# DEVELOPMENT AND UTILIZATION OF GLOBAL/WORLD MODELS IN INTERNATIONAL AFFAIRS

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ABSTRACT

The development and utilization of global/world models in the context of political implications of world economic trends is overviewed in terms of three streams of research, that of the multidisciplinary social scientists, of the econometricians, and of the system engineers. Socio-political processes impinge on world economic trends, just as such trends in turn impact on politics, both national and international. The use of simulations rich in system dynamics for the study of international affairs is found to have much potential, as documented in findings obtained by researchers throughout the world.

The creation and use of global models is not for the weak or the faint of heart. Yet such simulations are exciting and important tools to complement our understanding of some of the complex implications of world trends. Their construction, however, taxes extant knowledge at our command in the social sciences. Their demands for scholarly resources are overwhelming, and they strain the patience of their users. Given interdependence among nations, the potential of world simulations during the next quarter-century for use in national and foreign policy-making is great. Will the academies and institutes of planet Earth be able to accept the challenge, thereby leading decision-makers throughout the world in the development of global models worthy of the needs of mankind?

Research on simulations in international affairs by social scientists stems from century-old war-gaming traditions, even though such work was embodied only recently in person-computer format, as in our Inter-Nation Simulation (Guetzkow 1959). In the 1960s econometricians began linking their all-computer models of national economies into larger constructions, as exemplified in LINK (Hickman and Klein 1985). Thanks to the initiatives of the Club of Rome in the 1970s, systems engineers became interested in world modeling, too, often using such computer languages as DYNAMO (Forrester 1971) for their simulations. Today there are almost thirty models of wide scope in existence (Siegmann 1986).

As Dina Zinnes perceptively commented, a simulation is but the "construction of a dynamic model for purposes of obtaining conclusions when [mathematically] analytic results are not feasible" (Zinnes 1976: 222). In coaching participants for their contributions to the panels on the THEME "Global Modeling" at the 1982 meetings of the International Political Science Association in Rio de Janeiro, coordinators Helio Jaguaribe and Richard Merritt suggested the "central question is how scientists through modeling techniques can develop representations of global processes and their reciprocal interactions which are at once formally accurate, grounded in data from the real world, and increasingly comprehensive" (Jaguaribe and Merritt 1981). In surveying the eight models presented during the early symposia of the International Institute for Applied Systems Analysis,

there was agreement that the "most important forces shaping the future are social and political, and these forces are the least well represented in the models so far" (Donella Meadows, Richardson, and Bruckmann (1982: p. xxii) But some economists and systems engineers are joining hands with other social scientists. As this paper demonstrates, given the advances in sociology and political science, it is now possible to incorporate the findings of those disciplines, too, in formal models of international affairs.

## I. THREE ILLUSTRATIVE FINDINGS ON POLITICAL IMPLICATIONS OF WORLD ECONOMIC TRENDS (AND VICE-VERSA)

### A. Tangential Political Implications from World 2/3, the World Integrated Model (WIM), and from a Latin American World Model (Bariloche)

Researches of the industrial engineers in the United States and Western Europe have had much visibility among intellectuals concerned with world futures, even though their focus has been confined to the resource-economic components of the international scene (Meads, Richardson, and Bruckman 1982). A China version of the Forrester/Meadows Model 3 was constructed soon after the popularized The Limits of Growth appeared (Brinton, Rosenberg, and Wolfe 1974; Wolfe 1975). Perhaps the ideological controversies invoked by their models handicapped the engineers' ability to move more rigorously into political implications of the economic findings about the "limits of growth" characteristic of the western capitalist world models. Although they lament their neglect of formal inclusion of political variables in their models, their speculation on the political consequences indicates how even less-than-comprehensive formulations can be used as vehicles in generating qualitative insights.

For example, in concern about the economic gap between North and South, the World Integrated Model (WIM) was employed to check out the "Lima Conference target that 25 percent of world industrial capacity be [located] in the LDC's by 2000." It was found that "in no case does WIM suggest that the target can be realistically met." Through complementary runs of WIM, it was revealed that were the target "to be met by international transfers (aid, loans, investment abroad, tourism expenditures, and so on), it would require approximately a tripling of those transfers as a percentage of developed regions' GNPs" (Hughes 1980: 200). Although there is no rigorous discussion of political implications, the outcome of the study is rich in policy significance. Given the lack of variables concerned with international affairs, there was no opportunity for formal analysis of such implications through the model.

The Club of Rome models were immediately challenged by a group of neo-Marxist mathematicians operating from the Bariloche Foundation in Argentina (Herrera, Scolnik et al. 1976). Not content with mere polemics, these scholars constructed "A Latin American World Model" using optimization techniques (Figure 1). Instead of centering on industrial output as related to non-renewable resources and persistent pollution, the Bariloche model employed "life expectancy at birth" as its dependent variable, in terms of such basic needs as food, housing and education. According to their simulations, economic trends permitted fulfillment of basic needs in the

early 1990s for Latin America and by 2010 for Africa. But their model, even though extended from 1960 through 2040, predicted continuing shortcomings for Asia (p. 93).

