Simufor: An Exercise in Planning and Forecasting

How to Add an Important Element to Business Games

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In a free-enterprise economy the dynamics of business lead to conditions of uncertainty. Inevitably, this uncertainty requires that business leaders make plans based on forecasts of future industrial and economic environments. Yet, the most dramatic innovation in business education within this decade—the simulation exercise or business game—makes little or no attempt to deal with the planning function in this sense. Also, there is usually no provision for a macro-economic environment.[1] These games purport to stimulate and train the student in the planning function, but in most cases planning is limited to current decision-making involving a firm in a single oligopolistic industry with little concern for other industries or the general economy.[2] At most, some games make reference to a business cycle index based on some extraneous function. In a year's study of a complex management game, students consistently stated that the simulation pro-

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vided no basis for strategic decisions based on future plans. A most frequent quote was, "All decisions in this game are tactical. There's no basis for strategic planning."[3]

Let us recognize that activities of the firm are not solely dependent upon other firms in its industry, but they are interdependently related to other industries and the general economic condition as well. Planning, then, involves something more than just making allowances for the firm's activities within the confines of an oligopolistic environment. Furthermore, the planning function always implies some degree of futurity, which in turn implies that some projections of future conditions (regardless of the method) are necessary for sound planning. Therefore, any simulation exercise which intends to present the student with a learning experience in the planning function should contain provisions for both of these important facets of planning—an economic and industrial environment in which to relate the firm and a vehicle to provide the "planner" the opportunity to forecast. Such a simulation exercise becomes more than simply a tactical decision model; it provides learning exposure to factors necessarily concerned with strategic decisions.

To provide the student such an experience, a simulation model of an industrial and general economic environment (e.g., the U. S. economy) was designed for use as a pedagogical device in teaching industrial and economic forecasting. In some respects, the simulation exercise—called SIMUFOR—resembles a business game.[4]

Design of Model

The model itself consists of a system of equations which may be divided into three broad groups: (1) time-series equations, (2) industrial regression equations, and (3) general economic equations, an econometric model. There also are several subroutines which general certain variable values. The unique feature of the SIMUFOR model is that all exogenous variables are reduced to annual time periods. The time-series equations, therefore, provide the variables for the industrial and economic equations. The industrial equations in turn provide additional variables for the econometric model. Consequently, the only exogenous variables are time periods, which can be easily programmed by initializing a time variable and defining a terminal period. For example, the model may be programmed to begin with year 1 and incremented by one year to some terminal year, 100. The yearly periods then proceed in a consecutive pattern: 1, 2, 3, . . . 100. Industrial and economic data are generated for each year. The generic flow diagram on the next page shows the operational design of the model.

Time-Series Model: In constructing the time-series facet of the model, the multiplicative model was used. The assumption is that annual time-series are influenced by interaction among trend (growth), cyclical variation (economic conditions), and irregular variation (random variable). That is, 0 (original data) = T • C • I.[6] Trend values are generated from least-squares equations—linear or curvilinear—determined from empirical investigation for each series. The cyclical indexes are produced from sinusoidal functions of the cosine wave form. Irregular variation is supplied from a sub-routine generating random numbers. For example, the following equation produces annual values of automobile registrations.

$RA = (a + b(T) \cdot (CAT) \cdot (RANO)$

where, $a + b(T)$ provides the trend value.

CAT is the cyclical index com-

puted from the cosine wave form. RANO is a uniform random number derivative.

