SIMULATING THE FINANCIAL EFFECTS OF MAJOR CORPORATE POLICY CHANGES VIA A DISCRETE STATE SYSTEM MODEL

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Techniques originally developed to model and analyze complex systems of interacting physical components have recently been adapted for use in analyzing economic systems. These techniques can be applied to any phenomenon which can be identified as a collection of components interacting at clearly defined interfaces, as long as the behavioral characteristics of these components can be described mathematically, in terms of common flow and/or propensity variables. A system model thus developed can be utilized for various kinds of analysis, including simulation. In this study the business firm is viewed as a system of funds flows, both environmental, and between several internal asset collection points. A FORTRAN program is developed from this system model to simulate financial effects of three selected policy changes.

A business organization is viewed as interacting production and finance sectors; both with environmental interactions. The environment consists of customers for the firm's products, resources used in production, governmental taxing agencies, owners who provide equity capital and receive dividends, and other outside capital sources. The finance sector controls internal and external funds flows to properly meet environmental obligations and provide both working capital and production assets. Customer sales is the flow driver for the system and determines production asset requirements.

The system model is developed by first considering each sector of the firm independent of any constraints imposed by their interconnection pattern. The mathematical equations characterizing this unconstrained behavior are then combined to conform with the system interfaces, resulting in a state model and an output model. These two models, which comprise the system model, are well suited for system simulation. This model in matrix notation is

$$\Psi(n+1) = P\Psi(n) + Q_1 Y_1(n) + Q_2 Y_1(n+1)$$

$$R(n) = M\Psi(n) + N_1 Y_1(n) + N_2 Y_1(n+1)$$

The matrix P is the transition matrix, the matrices Q_1 and Q_2 are the excitation matrices, R is the response vector, and Ψ is the state vector. The coefficients in this system model are dependent upon, and uniquely determined by, the coefficients in the unconstrained sector models. Coefficient values in this study are derived from a data base corresponding to a typical large firm operating in the United States.

The state variables examined are net profit and debt. Their positions are simulated for twenty-five years of operation under variations within three basic operating policies. The three policies relate to fixed asset utilization, customer credit, and product styling. While the model is not restricted to linearity in the flow driver, for ease of analysis sales is taken as a linearly increasing function, and the annual financial accounting cycle is used as the discrete time period.

Figures 1 and 2 show the results of simulating different intensities of asset utilization. The standard work week for this firm is eighty hours, at which point management is "locked-in" to a minimum operating wage. This level of operation is shown by curve 4. Curve 5 indicates more intensive utilization of present production assets with the attendant increase in labor rates through overtime pay. The effect on profit and debt of a reduced work week are shown by curves 1 through 3. This simulation shows that the present level of asset utilization is the most desirable in terms of both maximum profit and fast debt pay-off, and increases in production should be accomplished by increases in production assets.

The second experiment simulates variations in customer credit. A more lenient credit policy will incrementally increase sales through the addition of marginal accounts, however the corresponding increase in the receivables collection period will require a larger amount of working capital. Curve 7 of figures 3 and 4 shows that although the most lenient credit policy extends the debt payback period it also results in maximum profitability, and management is thus advised to reduce the stringency of their credit terms.

The firm under analysis operates in a style-conscious industry and annually re-tools at a level of sixty dollars per production unit. Simulation three deals with variations in this tooling expenditure around this standard amount; sales are taken to be directly influenced by these styling changes. Figures 5 and 6 show that this firm devotes too much capital to these annual styling changes since maximum profit results from the minimum tooling expenditure, indicated by curve 1.

Simulating the operation of an industrial organization is a valuable experimental device for testing variations in both its internal and environmental characteristics. The model utilized in this experiment, while gross, is shown to provide valuable assistance in structuring the managerial decision process. Simulation is a tool available to management which can reduce the risk

inherent in developing and implementing business strategy and tactics.

RELATED REFERENCE SOURCES

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3. Mize, Joe H., and Cox, J. Grady. Essentials of Simulation. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1968.