Figure 1 Flowchart of the Bariloche Model

Overall the political implications of the alternative formulation of the Latin American Model were profound. If there is egalitarian income distribution instead of contemporary configurations, they found three to five times less GNP per capita would be required to satisfy basic needs (Herrera, Scolnik et al. 1976: 104). They then speculated, "The obstacles that currently stand in the way of the harmonious development of humanity are not physical or economic in the strict sense, but essentially sociopolitical" (p. 107). Yet their model did not incorporate a means for checking out the "radical modifications to the sociopolitical structure of the world" (p. 108) which might create a "new society."

It is important to realize that significant modifications can be made in extant models without undertaking an almost complete reconstruction. The drastic alterations by the Bariloche group to the simulations commissioned by the Club of Rome may not be necessary. For example, by altering parameters concerned with technological innovation in the Forrester/Meadows World 3 simulation, Bremer (1980) was able to create a model of "bloom" from a model widely proclaimed as a model of "doom." More recently, Akashi (1984) created his "F-Model" version of the Forrester world model (Forrester 1971) by inserting feedback loops embodying "human ingenuity" with respect to the "production of natural resources and the control of pollution generation." Without changing the fundamental structure of this initial Club of Rome model, by making parameter changes in the first instance and by adding feedback loops in the second, the outputs were radically transformed.

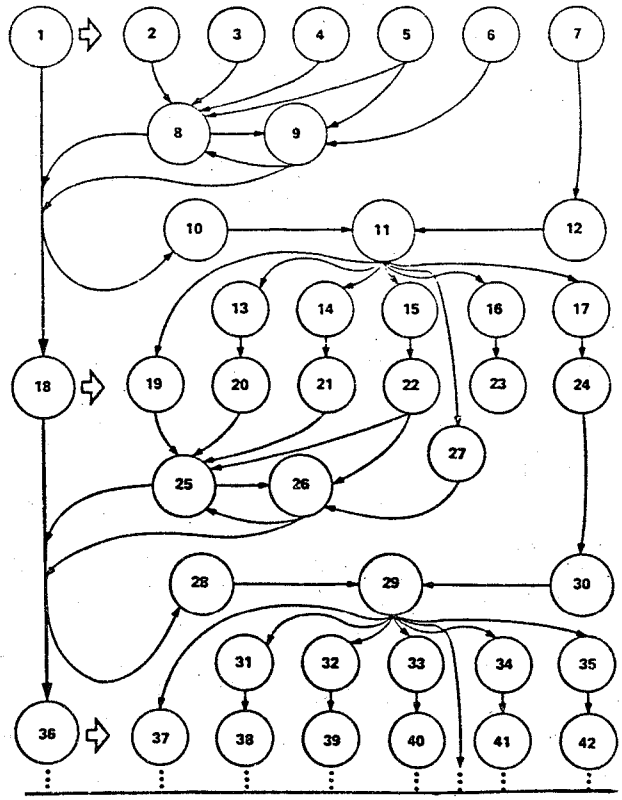
B. Generation of Political Implications from LINK and GIOM through the Use of Scenarios

The quality of the modeling of the international economic system by the econometricians, including both its trade and monetary components, is certified in its leadership by Nobel laureates, namely Lawrence R. Klein and Wassily Leontief. Although the work in the United Nations had begun already in the early 1960s within its Department of International Economic and Social Affairs, Leontief and his colleagues later reinforced the effort (Leontief with Carter and Petri 1977). Using the Wharton School at the University of Pennsylvania as a base of operations, Hickman and Klein (1979) have been able to inspire indigenous national modeling efforts by collaborators through the world. In a most creative fashion, they then linked some thirty-one national models together, allowing exogenous variables for each nation to be created endogenously by other nations in the system, as represented schematically in Figure 2.

