of a Linear Model with Applications to Asset Returns," Virginia Polytechnic Institute and State University Working Paper, 1977.

The first question which was asked was whether or not performance differed by diversification strategies. Since it has been hypothesized that firms in the constrained and linked strategies might be exploiting some firm specific capital through diversification, one would expect firms in those strategies to perform the best. It was found that single product firms in this sample were performing unexpectedly well. It was also found that where a significant difference existed, the strategies characterized by more firm specific capital tended to perform better than the other diversification strategies (single firms excluded) in 1960. In 1965 though, the performance of unrelated firms seemed to improve. These results can be seen in Tables 28 and 29.

It was then asked what the marginal effect of diversification was on the performance measures. In 1960 it was found that the marginal effect of diversification was negligible on most performance measures. Diversification did seem to cause the Beta coefficient and the correlation coefficient to rise. These results can be seen in Tables 30 and 31. In 1965 the marginal effect of diversification on Beta and correlation continued to be positive and significant. But diversification seemed to have a negative impact on other performance measures, such as the Sharpe, Treynor, and $\alpha/\sigma$. It would be consistent with the findings of Weston and Mansinghka[5] to suggest that this negative

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[5]J.F. Weston and S.K. Mansinghka, "Tests of the Efficiency Performance of Conglomerate Firms," Journal of Finance, Vol. 26 (September 1971), 919-36.

Table 28

Mean Performance Measures by Strategy Class

1960

| | Sharpe* | Treynor | $\sigma$ | $\beta$ | $\alpha$ | $\alpha/\beta$ | $\alpha/\sigma$ | $r/\beta$ | r |
|---|---|---|---|---|---|---|---|---|---|
| Single | 0.283 | 0.025 | 0.064 | 0.872 | 0.014 | 0.018 | 0.229 | 0.506 | 0.427 |
| Vertical | 0.234 | 0.016 | 0.070 | 1.229 | 0.009 | 0.008 | 0.132 | 0.461 | 0.540 |
| Constrained | 0.279 | 0.018 | 0.069 | 1.095 | 0.013 | 0.013 | 0.195 | 0.449 | 0.496 |
| Linked | 0.261 | 0.017 | 0.069 | 1.062 | 0.013 | 0.012 | 0.190 | 0.477 | 0.522 |
| Unrelated | 0.221 | 0.016 | 0.066 | 1.042 | 0.009 | 0.010 | 0.164 | 0.500 | 0.444 |
| F Statistic | 0.45 | 1.02 | 0.32 | 3.84 | 1.64 | 2.90 | 1.91 | 1.04 | 2.05 |

*In calculating the Sharpe and Treynor index the risk free rate of return needed to be used. Since this was not known, a zero was used rather than some positive estimate such as .015.

Table 29

Mean Performance Measures by Strategy Class

1965

| | Sharpe | Treynor | $\sigma$ | $\beta$ | $\alpha$ | $\alpha/\beta$ | $\alpha/\sigma$ | $r/\beta$ | r |
|---|---|---|---|---|---|---|---|---|---|
| Single | 0.233 | 0.021 | 0.071 | 0.734 | 0.011 | 0.011 | 0.154 | 0.822 | 0.497 |
| Vertical | 0.115 | 0.008 | 0.064 | 1.061 | 0.011 | 0.012 | 0.189 | 0.654 | 0.647 |
| Constrained | 0.152 | 0.011 | 0.073 | 1.133 | 0.013 | 0.012 | 0.193 | 0.549 | 0.581 |
| Linked | 0.130 | 0.009 | 0.067 | 1.100 | 0.013 | 0.012 | 0.196 | 0.597 | 0.611 |
| Unrelated | 0.114 | 0.005 | 0.071 | 1.223 | 0.013 | 0.013 | 0.235 | 0.487 | 0.594 |
| F Statistic | 0.97 | 2.53 | 1.25 | 3.20 | 0.90 | 0.09 | 0.54 | 3.05 | 1.94 |

Table 30

Diversification and Performance 1960

| | Sharpe | Treynor | σ | β | α | α/β | α/σ | r/β | r |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 Digit Diversification | | | | | |
| Constant | 0.263 | 0.018 | 0.065 | 1.002 | 0.012 | 0.014 | 0.199 | 0.508 | 0.492 |
| | (6.37) | (7.45) | (18.59) | (17.12) | (8.45) | (8.25) | (9.18) | (15.65) | (18.37) |
| Div | 0.001 | -0.001 | 0.002 | 0.042 | ** | -0.001 | -0.006 | -0.170 | -0.001 |
| | (0.04) | (-0.43) | (1.06) | (1.74) | (-0.12) | (-1.16) | (-0.66) | (-1.26) | (-0.04) |
| R Square | * | * | .01 | .03 | .01 | .01 | * | .01 | * |
| | | | | 3 Digit Diversification | | | | | |
| Constant | 0.271 | 0.019 | 0.067 | 1.017 | 0.013 | 0.014 | 0.195 | 0.47 | 0.466 |
| | (10.29) | (9.69) | (24.24) | (21.97) | (10.86) | (10.16) | (11.33) | (18.17) | (22.14) |
| Div | -0.002 | -0.001 | 0.001 | 0.020 | ** | -0.0001 | -0.002 | ** | 0.007 |
| | (-0.35) | (-0.96) | (0.21) | (2.03) | (-0.44) | (-1.33) | (-0.83) | * | (1.55) |
| R Square | * | .01 | * | .04 | * | .02 | * | * | .02 |
| | | | | 4 Digit Diversification | | | | | |
| Constant | 0.274 | 0.019 | 0.068 | 1.032 | 0.013 | 0.014 | 0.193 | 0.467 | 0.468 |
| | (11.29) | (10.61) | (26.70) | (24.17) | (11.89) | (10.87) | (12.21) | (19.55) | (24.24) |
| Div | -0.002 | -0.001 | ** | 0.012 | ** | -0.0001 | -0.001 | 0.001 | 0.004 |
| | (-0.53) | (-1.17) | (-0.21) | (1.89) | (-0.61) | (-1.30) | (-0.59) | (0.30) | (1.63) |
| R Square | * | .01 | * | .04 | * | .02 | * | * | .03 |