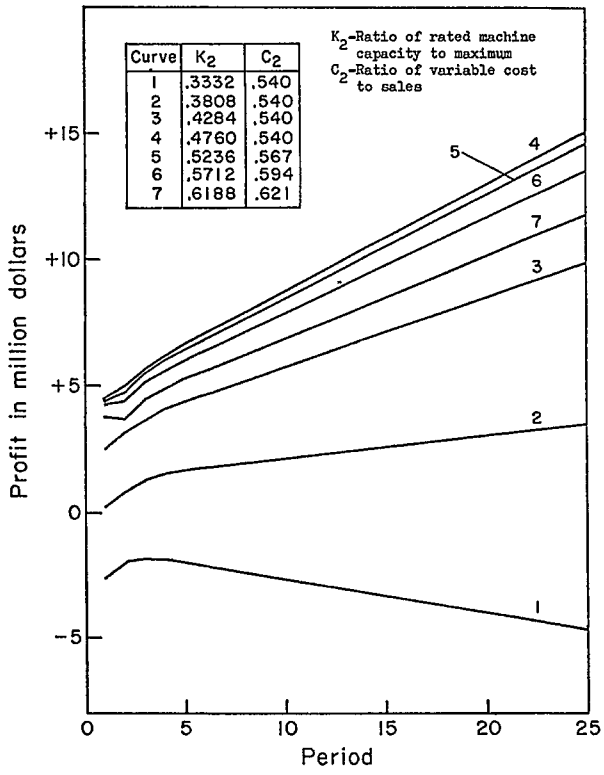

Figure 1.--Effect on profit of various fixed asset utilization levels.

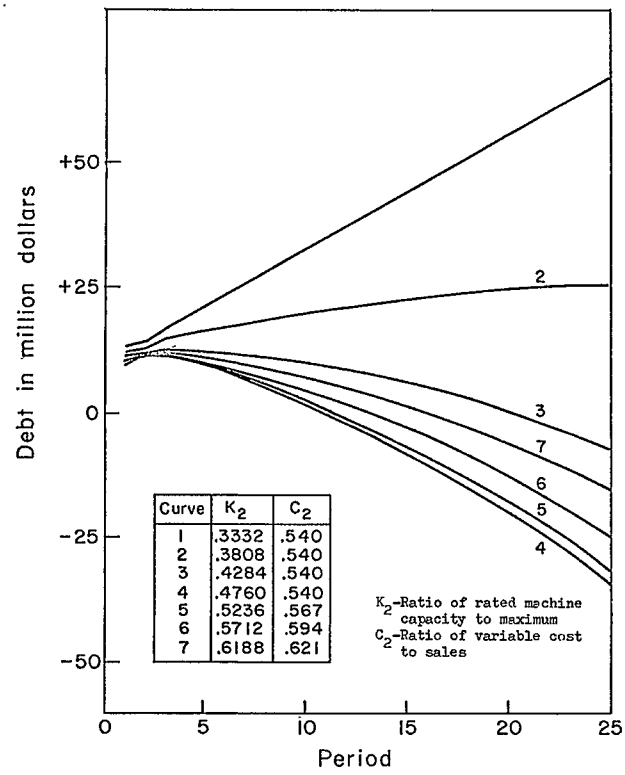

Figure 2.--Effect on debt of various fixed asset utilization levels.

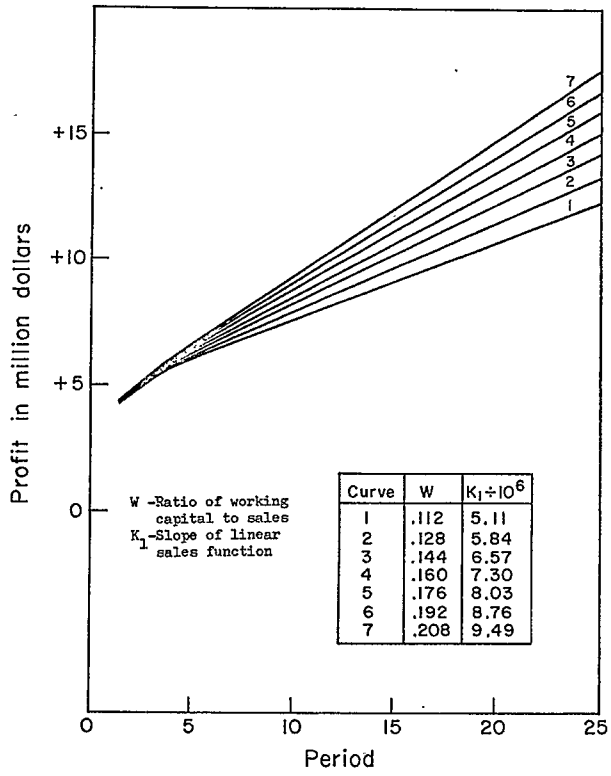

Figure 3.--Effect on profit of various credit policies.