Figure 2 Schematic Diagram of LINK System

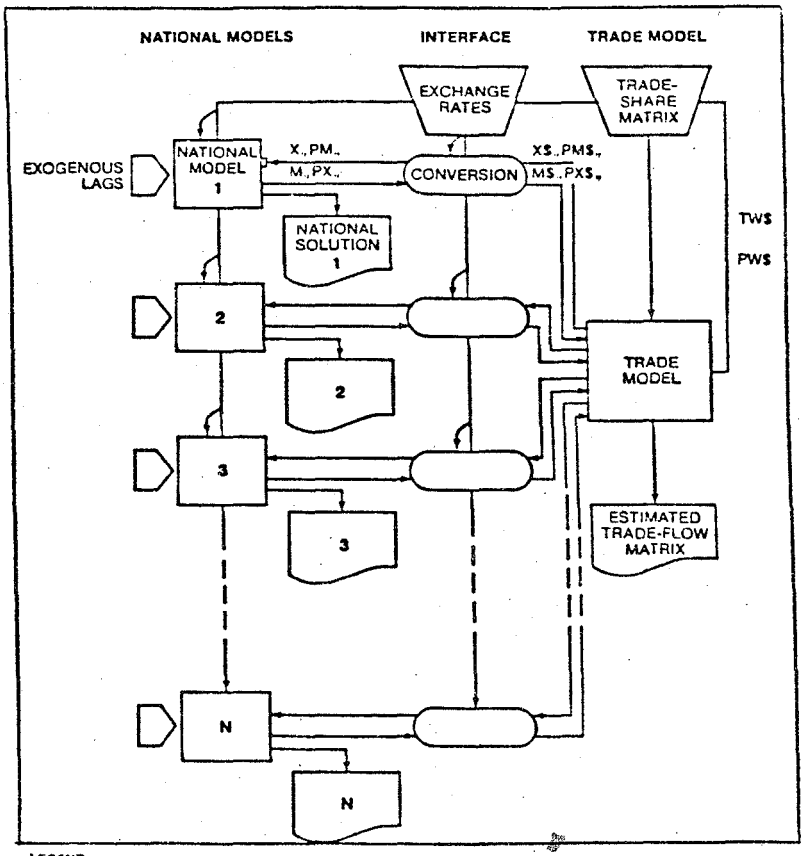
Although no explicit socio-political variables are incorporated into the models of the econometricians, they have used comparisons among alternative scenarios for seeking insight into political implications of economic trends. For example, concerned with the politics of oil, Klein,

Figure 1 Flowchart of the Bariloche Model (Herrera, Skolnik et al., 1982, pp 40 & 41)




1 Total population
2 Active population secondary sector
3 Protein & calories per person
4 Urbanization rate & houses per family
5 Initial school enrollment rate
6 Active population primary sector
7 Total capital 1980
8 Birthrate
9 Life expectancy
10 Total labour 1981
11 Optimization
12 Total capital 1981
13 Production of protein & calories
14 Urbanization & housing
15 Macroeducation: educational places
16 Consumer goods & services
17 Capital goods
18 Total population 1981
19 Active population secondary sector
20 Protein & calories per person
21 Urbanization rate & houses per family
22 Initial school enrollment rate
23 Quality of consumer goods & services
24 Total capital 1982
25 Birthrate
26 Life expectancy
27 Active population primary sector
28 Total labour 1982
29 Optimization
30 Total capital 1982
31 Production protein & calories
32 Urbanization & housing
33 Macroeducation: educational places
34 Consumer goods & services
35 Capital goods
36 Total population 1982
37 Active population secondary sector
38 Protein & calories per person
39 Urbanization rate & houses per family
40 Initial school enrollment
41 Quality of consumer goods & services
42 Total capital 1983

Figure 2 Schematic Diagram of LINK System (Klein, Pauly and Voisin 1982, p. 11)



Fardoust, and Filatov (1981) contrasted baseline outcomes for the 1980s with those obtained from an alternative projection involving petroleum price shocks analogous to those of the 1970s, as displayed in Table 1. Note how differences in political systems (as revealed in the outcomes for the "developed market economies" vs. the "centrally planned economies") are reflected in the outputs for both gross domestic products and the trade balances. The price shocks are contained by the centrally planned systems. These same shocks produce deleterious effects within the western political systems. Not having represented the socio-political processes within their models, the econometricians are unable to explore specific ways in which politics are implicated in the absorption of the shocks.

Table 1 Effect of Decade Oil Price Shocks (average annual percentage changes in real terms for period 1980-1990) Klein, Fardoust and Filatov 1982, p. 14)

| | *Baseline solution* | *Scenario* |
|---|---|---|
| **Gross domestic product** | | |
| Developed market economies | 3.4 | 3.0 |
| Non-oil-exporting developing countries | 5.1 | 4.0 |
| Oil-exporting developing countries | 5.8 | 5.8 |
| Centrally planned economies | 4.4 | 4.5 |
| **Consumer prices** | | |
| Developed market economies | 5.8 | 6.4 |
| Non-oil-exporting developing countries | 15.1 | 18.0 |
| Oil-exporting developing countries | 7.8 | 7.6 |
| Centrally planned economies | — | — |
| **Trade balance** (absolute dollar values) | | |
| Developed market economies | 12.8 | -248.1 |
| Non-oil-exporting developing countries | -156.7 | -154.7 |
| Oil-exporting developing countries | 152.9 | 391.6 |
| Centrally planned economies | -3.4 | 11.3 |

Note: Oil-exporting developing countries are OPEC countries only.

Political implications of econometric processes, as represented in military spending, have been touched by Leontief and Duchin (1983) in work completed under contract with the UN Centre for Disarmament and Development and the U. S. Arms Control and Disarmament Agency. Complementing their simulation of economic trends from 1970 to the year 2000 with five scenarios involving increases as well as decreases in military expenditures, along with variations in aid, they found "it is the poorest of the less-developed regions whose output and per capita consumption improved the most...." Having but economic variables in their model, they concluded that "this growth is explained by sizable additions to capital stocks made possible in part by replacing military imports by shipments of machinery and other capital goods" (p. 66). More recently, alternative simulations were developed for the FUGI macroeconomic model by Onishi (1984). One of his five alternative scenarios involved global disarmament, with a freeze of defense expenditures at the 1982 level from 1983 through 1990. Although he found that world economic trends would be accelerated generally, such

improvement was not obtained for China and the other Asian centrally-planned economies (Table 2).