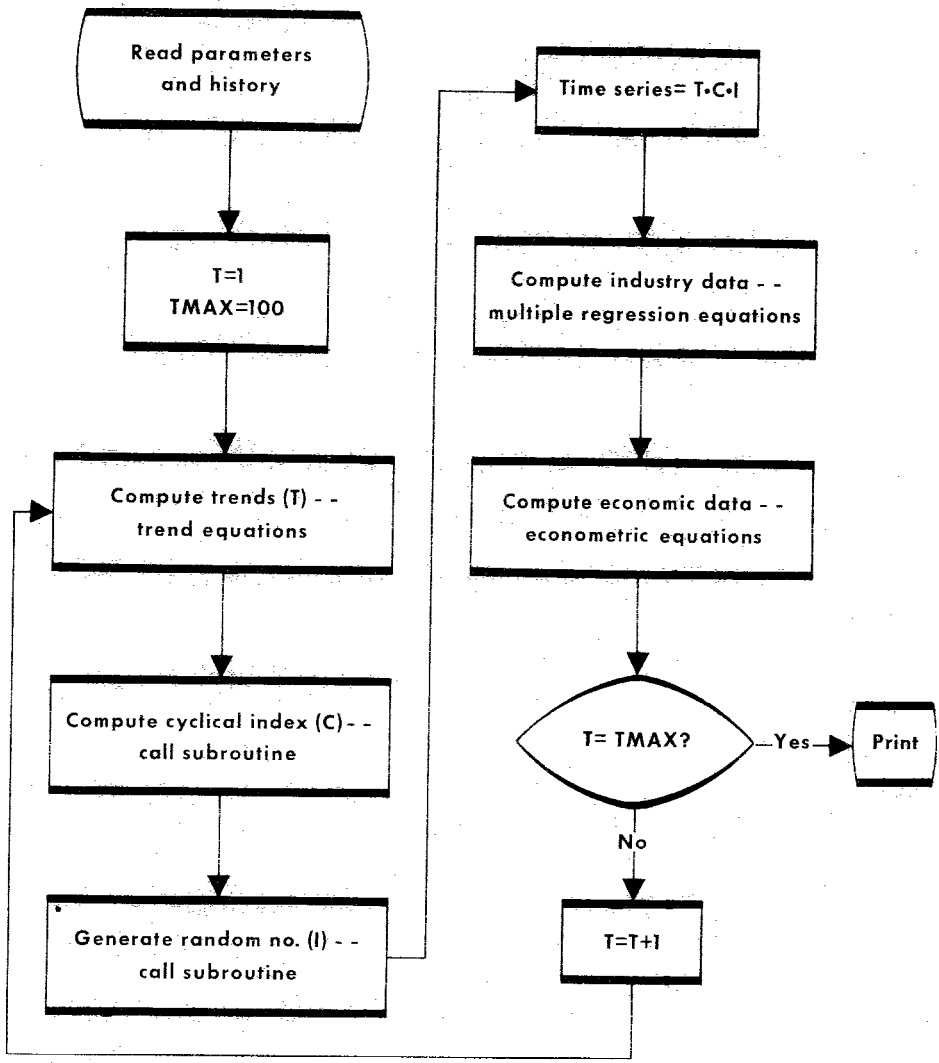
Industrial Model: The industrial model consists of a system of multiple-regression equations, each of which generates annual data for the following industries.

Personal Consumption Expenditures

Non-durable:
- Cigarette Industry
- Gasoline Industry

Durable:
- Automobile Industry

Generic Flow Diagram of Simufor Model



Service:
Electric Power Industry
Life Insurance Industry

Private Investment

Housing Industry
Plant and Equipment Industry

Most of the independent variables in the industrial model are supplied from the time-series model. In this sense, the independent variables are endogenous. Dependent variables produced by the industrial model include unit sales, price, and dollar volume of sales for most of the industries.

Econometric Model: The econometric aspect of the SIMUFOR model is a fairly complex version of a simple National Income-Gross National Product determinant model. The industry data generate their respective G.N.P. accounts—e.g., cigarette sales plus gasoline sales time some multiplier yields the Personal Consumption Expenditure, Non-durable account for the time period. Considering the expenditure approach, the consumption and investment accounts plus government expenditures total to G.N.P.

Using the receipts approach, the G.N.P. data generate such data as national income, disposable income, and corporate profits. The result is that the model generates a complete spectrum of industrial and economic data for each time period.