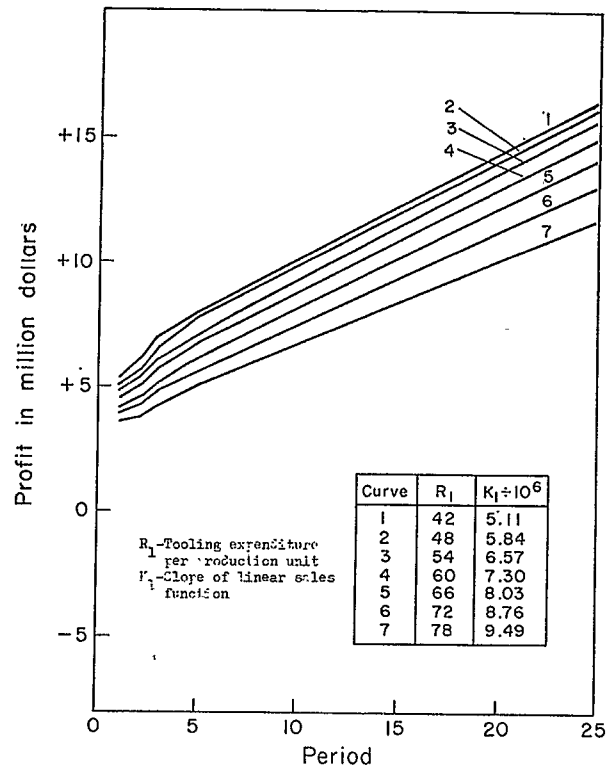

Figure 5.--Effect on profit of various tooling levels.

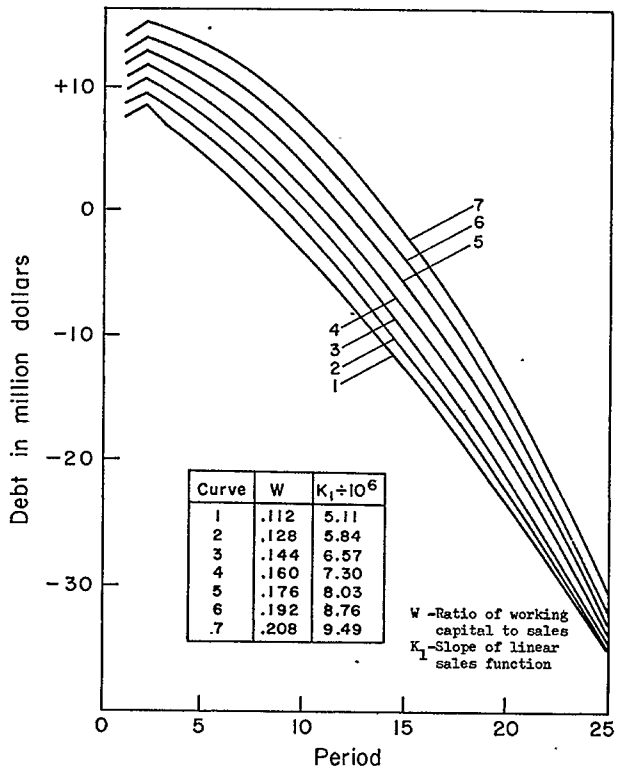

Figure 4.--Effect on debt of various credit policies.

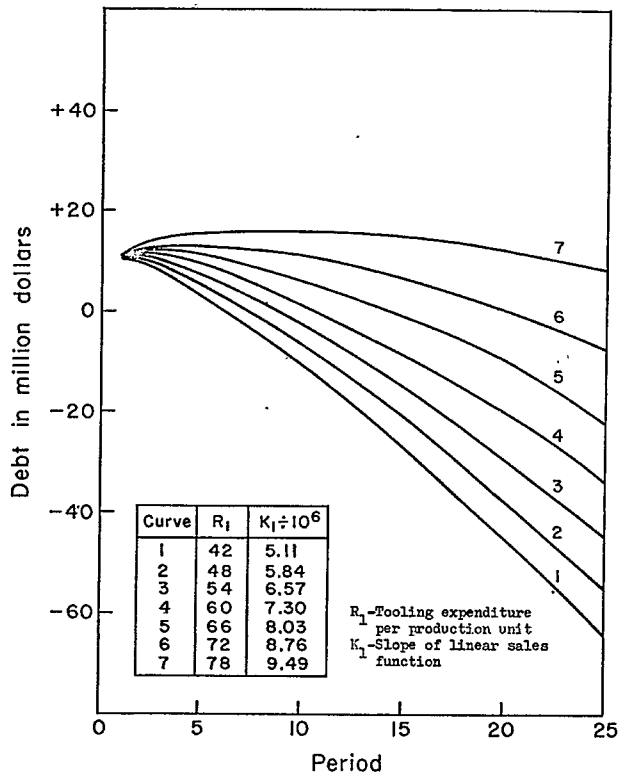

Figure 6.--Effect on debt of various tooling levels.