Table 2 Annual Average Growth Rates of Real GDP (Onishi, 1984, per Table 5)

UNIT : %

| | 1983 | 1984 | 1985 | 80-85 | 85-90 | 80-90 | 90-00 |
|---|---|---|---|---|---|---|---|
| WORLD | -.179 | .292 | .312 | .086 | .306 | .195 | .000 |
| WORLD ( EXCLUDING CPE ) | -.207 | .342 | .353 | .096 | .319 | .207 | .000 |
| AME | -.223 | .299 | .247 | .063 | .159 | .111 | .000 |
| OECD | -.227 | .304 | .251 | .064 | .166 | .115 | .000 |
| EC | -.072 | .170 | .119 | .043 | .173 | .108 | .000 |
| OTHER AME | .000 | .000 | .027 | .005 | -.180 | -.087 | .000 |
| OME | -.137 | .517 | .763 | .226 | .866 | .545 | .000 |
| OIL EXPORTING COUNTRIES | -.007 | .121 | .148 | .052 | .340 | .196 | .000 |
| OPEC IN MIDDLE EAST | .000 | .156 | .242 | .079 | .395 | .237 | .000 |
| NON OIL EXPORTING COUNTRIES | -.224 | .781 | 1.173 | .342 | 1.230 | .784 | .000 |
| NICS | -.377 | .830 | 1.066 | .297 | .766 | .531 | .000 |
| ASIAN NICS | -.338 | .243 | 1.185 | .215 | .624 | .419 | .000 |
| LATIN AMERICA NICS | -.389 | 1.010 | 1.031 | .321 | .811 | .565 | .000 |
| ASIA | -.160 | .294 | .668 | .160 | .724 | .442 | .000 |
| EAST ASIA | -.381 | .251 | 1.293 | .229 | .624 | .426 | .000 |
| ASEAN | -.128 | .128 | .284 | .057 | .520 | .288 | .000 |
| OTHER ASIA AND PACIFIC | -.069 | .463 | .675 | .214 | 1.032 | .623 | .000 |
| MIDDLE EAST | .000 | .208 | .338 | .108 | .537 | .322 | .000 |
| AFRICA | .000 | .575 | .814 | .276 | .811 | .543 | .000 |
| LATIN AMERICA AND CARIBBEAN | -.242 | .811 | 1.011 | .310 | 1.133 | .720 | .000 |
| CPE | .000 | .061 | .122 | .036 | .250 | .142 | .000 |
| USSR AND EAST EUROPE | .000 | .088 | .179 | .053 | .383 | .217 | .000 |
| CHINA AND OTHER ASIAN CPE | .000 | .001 | .002 | .001 | .003 | .002 | .000 |

In analog to the way in which changes were introduced by Bremer and Akashi in the Club of Rome models, the econometricians develop their scenarios by making changes in a constellation of parametric and minor structural modifications, involving packages of some five to ten adjustments.

C. Creation of Political Implications through Simulation in the Social Science Models, SIMPEST and GLOBUS

Because the social scientists at the end of the 1950s already were attempting to incorporate political variables into their hybrid person-computer simulations of international affairs, as in the INTER-NATION SIMULATION (INS) at Northwestern University (Guetzkow, Alger, Brody, Noel, and Snyder, 1959), implications of world economic trends now can be explored directly in a rigorous manner. The transformation of the INS into an all-computer format allowed Bremer to study experimentally the political outcomes of variation in world economic trends (Bremer 1977: Chapter 4). The carefully validated work of Luterbacher and Allan (1982) in the SIMPEST simulation of the superpower triad (PRC, USSR, and USA) integrally incorporates such effects in its findings. More recently the twenty-five nation GLOBUS being developed at the Wissenschaftszentrum in West Berlin has demonstrated its emerging capacity to explore political implications of global economic trends.

During the early 1970s, SIMPEST was unusual among extant models in constructing its superpowers with a program structured to reflect its nation's attributes in a differential manner (Luterbacher and Allan, 1982). WIM and SIPER distinguish among nations only by using contrasting parameters

within a set of programs common to all nations. As illustrated in Figure 3, the Chinese economic sub-model within SIMPEST incorporates not only centrally-planned agricultural along with non-agricultural sectors, similar to the module for the USSR, but SIMPEST then further differentiates grain production and imports. Figure 4 presents an example of the political implications explicitly simulated through the SIMPEST program in terms of impact of various components, including economic trends upon two indices used for portraying military capabilities to the year 1990.

