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A GENERALIZED INVESTMENT MODEL*

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A generalized financial/product portfolio theory is developed, based on the underlying economic factors determining product profitability and risk, for applications involving the firm's product investment decisions. The model developed provides a means for differentiating market related risk and return from firm specific risk and return for each product. Two hypothetical illustrations of the model are described and the managerial implications are discussed.
(PRODUCT RISK, PRODUCT PORTFOLIO THEORY, STRATEGIC DECISION MAKING)

There has recently been considerable interest in the application of financial theory to the investment decisions of individual firms. These applications are natural extensions of prior work in marketing, research & development, finance, and strategic planning. Despite significant activity in this area, there remains fundamental dissatisfaction with extant approaches, regardless of whether the approaches are derived from traditional product portfolio theory or traditional financial investment theory. The present paper offers a new approach to the firm's portfolio problem based on a fundamental analysis of the risk and return characteristics of products within the firm. In addition, the policy implications of this approach are discussed and two simple numerical examples are presented.

1. Background

Among the more vexing problems of a business organization are decisions relating to the optimal allocation of resources among competing investment opportunities. While such decisions must be made even in single-product firms, where trade-offs must be made among product development, advertising and promotion, the development of more efficient production or distribution systems, and so forth, the problem takes on Herculean dimensions in multi-product firms. The likelihood of suboptimal choices being made in such firms is quite high. It was inevitable, then, that attempts were made to develop tools to aid managers in making these resource allocation decisions.

The development of tools for use in the resource allocation process has taken two parallel, but conceptually different routes. At the *strategic* level a host of conceptual and analytic tools have been suggested for determining the mix of product offerings by the firm. These tools have come to be known as product portfolio approaches. Among the better known such approaches are those attributable to Drucker (1963), the Boston Consulting Group (1970), A. D. Little (Wright 1978), Shell International (Dutch Shell Co. 1975), and McKinsey/General Electric (Allan 1979, Wind 1975, and Sheth and Frazier 1983). At a more *tactical* level, researchers concerned with R & D have proposed a variety of tools for use in the selection of individual projects. Examples of these latter approaches include scoring procedures (cf. Dean and Nishry 1965, Moore and Baker 1969), present value computations (Moore and Baker 1969, Bonini 1975, Fox,

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Baker, and Bryant 1984), and various process models of innovation (Utterback and Abernathy 1975).

Although these two parallel streams of research differ in focus, strategic versus tactical, and in the degree to which mathematical tools are employed in the service of decision making, they share a common concern for the question of resource allocation within the firm. There is, in fact, a kind of hierarchical relationship between the two, in that, included in most R & D decisions are questions related to the design or modification of products. R & D projects may, of course, take a variety of other forms, ranging from cost reduction programs to marketing research. Ultimately, however, even these types of projects must be related to firm's product offerings in order to determine their relative benefit.

The usefulness of product portfolio models is well documented by the amount of attention they have received from corporate management and the academic literature. These models are not without their problems, however. All are classification systems, and the rules for classification are often vague and ambiguous. In addition, different portfolio models appear to produce different managerial implications (Wind, Mahajan, and Swire 1983). One reason for this state of affairs is that the analogy of the investment portfolio was initially borrowed without the conceptual and logical rigor that characterizes the financial investment literature. There is, then, a need to create more rigorous models of the product investment decision that are tied more specifically to such financial criteria.

Like product portfolio models, there is evidence that project selection models are in widespread use (Baker and Freeland 1975, Fox, Baker, and Bryant 1984). Such models also present problems. For example, virtually all such models make simplifying assumptions about the firm and its environment that make the problem tractable, but also leave the question of practical validity unanswered (Fox and Baker 1985). In addition, most project selection models that do yield definitive managerial recommendations tend to provide go/no go or directional types of output rather than information related to profitability. Finally, most such models rest on assumptions about relationships among the firm's product offerings that must be obtained outside of the project selection model.

