THE PLACE OF THE SİMULATİON IN ECONOMETRİC MODELLİNG

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Summary

Simulation is a testing of theory by developing model-based activities. In this point of view, place of the simulation, especially in econometric modelling, has very big importance. Of course, simulation has many application field to get various experimental objectives. The main aim of this study is to show ability of simulation and its implementation structure to the various problem and econometric modelling. Later, the real econometric modelling example made by Oren and Gunes, at the University of Ottawa, is expressed with their model formulations. As a conclusion, the necessities of modelling by simulation is showed to create new and sufficient policies.

1-INTRODUCTION

Simulation which is experimentation with models is an important decisions making techniques(Oren,1981).Simulation has several definition made bay Oren and other author, such as below: simulation is a type of knowledge generation (Oren, 1987).

Simulation as a numerical tecnique for conducting experiments with certain type of mathematical models which describe the behavior o`a complex system on a digital computer over extended periods of time (Naylor,1971).

Simulation is a process of running a model (Bobillier P.A., Kahan, B.C. and Probst, A.R., 1976).

It is clear from the above definition that simulation studies depends on the models. In fact, there is a very big importance of modelling in simulation experiments.

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The other definition of simulation made by Oren is this: Simulation is experimentation with dynamic model (Oren, 1987). In simulation, the model driven under some experimental conditions to generate model behavior.

Simulation has several application area. It applied to the engineering, manegement science and economic models, social sciences, artificial inteligence and so on. At the same time "Machine Learning" is the another application area of simulation. Ability to learn is the gist of intelligent system. Of course, there are several techniques and possibilities for machine learning (Oren, T.I., Zeigler, B.P., 1986).

The main aim of this article is to show the place and importance of simulation in econometric studies and modelling. Simulation techniques can also applies to the ecnometric models such as it could apply to the another models.

2- BENEFITS OF SIMULATION STUDIES

There are theoretical, metatheoretical and practical benefits of simulations in its applications fields.

A more reasonable approach and that taken by most contemporary simulation workers, is that theory and computer models are inseparable but different.

The simulation program represents the theory, and theory represents the simulation program. The simulation is a test of theory and theory is regarded as the parent to the program (Lehman, 1977). An important benefit is the clasification of theoritical statements. Simulation may also a critique of a theory. By this way, it can be possible to find or generate new hypotheses and implications of therotical knowledge.

As a practical benefits of a computer simulation, we can say that in an computer model, it is easy to represent randomness and to deal with random variables (Lehman, 1977).

Simulation, being a model-based activity, has strong ties with other scientific disciplines such as general system theories, cybernetics and artaficial intellegence (Oren, 1987).