Figure 3 Simplified Representation of the Chinese Economic Submodel (Luterbacher and Allan, 1982, p. 418)

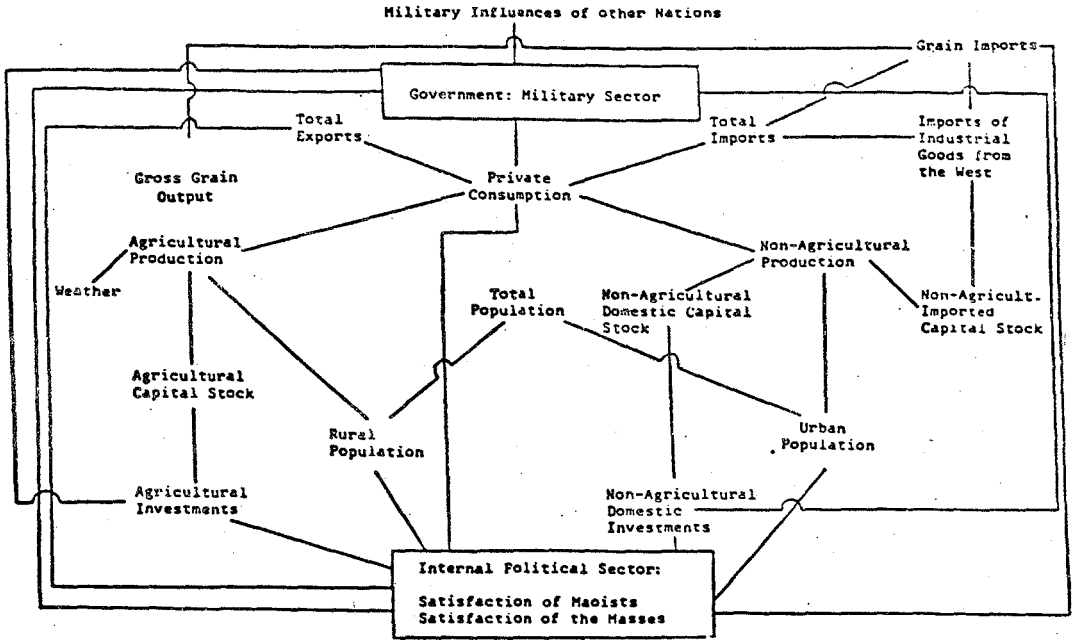
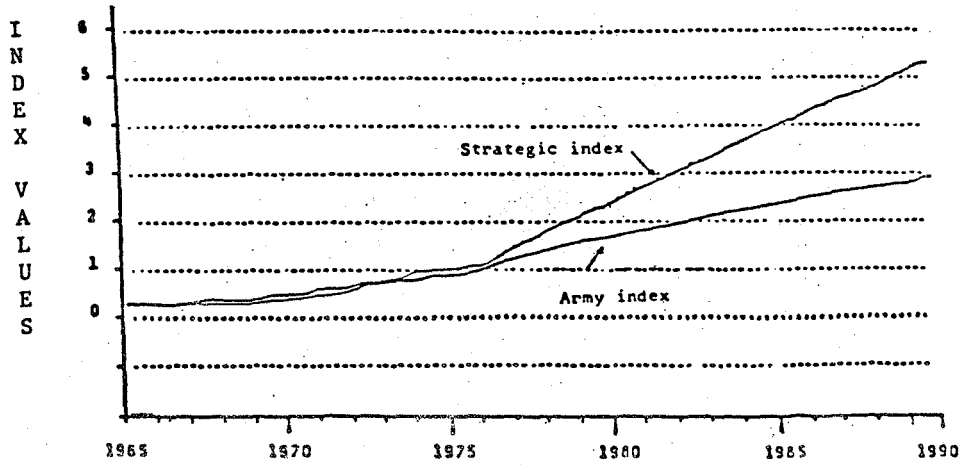



Figure 4 Simulation Outputs for China for Military Capabilities (Luterbacher and Allan, 1982, p. 422, as supplied by authors)



Although more comprehensive social science models permit one to check out quite explicitly the military-political consequences of economic trends, such simulations as SIMPEST may also be used in contrasting scenarios in which the economic components are held constant but with variation in packaging of political variables, per se. This is in contradistinction to the work done by the systems engineers and econometricians, whose scenario changes are limited to non-political variables. For example, Allan and Luterbacher (1983) were able to check out the effects of a series of some five scenarios against a base run covering the period 1965-2000 for the USA vis-a-vis the USSR. They contrasted a scenario involving a new period of detente with a new period of cold war, beginning in 1981 (pp. 297-303). Later they developed outcomes from a specific policy orientation, as when the USA was programmed to negotiate from a "position of strength" (pp. 313-317). The huge build-ups in arms resulting from such an American confrontation are represented in Figure 5. The authors note that such a scenario, however, "stimulates the U.S. economy, adding 1 to 1.5 percent to the growth rate." In working with more encompassing models, as with INS, SIPER, and SIMPEST, it is possible not only to consider the impact of econometric trends upon political components, but to study also the effects of political variables upon economic outcomes, as just illustrated.