*less than .01.
**absolute values less than .0001.

Table 31

Diversification and Performance 1965

| | Sharpe | Treynor | σ | β | α | α/β | α/σ | r/β | r |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 Digit Diversification | | | | | |
| Constant | 0.189 | 0.014 | 0.070 | 0.976 | 0.011 | 0.011 | 0.076 | 0.650 | 0.562 |
| | (6.62) | (6.57) | (19.82) | (15.80) | (7.40) | (7.75) | (2.54) | (14.19) | (21.33) |
| Div | -0.021 | -0.002 | -0.001 | 0.049 | 0.001 | 0.0001 | -0.024 | -0.025 | 0.016 |
| | (-1.97) | (-2.40) | (-0.18) | (2.11) | (1.31) | (0.72) | (-2.15) | (-1.43) | (1.60) |
| R Square | .04 | .06 | * | .04 | .02 | .01 | .05 | .02 | 0.02 |
| | | | | 3 Digit Diversification | | | | | |
| Constant | 0.178 | 0.014 | 0.071 | 0.992 | 0.013 | 0.13 | 0.067 | 0.620 | 0.554 |
| | (7.73) | (7.80) | (24.96) | (20.03) | (10.48) | (10.93) | (2.78) | (16.66) | (26.62) |
| Div | -0.009 | -0.001 | -0.001 | 0.023 | 0.00 | -0.0001 | -0.011 | -0.006 | 0.010 |
| | (-2.06) | (-2.76) | (-0.70) | (2.45) | (0.02) | (-0.67) | (-2.43) | (-0.92) | (2.67) |
| R Square | .04 | .07 | * | .06 | * | .004 | .06 | .01 | .07 |
| | | | | 4 Digit Diversification | | | | | |
| Constant | 0.166 | 0.012 | 0.071 | 1.023 | 0.013 | 0.013 | 0.054 | 0.600 | 0.56 |
| | (8.13) | (7.96) | (28.39) | (23.17) | (12.37) | (12.70) | (2.51) | (18.21) | (30.59) |
| Div | -0.005 | -0.001 | 0.000 | 0.011 | -0.0001 | -0.001 | -0.006 | -0.001 | 0.006 |
| | (-1.75) | (-2.30) | (-0.95) | (2.03) | (-0.62) | (-1.18) | (-2.14) | (-0.35) | (2.72) |
| R Square | .03 | .05 | * | .04 | * | .01 | .05 | * | 0.07 |

*less than .01.

result was due to firms diversifying into low performance activities in hopes of raising the performance in the future.

To go one step further the differing marginal effects of diversification in different strategies were examined. In general though, the marginal effects were not significantly different, and the main difference seemed to be in the mean performance of firms in each strategy class.

There are two basic conclusions of this study. First, single business firms performed surprisingly well, although they did seem to be the most risky. (They had the highest earnings variability.) In the other diversification strategies the classes which one would expect to have the most firm specific capital seemed to perform the best. Secondly, the marginal effect of diversification was not in general associated with an improvement in performance, except in the case of the correlation coefficient.

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# FIRM SPECIFIC CAPITAL AND CORPORATE DIVERSIFICATION

by

William D. Manson

(ABSTRACT)

It has been observed that there has been an ever growing trend toward more extensive corporate diversification. The thesis here is that a great deal of the observed diversification has been the result of an effort by firms to develop internal markets for resources which do not trade well through external markets. The nature of this resource, called firm specific capital, is examined theoretically and empirically.

The work begins with a presentation of a neoclassical model of the firm, where firm specific capital is produced as a joint output in the firm. It is shown how this capital, which for simplicity can be thought of as managerial expertise, would lead a firm to diversify. Then the model is subjected to an empirical test. This test supports the argument that firms use diversification to develop and exploit internal markets. In addition, the test suggests that the diversification process is procompetitive, not anticompetitive as some have argued.

After the general industry level test, the study examines the effect of diversification on the individual firm. This portion of

the study was concerned with the impact of diversification on corporate risk. Using risk and performance measures derived from the Capital Asset Pricing Model, and diversification measures calculated for individual firms, the study analyzes the impact of diversification on 97 firms for the years 1960 and 1965. The results of this portion of the study also demonstrate the importance of firm specific capital in the firm's diversification decision.