Description of Exercise

Once the model is designed and programmed on a computer of sufficient capacity, the exercise involving student and instructor is relatively simple.[7] In fact, it is at this point that SIMUFOR no longer resembles a business game. For in a business game players repeatedly make decisions which become input information in the simulation, the model in turn develops information based on the input. The players then make more decisions based on the previous simulation output. Here the situation is quite different. The SIMUFOR model generates data completely independent of the players' activities. No decision made by a player will affect the output of the model (at least in its present state).

The recommended procedure for the exercise may be summarized as follows. The instructor may first discuss industry and economic forecasting techniques. He may supplement his discussion of these techniques with any desired class material. In fact, the success of the learning exercise depends heavily on teaching activities and materials extraneous to the model. When the instructor is ready to present the student with the problem of forecasting, he may want to group them. There is no specific limit to the number of players assigned to each group, but it is recommended that the group be small enough for each member to contribute. Third, each group is given one or more industries for which forecasts are to be made for some specified time period(s). A more desirable procedure is to establish a situation requiring planning for some industry. Each group will then be required to forecast in order to formulate such plans. Next, the termination period is defined and the computer generates the data in compact tabular form, which is given to the student for analysis. Using the data supplied by the model, the groups then formulate their forecast procedure and make their respective forecasts. For example, the player groups may have been supplied data from the year 1 through the year 22; they may have been instructed to make forecasts for the years 23, 24, 25, 26 and 27. The exercise administrator then has the model generate data to include the forecast periods. The players check their re-

spective forecasts. They compare their plans and the appropriateness of the plans with what occurred in the model. The final step—the aftermath of the exercise—is an analysis in retrospect. Here the players re-evaluate their procedures to determine the extent to which they may have improved the forecast and the plan. They also examine the causes of error.

Evaluation of the Exercise

The obvious advantages to the SIMUFOR exercise are included in the many well-known advantages attributed to the business game—i.e., collapses the time dimension, allows for error under simulated conditions, stimulates student interest, provides reinforcement so essential in learning.[8] Moreover, there are unique advantages associated with SIMUFOR. First, it provides a convenient vehicle allowing students to experiment with certain forecasting techniques. Student decisions do not affect the output of the model. Second, it allows for consideration of both short-run and long-run plans integrated with short-run and long-run forecasts. Third, the model incorporates a general economic system. That is, the industry does not exist in an economic vacuum. Finally, because of the nature of the model, it has outstanding research potential. This research may take the form of studying the effects of changes in economic policy (involving changing parameters values in the model); testing alternative forecasting procedures and new techniques; and examining inter-industry effects.

The single important disadvantage to the exercise is the model's understatement of the complexity of the economy. While SIMUFOR does not attempt to completely simulate any existing industrial or economic situation, the student is prone to think in terms of a familiar environment—his own. He may mistakenly fail to distinguish between the simulated and real worlds.

Epilog

To those who object to SIMUFOR because it is not "game-like" enough, a proposal for the future may offer some consolation. Any of the better-known business games can be reasonably integrated with SIMUFOR, constrained only by computer capacity and expense. A business-game industry can easily become one of the industries in the SIMUFOR model. In such a case, management decisions within the firm not only affect the firm's industry but would also have some effect on other industries and the entire economic environment in the model. Likewise, the industrial and economic situation in SIMUFOR would have some effect on the game industry and the individual firms in it.

For example, the Carnegie Tech Management Game simulates the detergent soap industry.[9] It would be a relatively simple matter to add this industry to the SIMUFOR model as another industry in the Non-durable, Personal Consumption Expenditure sector of the economy. Annual industry sales would contribute to the non-durable account which in turn affect G.N.P. and other G.N.P.-derived accounts. Changes in the economic picture would then affect management plans in a particular firm in the detergent industry.

Extending this notion a step further, it is not difficult to perceive of a gigantic model like SIMUFOR whose industries are the game industries of a whole array of business games; so that a decision made by players at Carnegie Tech in the simulated detergent industry might affect the players in a game at U.C.L.A. dealing with the flour industry. This notion may seem incredible, but it is possible.

References

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