Figure 5 Strategic Indices for the Scenario (S) of Negotiations from a Position of Strength

In moving from but a few nations to an assembly of twenty-five nations, covering some 74% of the world's population and 82% of its GNP, Bremer and his associates (Bremer, 1983, p. I.4) found it expeditious to use prototype program structures to represent differences among nation-types. Thus they allowed for parametric differences within each prototype to handle variations among the countries involved. GLOBUS consists of six modules, as exhibited in Figure 6. Four are concerned with internal processes: a "Domestic Economic Subsector" (ECOMOD), a "Domestic Political Subsector" (POLMOD), a "Government Budget Subsector" (GOVMOD), and a "Demographic Change Subsector" (DEMOD). The nations are linked together via a "Trade Policy Subsector" (TRDMOD) and a "Foreign Policy Subsector" (FORMOD). Qualitatively different modules are being built for developed, developing, and centrally planned countries.

Figure 6 The Modular Components of a GLOBUS nation (Bremer, 1983, per Figure 1)

In a recent exercise by Cusack (1984), scenarios were developed for exploration in GLOBUS of the political impact of world economic trends upon politics, concomitant with interactive effects of the flow of hostility and cooperation in the international arena. Low economic growth was combined with stabilized hostile/cooperative relations in experiment 1--and with an unfrozen, changing international political environment in experiment 2. High economic growth was combined analogously with stabilized and then changing hostility/cooperation in experiments 3 and 4. Simulating outcomes with respect to military capability for the period from 1970 through 2000 yielded contrasting patterns for different groups of nations, as for those in NATO vis-a-vis WTO. An interesting set of outputs is displayed in Figure 7 for the South. The figure tells that "economic growth...induces expansion while decline in economic performance leads to stagnation in the

Figure 5 Strategic Indices for the Scenario (S) of Negotiations from a Position of Strength (Allan and Luterbacher 1983, p. 315)

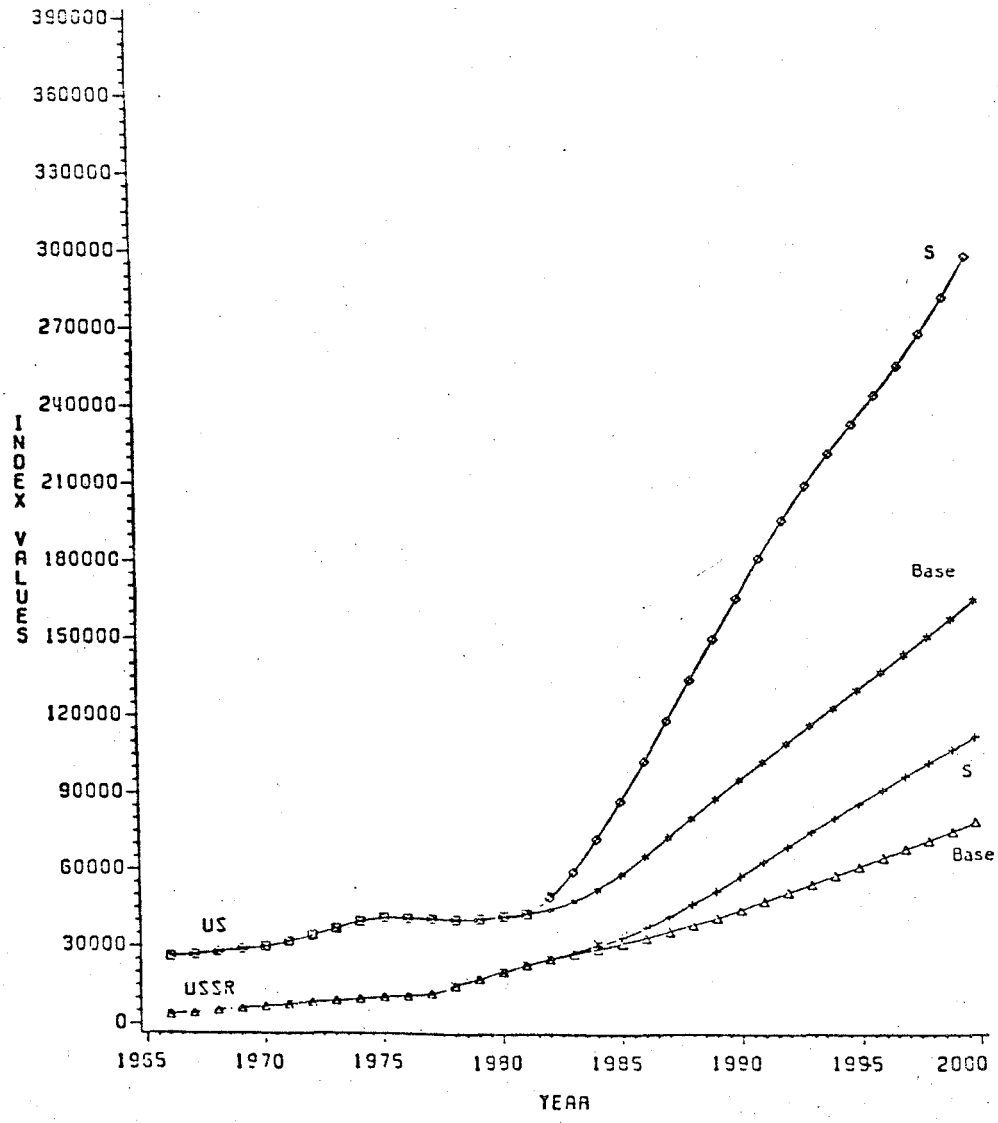
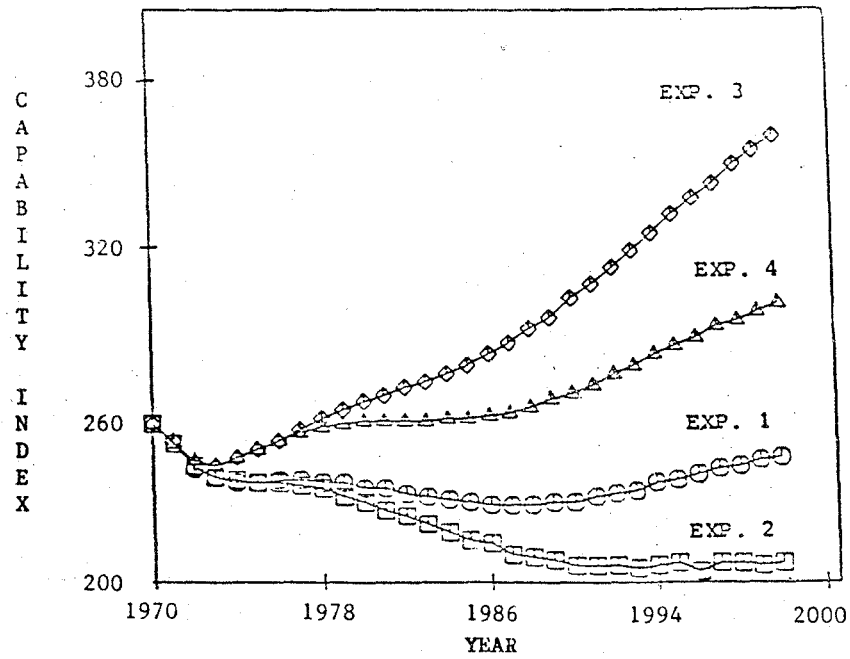