3- FUNDEMENTAL ELEMENTS OF A SIMULATION STUDY
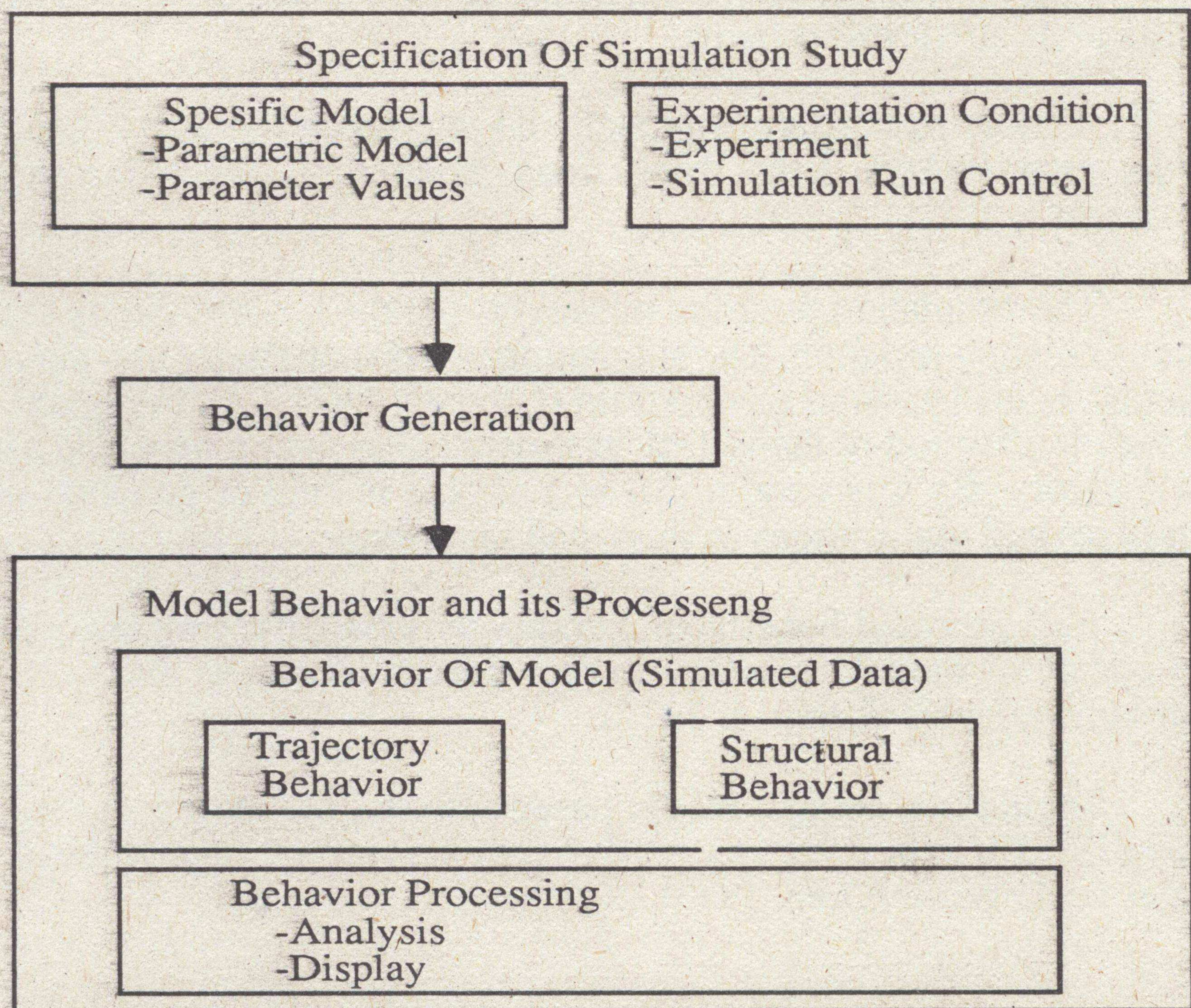
Specification of the simulation study necessitates:

1) Knowledge of a specific model, i.e., knowledge of a parametric model and knowledge of aparameter values (i.e., a parameter set) and,

2) Knowledge about experimentation (Oren, 1987)

The fundemental elements of simulation study are defined very briefly by Oren. In his very clear taxonomy of simulation studies, fundemental elements are in two main parts. These are following :

1-Specification of Simulation Study.

2-Model behavior and its processing.

Detailed knowledge on the elements of simulation study is shown in Figure-1 (Oren, 1987).