In recent years, there has been a growing interest in incorporating financial planning tools in product portfolio approaches and project selection techniques. Anderson (1981) has reviewed a number of such tools and discussed their particular strengths and weaknesses. He suggests that the capital asset pricing model (CAPM) offers the best alternative to nondiscounted or subjective risk-adjusted methods. Indeed, there have been several recent efforts to apply CAPM to the product investment and project selection decisions. For example, Van Horne (1980) offers a case study of one of the earliest applications of CAPM to financial decision making in the firm, but does not provide a general model. More general applications of CAPM to the product investment decision are found in Naylor and Tapon (1982) who applied the model to strategic planning and internal firm diversification, and Cardozo and Smith (1983) who applied the financial portfolio theory of Markowitz (1959) to specific products within the firm.

CAPM does not appear to be a fully satisfactory approach to the problem, however. Applications of CAPM to the firm's investment decision have been criticized by Devinney, Stewart and Shocker (1985), Wensley, Barwise and Marsh (1985), Naylor and Tapon (1985), and Wernerfelt (1985). Much of this criticism revolves around concerns that CAPM is not easily applied to investments within the firm because product investments by the firm are structurally different from financial market investments. This same criticism has been echoed in the project selection literature where attention has been called to the need to account for project interactions (Fox, Baker,

and Bryant 1984). Interactions among product and project investments are common within the firm, but do not, by and large, exist within traditional financial investments and are unaccounted for by CAPM.

These criticisms of CAPM as a strategic planning tool within the firm suggest the need for a more general model that recognizes the unique character of the investment decision within the firm, a model in which synergies among products and projects are identified and explicitly considered. In addition, a model of investment decision within the firm must recognize that unlike financial investments where the level of investment is independent of the level of risk, there is frequently an association between level of risk and level of investment in product investment.

The present model represents an extension of the microeconomic theory of the firm, with particular emphasis on the importance of demand and supply interdependencies in the consideration of product line investment strategies (Baumol, Panzar and Willig 1982). Although the emphasis of the model is on the strategic decision, product investment, rather than on the more tactical issue of project investment, the model is structurally similar to recent work on R & D project selection when project interaction exists (Fox, Baker and Bryant 1984) and multi-market oligopoly (Bulow, Geanakoplos and Klemperer 1985). Unlike prior work, we investigate both the profit and the risk impact of synergies.

2. Products As Investments: A Simple Alternative to Traditional Product Portfolio Theory

The concept of a portfolio of products should imply nothing more than the fact that products are investments and should be treated as such. However, products differ from pure financial market investments because they are imperfectly traded. While the market may correctly value the bundle of products known as the firm, there is no reason to believe that this aggregate valuation is correct for each of the individual products. Imperfect techniques for measuring the cost of capital of new products, such as the weighted average cost of capital, appear to be a recognition of this fact. The question to be addressed then is, what does the unique nature of product investment imply about necessary changes in underlying assumptions in portfolio theory?

1. *The Return Characteristics of Product Investments*

A theory of investment within the firm must ultimately deal with the unique character of product line investments. As Devinney, Stewart, and Shocker (1985) have shown, the violation of key assumptions invalidates much of the usefulness of financial portfolio models in a product context. The present section will outline the unique return characteristics of investments within the firm.

A. *The Unique Character of Product Investments.* Product markets differ structurally from financial markets with respect to what affects profits or returns, in five major respects: (1) managerial control, (2) risk-return relation, (3) external investment alternatives, (4) specific knowledge, and (5) production economies. Each will be discussed below.

Managerial Control. In financial markets, an individual investor seldom has control over the risk/return characteristics of an investment. Indeed, this is an assumption on which current models of financial markets are based (cf. Brigham 1979). In contrast, many firms, particularly in the long run, exercise a rather significant degree of control over the risk/return characteristics of their products (Abel and Hammond 1979). Existing product portfolio theory implies that firms incur more or less risk by shifting investment to more or less risky products. While this is true, it is a very limited view of a firm's options. A broader set of options exist: (1) the firm can adopt a more or