Figure 6 The Modular Components of a GLOBUS Nation (Bremer 1983, per Figure 1)

| ECOMODx | GOVMODx |
|---|---|
| Determines changes in a nation's aggregate output, personal consumption, savings, prices, capital stock, interest rates, money supply, etc... | Determines changes in a government's taxing and spending policies, including defense, education, health, administration, and foreign aid. |
| POLMODx | DEMMODx |
| Determines changes in a population's support and opposition to the government and the government's reaction to opposition. | Determines changes in a nation's demographic structure, including labor force, school and retirement age pupulation. |
| TRDMODx | FORMODx |
| Determines changes in a nation's import demand, export prices, and import biases. | Determines changes in a government's reactivity to hostility and cooperation received from others. |

accumulation of arms" with exacerbation of such effects due to the interactions with the differences in the international political environment (p. 63). Such effects were not obtained for the North.

Figure 7 Military Capability in South (Cusack, 1984, p. 62)




## II. SOME METHODOLOGICAL CONSIDERATIONS

Many believe global simulations, regardless of their format (be they manual, hybrid, or all-computer), are merely ways of mounting in a holistic fashion something of the complexities in our theories about international affairs. Often military groups prefer all-manual exercises, as befit their traditions in war-gaming. Those rooted in systems engineering and econometrics opt for all-computer simulations, given their proclivities for "number-crunching." Social scientists treasure the potential for creativity exhibited by policy-makers in person-computer hybrids, recognizing contemporary limitations of programs utilizing artificial intelligences for decision-making. As illustrated above in Section I-C, however, they often are constrained to employ all-computer configurations, given the costs incurred when involving experienced, adult humans in person-computer experiments.

In global modeling, leverage in understanding derivations from one s theories about international affairs is gained by virtue of the way in which simulations permit exploration of concomitant relationships among variables. These variables may be taken one at a time or assembled in packages as modules. Note how in the illustrations given above in Section I there was a

progression from consideration of political implications of economic growth to the reverse relationship, highlighting the impact of political facets upon economic growth. Simulations permit rich feed-backs among variables and between modules, so that one may experiment conceptually with a wide variety of outcomes, per one's research focus. Thus, a given global model may interrelate such outcomes as resources, energy, pollution, population, economic growth, quality of life, and political stability.

Some researchers regard global modeling as an overwhelming task beyond present competencies, believing it preferable at this time to develop more sectoral approaches, involving concern, for example, with food, as illustrated in the MOIRA model, pioneered by the Dutch (Parikh and Rabar 1981). Such work, however, may impede fuller explanation by treating many components as exogenous, as dramatically illustrated in the modeling work of the government of the United States (Barney 1980). In fact, when Robinson and her colleagues experimented by de-linking modules within the Meadows' World 3 and Mesarovic-Pestel-Hughes' WIM, they found distortion in outcomes (Barney 1980: Vol. II, pp. 663-681). Similarly, employing their nation-centered economic models in supporting policy judgments, national banks in Latin America and some planning offices in eastern Europe found themselves encouraged in making overly optimistic assessments of their national futures in the 1970s because of their neglect of impingements of model-exogenous world economic developments.