Figure-1 : Fundemental Element Of A Simulation   Study

```
┌─────────────────────────────────────────────────────────────┐
│            Specification Of Simulation Study                  │
│  ┌───────────────────────┐  ┌──────────────────────────────┐ │
│  │ Spesific Model        │  │ Experimentation Condition    │ │
│  │ -Parametric Model     │  │ -Experiment                  │ │
│  │ -Parameter Values     │  │ -Simulation Run Control      │ │
│  └───────────────────────┘  └──────────────────────────────┘ │
└─────────────────────────────────────────────────────────────┘
                          │
                          ▼
          ┌──────────────────────────────┐
          │   Behavior Generation         │
          └──────────────────────────────┘
                          │
                          ▼
┌─────────────────────────────────────────────────────────────┐
│  Model Behavior and its Processeng                            │
│  ┌──────────────────────────────────────────────────────┐   │
│  │       Behavior Of Model (Simulated Data)              │   │
│  │  ┌─────────────────┐      ┌──────────────────┐        │   │
│  │  │ Trajectory      │      │ Structural       │        │   │
│  │  │ Behavior        │      │ Behavior         │        │   │
│  │  └─────────────────┘      └──────────────────┘        │   │
│  └──────────────────────────────────────────────────────┘   │
│  ┌──────────────────────────────────────────────────────┐   │
│  │  Behavior Processing                                  │   │
│  │    -Analysis                                          │   │
│  │    -Display                                           │   │
│  └──────────────────────────────────────────────────────┘   │
└─────────────────────────────────────────────────────────────┘
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As it is shown from figure-1 that behavior of models consists of trajectory behavior and structural behavior. During the simulation behavior

can appear trajectory or structural.

The last thing to do in this part is behavior processing. Behavior processing is also consist of analysis and display. At the end of simulation of model, behavior data is obtain. It is possible to make analysis, compression and display the purposes by using behavior data.

In some literatures, computer simulation experiments with model of economic system, usually consists of six steps as follows:

1-The Formulation Of The Problem

2-The Formulation Of The Mathematical Model

3-The Formulotion Of The Computer Program

4-Valitation

5-Experimental Design

6-Data Analysis

Computer simulation experiment should begin with the formulation of a problem or with an explicit statement of the objectives of the experiment,since there is a little benefit to be derived from experiments that involve simulation for the aim of similation.

These objectives usually take the form of (1) question to be answered, (2) hypotheses to be tested, and (3) effetcts to be estimated (Naylor,1971).

After the formulation the experimental objectives, the next step is the formulation of mathematical model. İn this step the endogeneos and exogenous, related with model, are determine by using some statistical medhods.

