

THE DEVELOPMENT GAME

A Simulation Exercise in Economic Development

by Clive Bell\*

The Development Game is a response to a need arising out of one of the main activities of the Institute of Development Studies - namely, that of providing study seminars on specific problems in the field of economic development. The seminars are intended to improve the power of senior level civil servants from less developed countries to make well-informed decisions.

After some initial experience with these courses, it was felt that certain seminars might benefit from the introduction of a total development simulation exercise. The model-building phase began in January, 1968 and by the end of the same year, a prototype programme had been used with considerable success in seminars on "Aid and Trade" and on "Implementing Development Plans".

The core of the Game is a mathematical model of an economy defined by about 130 equations and constraints, of which some 90 determine the behavioural structure of the system, while the rest are identities. This hypothetical economy produces five sorts of goods:- food, raw materials, textiles, machines and reclaimed land, with the aid of three factors of production:- labour, land and machines. The agricultural sector, which produces food and raw materials, and the sector which produces textiles, are privately owned; machines and reclaimed land are produced by government corporations. The production function relating to each good is such that technical progress affects the productivity of each factor of production to the same extent relatively. The rate of technical progress in each sector depends on the rate of investment in that sector. However, the level of production of each good is subject to random shocks, which are analogous to the vagaries of the weather or teething troubles with industrial plant. The role of foreign exchange is felt at two levels. At the macro-level, balance of payments constraints operate so as to limit the level of output by placing an upper bound on the capacity to import. This may be alleviated to some extent by flows of aid, part of which is set by the umpire, while the remainder is set by the players and incurs increasingly unfavourable repayment terms as the sum bargained for becomes larger. At the micro-level, raw

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materials and textiles may be exported, and all goods, with the exception of land, may be imported. Moreover, the production processes for textiles and machines require inputs of a good which cannot be produced domestically. Lastly, foreign exchange is required to meet the cost of sending personnel abroad for specialised training. This skilled labour can become a critical bottleneck if attempts are made to expand the machine-building sector at a great pace.

Players may control the rate and direction of development of the "economy" by means of a battery of some 20 instrumental variables. In particular, the rates of production of machines and reclaimed land are determined by the (chosen) relevant labour inputs, while the rate of increase of the output of machines depends on the proportion of the current supply of machinery retained for use in the public sector. Apart from those mentioned above, other policy instruments include:- domestic and trade taxes on goods, taxes on wages and profits, price and stock policies for agricultural products, and the current rate of interest.

Moreover, there will be additional hazards to decision making in that some policy instruments will increase the degree of uncertainty attached to expected outcomes more than others; also, certain distributions of income will incur political upheaval. There is, however, no set of outcomes which will 'win' the Game. Teams are required to declare in advance what combination of objectives they want to maximise and, in addition, they must make explicit the relative weights they attach to, inter alia, growth, inflation, balance of payments, and the distribution of income. Each planning team is then "marked" according to two criteria -

- (i) its success in achieving its initially-stated objective function, modified by:-
- (ii) how difficult that function is to achieve.

A 'play' of the Game normally covers some ten to twelve moves ('years') spread over two or three days.

At the most general level, it is hoped that the educational impact of the exercise will be felt in the fact of players being faced with the problems of controlling a complex, highly interdependent, multivariate system. A rapid learning process through intelligent analysis of the system's behaviour in response to the instrumental stimuli is therefore of critical importance. But how the game is used and what lessons are derived from it will depend on the user. In the case of civil servants, for example, the main purpose is to teach that variables are interrelated, rather than how they are interrelated. Practical men often work, explicitly or more commonly implicitly, with very

simple and occasionally uni-causal models. The purpose of this exercise is to wean them from such intellectual habits and to open their minds to the need for the analysis of complex systems. The aim is more in the nature of a therapy for intellectual cramps than the presentation of a universal model.

The scope for students and professional economists is rather greater. So often economic analysis is hamstrung by the assumption of ceteribus paribus and mutatis mutandis. The structure of the development game is such, however, that economists can seek to use the tools provided by economic analysis to 'optimize' the performance of a general equilibrium system. Moreover, the programme need not be used as a game. It can also be used as the basis for studying comparative statics or changes in the values of the model's parameters.

But the usefulness of the model does not end at providing a teaching device; it also suggests some exciting research possibilities. The model could be expanded to include two new subsystems. First, a subsystem for education would give rise to two categories of labour; and a second subsystem would introduce the possibility of radically transforming the composition of output and the structure of the economy - principally by means of import substitution and "learning by doing". The model would then assume a form permitting very long run simulation studies. In particular research could be directed towards examining which policies will achieve what objectives most efficiently. The implications of radically different development strategies - for example, an agricultural as opposed to industrial bias in planning - could also be explored. Then there are issues revolving around stability and sensitivity. Obvious questions in this context are: Does the model possess unstable domains; which areas are sensitive to which instruments; and what is the impact of parametric variation?

All of the above, however, is rather speculative. It is based on limited experience, especially in relation to the complexity of the model. The best ways of presenting the Game will surely emerge from future use rather than from a priori argument.

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