Global modeling may be viewed from an alternative perspective, in terms of insights being generated through the use of artificial intelligence programs. Instead of conceiving of researchers as objective agents attempting to describe international affairs, perhaps it is fruitful to realize their conceptions of the world may be matched with those of policy-makers. Such are studied in research on cognitive maps of foreign policy decision-makers (Bonham 1976). The work of Bennett with Alker (Bennett and Alker 1977) is seminal; they employed a series of artificial intelligence ("AI") programs in tracing the decision-making of central actors for some seventy years before and a little after the War of the Pacific (1879-1884). It will not be long before the penetrating work of George and his colleagues (George 1979) in the charting of "operational codes" will be ready for mounting in computer formats, used in the simulation of cognitive maps of policy-makers. Recently Schrodt (1986) has developed a "PWORLD" simulation, richly endowed wth decision processes drawing extensively upon artificial intelligence formulations.

Important in understanding the nature of global models is realization that the outputs, as in all forms of deductive theorizing, are quite dependent upon the substantive assumptions incorporated into the program. At the same time, they are dependent upon the specification of parameters used in weighting variables, as well as the assignment of initial conditions. As mentioned above in Section I-B describing the modifications made by Bremer (1980) and Akashi (1984) in the Forrester/Meadows Model, a radical reversal of outputs may be obtained by changes (in these cases those governing innovation) in parameters and minor revision of program assumptions. Thus, just as one can manipulate quantitative conclusions through statistical techniques, so one can secure outcomes as desired in simulation through selective handling of program assumptions, parameters, and initializations. Users of global modeling, therefore, must be sensitive

to its fundamental vulnerability to political abuse. Recently Brewer (1983) dramatized the significant costs and the unintended politico-social consequences sometimes involved in building large-scale social systems, drawing upon his extensive experiences in urban and military policy-related activities. But what theory and what data in the social sciences are not subject to such distortion when scholars lose professional integrity?

In reviewing Recent Developments in World Modeling for UNESCO's program entitled "Reflection on World Problems and Future Oriented Studies," Heinrich Siegmann observed, "In recent years, modeling efforts have increasingly sought to explicitly incorporate political features, the lack of which had been a major criticism regarding earlier models.... New models have been constructed, and equally notable, existing models have been resurrected for modification, extension, or combination with other models.... The data base is still considered inadequate but more, and more easily usable data sets have become available" (Siegmann 1986: personal communication). An exhortatory description of the move toward the inclusion of political components can be found in an essay, "Toward Integrated Global Modeling" (Ward and Guetzkow 1979). Persons knowledgeable about global/world modeling regard the GLOBUS model of the Wissenschaftszentrum in West Berlin (Bremer 1985) as having incorporated more domestic and international political processes in its formulation than any other simulation to date.

## III. IMPERATIVES FOR WISE SCHOLARS

The deliberation of the Sixth Symposium on Global Modeling convened by the International Institute for Applied Systems Analysis in 1978 are replete with sage observations for scholars ready to undertake global modeling (Meadows, Richardson, and Bruckmann 1982: Chapter 5). Wise scholars embarking on practical development of global modeling may wish to consider the following imperatives:

--begin modestly, but in a holistic manner, allowing your model to evolve early with feedback loops among its modules as its complexity increases.

Exemplar: the evolutionary synthesis of two macroeconometric models articulated with a micromodel of mineral resources as developed by Kaya and his associates (Kaya and Onishi 1980).

--collaborate early on with your potential users, so they may thoroughly understand the limitations and potentials of your construction as a complementary tool in their decision-making.

Exemplar: the close collaboration Gvishiani and his associates maintain with government decision-makers, in that their Institute for Systems Studies is sponsored by both the Academy of Sciences and the State Committee on Science and Technology of the USSR (Gelovani 1981).

--subject your modeling to competition, within your own team as well as in confrontation with the models developed by others.

Exemplar: the comparative work among models being executed by the Documentation Centre of Development-Policy Modelling of the Systems Studies Institute in Pune, India (Krishnayya 1984).

End Notes:- In the fall of 1983, Dr. Gerald O. Barney and Patricia Maimon-Music began editing the GLOBAL PERSPECTIVE QUARTERLY. In this newsletter the editors "share a belief in the need for a global perspective to enable us to identify and act on the many problems and possibilities before us. Toward that end we will be sharing a wide range of information and ideas. Each one of us needs to be able to organize diverse information into an integrated, coherent whole, and have the capacity to view developments, events and possibilities in their global context and their relative importance" (Barney and Maimon-Music 1983: p. 2). One may subscribe to the GLOBAL PERSPECTIVE QUARTERLY through the Global Studies Center, 1611 N. Kent Street, Suite 600, Arlington, VA 22209 USA. The Center has also recently issued its Managing a Nation: The Software Source Book.

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