The computer simulation program can either write in a general purpose language such as Fortran, PL/I or algol. There are also a special purpose simulation languages such as GPSS-V,GPSS/360,SIMSCRIPT-II,SIMPL/I,DYNOMO,SIMULATE and SIMULA 67. Espacially Simstcript-II and Simulate simulation languages are designed for simulating large-scale economic systems that have been formulated as econometric models consisting of large sets of equations.
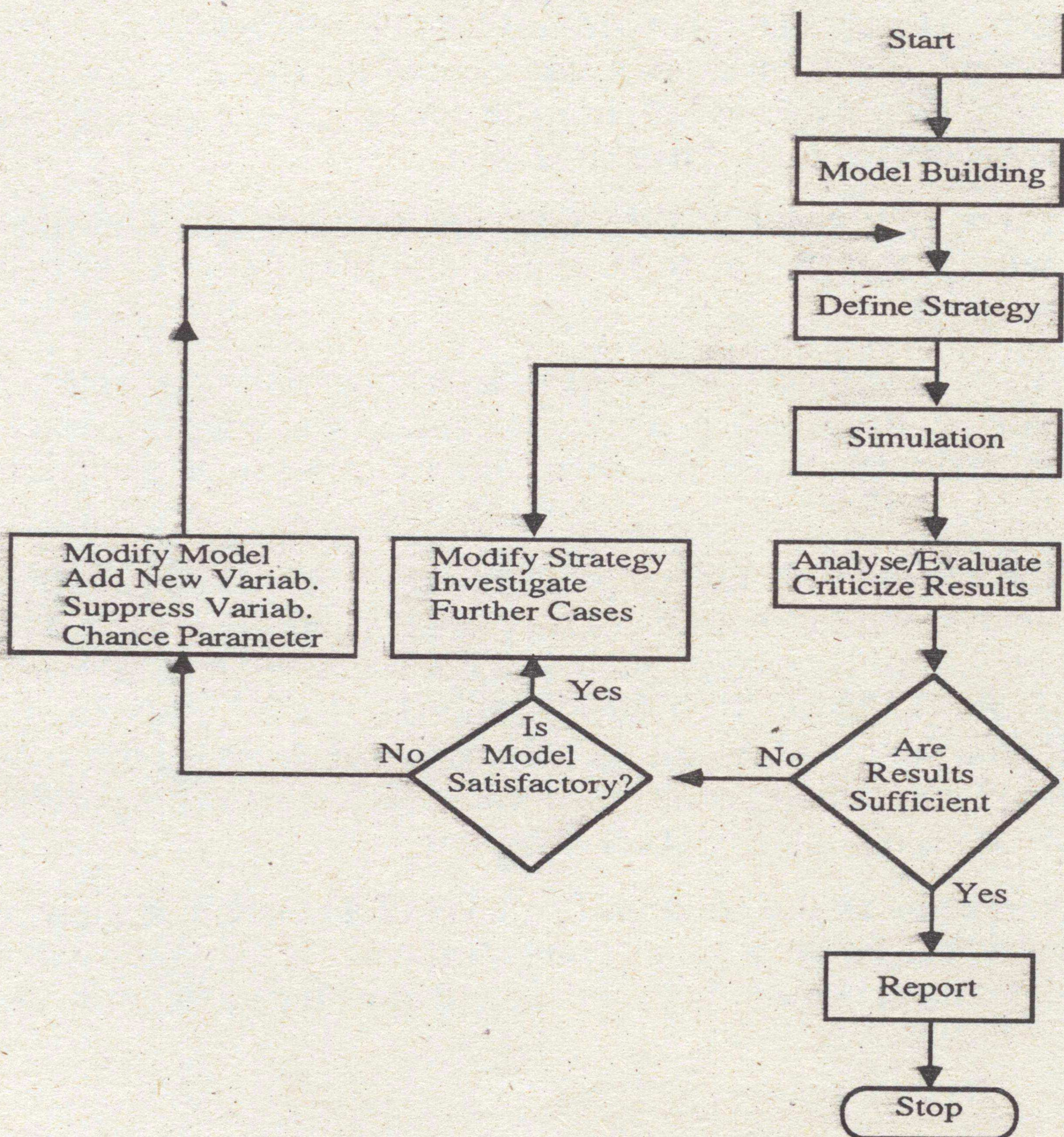
Validation is also an important level of a simulation study. On the other hand"Validation of simulation experiments is merely part of a more general problem, namely, the validation of any kind model or hypothesis (Naylor,1971).

There are also two important terms in the language of experimental design. Two of those are factor and response, and represents the variables. Let say we are study on econometric (maybe multi-equation) model. Exogenous variables of our model can represents by factor inthe experimental design. In this case, behavior of model will be response and it is clear that response must be endogenous variable the exogenous variable is also called policy (input) variable.

Analysis of variance and regression analysis could use in data analysis. The analysis of variance is a collection of techiques for data analysis that are appropriate when qualitative factor are present .Regression analysis is a collection of tecniques for data analysis that uses the numerical properties of the level of quantative factors.

There are a few differences explanation of steps of simulation experiment. One of these is shown in figure-2, made by Bobillier(1976), following:

Figure 2 : STAGE OF SIMULATION STUDY

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                                              ┌──────────────┐
                                              │    Start     │
                                              └──────┬───────┘
                                                     ▼
                                              ┌──────────────┐
         ┌───────────────────────────────────│ Model Building│
         │                                    └──────┬───────┘
         │                                           ▼
         │                                    ┌──────────────┐
         │                      ┌─────────────│Define Strategy│
         │                      │             └──────┬───────┘
         │                      │                    ▼
         │                      │             ┌──────────────┐
         │                      │             │  Simulation  │
         │                      │             └──────┬───────┘
         │                      │                    ▼
┌─────────────────┐   ┌──────────────┐   ┌──────────────────┐
│Modify Model     │   │Modify Strategy│  │Analyse/Evaluate  │
│Add New Variab.  │   │Investigate    │  │Criticize Results │
│Suppress Variab. │   │Further Cases  │  └────────┬─────────┘
│Chance Parameter │   └──────▲───────┘           ▼
└────────▲────────┘          │ Yes        ┌──────────────┐
         │             ┌─────◇──────┐  No  │  Are Results │
         └────── No ───│ Is Model   │◄─────│  Sufficient  │
                       │Satisfactory?│     └──────┬───────┘
                       └────────────┘            │ Yes
                                                 ▼
                                          ┌──────────────┐
                                          │    Report    │
                                          └──────┬───────┘
                                                 ▼
                                          (    Stop    )
```

4- SIMULATION IN ECONOMETRIC MODELLING

The another application area of simulation is econometric modelling. Simulation can also easily apply to the economic events, but at the same time computers has very big importance. The role of computers in simulations is not limited to behavior generation, they can also be used for behavior processing, as well as modelling and knowledge based management for several types of knowledge which may exist in advenced simulation environments (Oren,1986).

Forecasting is important factor on decision making. Especially ;Goverment Planning Organisation or top manager of firms needs further information to processes their development plan. For example, upper manager of any firm can decide sales level of next year by using previous years data. So that, forecasting is became more important tool for the future of the firm.

In this case mathematical formulation can be optain by using some statistical techniques i.e., O.L.S., or 2S.L.S. and so on. As it is mentioned at previous part that the using of computers gives a big advantage for progressing the simulation studies.

Each econometric model consist of two kind of variables, called endogeneous and exogenous. The behavior of such models depends on exogenous variable, named input (policy)

Endogenous variables are also output values of the model after simulation for any period. One could decide the next policy of a firm by using this output values. It is also possible to simulate the econometric models, gives further knowledge to the government or top manager of planning organization.

One of the econometric model simulation study is made by OREN and GUNES at the University Of Ottawa. In this study, multi-equation econometric model is following:

$$C_t = a_0 + a_1 (Y_t - T_t) + u_1 \quad \text{............ Consumption Function}$$

$$I_t = b_0 + b_1 Y_t + b_2 Y_{t-1} + u_2 \quad \text{......Investment Fonction}$$

$$T_t = c\, Y_t + u_3 \quad \text{........................ Texation Function}$$

$$T_t = m_0 + m_1 Y_t + U_4 \quad \text{............... Import Function}$$

$$Y_t = C_t + I_t + G_t \ E_t - M_t \ \dots\dots\dots \text{National Income Funtion}$$

It is shown from above that , there are five endogenous and four exogenous variables in our model . Policy (Input) variables are Y_{t-1}, P_{t-1}, G_t and E_t . Each of those are lagged income, lagged price level, government expenditure and exports, respectively . Behavior of the model depends on these four variables. G and E are determine by government at the end of previous period while making developmet plans . Mathematical formulation `of the model was ready and computer program of calculation made in Fortran - 77 language .

Behavior of the model is obtained by giving initial values to the policiy variables, at the same time, it is also possible to change the level of initial values. By this way, many possibilities of response can be obtain after each simulation step of model .

Therefore; very usefull knowledge on economy can obtain to give new direction the upper manager of government or planning organazition staffs . It can be possible to calculate of many possibilities on economy.For example, in some case the level of the export or government expenditure could be held in a constant level . Of course, the beavior (or response) of the model will be different .Therefore, the most suitable solition or government policy may choise between possibilities .

It is clearly shown from above explanation that simulation gives us more wide perspective on economy policy .For this reason , there is very big importance of simulation in modelling espicially in econometric modelling .

5- CONCLUSION

The objective of simulation study can be the finding of best policy or to test of hypothesis that there is no difference between two or more policies on economy or another subject .

Simulation experiment gives the value of the parameter during and at the end of simulation (Bobillier P.A.., Kahan, B.C. and Probst , A.R., 1976). These values derived from simulation will be a model to the researcher to choice the best situation .Because of a computer simulation is a model of a same real process, the program activities can be made to parellel the actual processes, to a greater degree than is possible with other forms of model .

With modelling a new minitheory can often be developed rather quickly; Certainly much more quickly than by the traditional approach of a series of experimental studies to explore a new explanatory conception (Lehman ,1977) .

EKONOMETRİK MODELLEMEDE BENZETİM YERİ

Bu çalışmada; modellemede önemli bir yeri bulunan benzetimin ekonometrik çalışmalarda da kullanılabilecegi konu edilmiş ve bazı çalışmalarla örneklendirilmiştir .

Benzetimin çeşitli tariflerinin yapıldığı giriş bölümünden sonra faydaları üzerinde tartışılmıştır. Daha sonra bir benzetim çalışmasının adımları verildikten sonra bu yapı şekillede verilmeye çalışılmıştır . Ekonometrik modellemede de benzetimin rahatlıkla kullanılıp çeşitli ileri tahminlerin yapılabileceginin işlendigi üçüncü kısımda , bu konuda yapılan bir çalışma örnek gösterilerek , geliştirilen ekonometrik modelin çeşitli alternatif durumlar karşısında verecegi davranış anlatılmaktadır. Çalışmada örnek olarak alınan Keynes ' in çok denklemli ekonometrik modelidir. Bu modelin benzetimi ile ilgili çalışma Oren ve Güneş tarafından Ottawa Üniversitesi 'nde yapılmıştır (1988) .

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