

# Introduction to IFs

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## Purposes

**International Futures (IFs) is a tool for thinking about long-term global trends and planning more strategically for the future.**

IFs can help you:

- Understand the state of major global systems
- Explore long-term trends and consider where they might take us
- Learn about the dynamic interactions between global systems
- Clarify long-term organizational goals/priorities
- Develop alternative scenarios (if-then statements) about the future
- Investigate how different groups (households, firms or governments) can shape the future

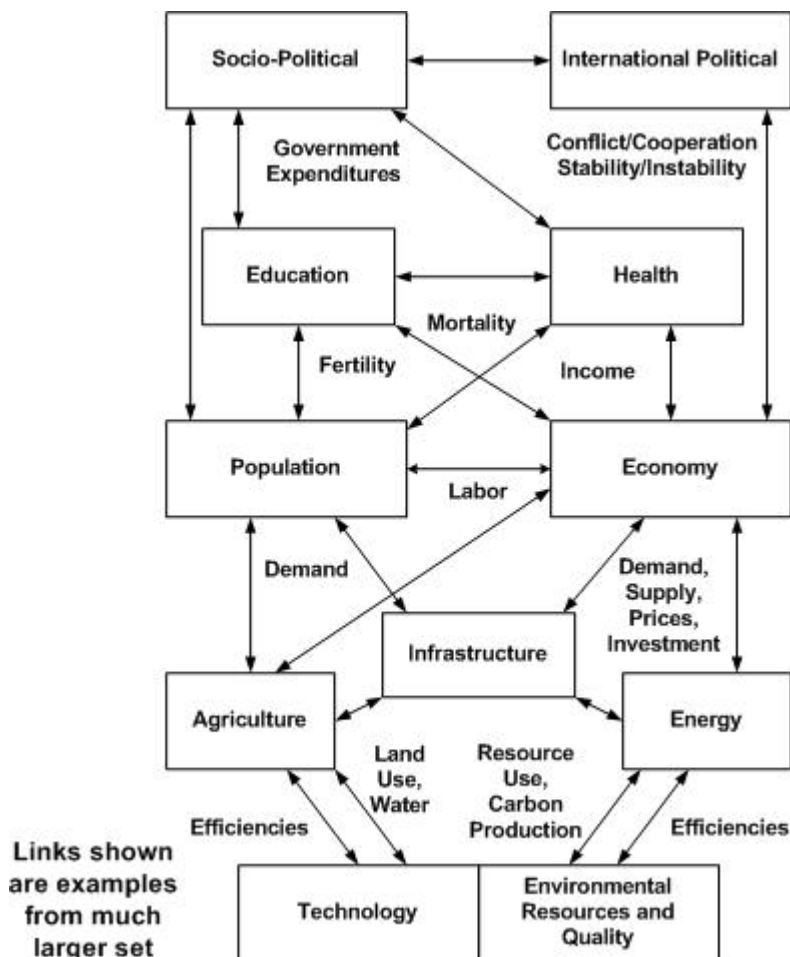
**The IFs platform relies on core, underlying assumptions, including the following.**

- Global issues are becoming more significant as the scope of human interaction and human impact on the broader environment grow.
- Goals and priorities for human systems are becoming clearer and are more frequently and consistently communicated.
- Understanding of the dynamics of human systems is improving rapidly.
- The domain of human choice and action is broadening.

**Which issues can you investigate with IFs? Some examples include:**

- Environment: Atmospheric carbon dioxide levels, world forest area, fossil fuel usage
- Socio-Political Change: Life expectancy, literacy rate, democracy level, status of women, value change
- Demographics: Population levels and growth, fertility, mortality, migration
- Food and Agriculture: Land use and production levels, calorie availability, malnutrition rates
- Energy: Resource and production levels, demand patterns, renewable energy share
- Economics: Sectoral production, consumption, and trade patterns and structural change
- Geopolitics: Country and regional power levels

## IFs Issues and Modules: Visual Representation



Visual representation of IFs structure

Among the philosophical premises of the International Futures (IFs) project is that the model cannot be a "black box" to users and be truly useful. Model users must be able to examine the structures of IFs in order (1) to have confidence in them, and (2) learn from them.

The following topics are useful starting points for better understanding the model.

- Dominant Relations of the model structure
- Structure-Based and Agent-Class Driven Modeling
- Equation Notation
- IFs Bibliography of data and data sources

## IFs Issues and Models: Quick Survey

International Futures is a collection of interconnected models (sometimes referred to as modules). Below is a quick survey of the major models in IFs. For more information on each one, please click on the model headings.

The **population** model:

- represents 22 age-sex cohorts to age 100+
- calculates change in fertility and mortality rates in response to income, income distribution, and analysis multipliers
- computes average life expectancy at birth, literacy rate, and overall measures of human development (HDI) and physical quality of life
- represents migration and HIV/AIDS
- includes a newly developing submodel of formal education across primary, secondary, and tertiary levels

The **economic** model:

- represents the economy in six sectors: agriculture, materials, energy, industry, services, and ICT (other sectors could be configured, using raw data from the GTAP project)
- computes and uses input-output matrices that change dynamically with development level
- is a general equilibrium-seeking model that does not assume exact equilibrium will exist in any given year; rather it uses inventories as buffer stocks and to provide price signals so that the model chases equilibrium over time
- contains an endogenous production function that represents contributions to growth in multifactor productivity from R&D, education, worker health, economic policies ("freedom"), and energy prices (the "quality" of capital)
- uses a Linear Expenditure System to represent changing consumption patterns
- utilizes a "pooled" rather than the bilateral trade approach for international trade
- is being imbedded during 2002 in a social accounting matrix (SAM) envelope that will tie economic production and consumption to intra-actor financial flows

The **agricultural** model:

- represents production, consumption and trade of crops and meat; it also carries ocean fish catch and aquaculture in less detail
- maintains land use in crop, grazing, forest, urban, and "other" categories
- represents demand for food, for livestock feed, and for industrial use of agricultural

products

- is a partial equilibrium model in which food stocks buffer imbalances between production and consumption and determine price changes
- overrides the agricultural sector in the economic module unless the user chooses otherwise

The **energy** model:

- portrays production of six energy types: oil, gas, coal, nuclear, hydroelectric, and other renewable
- represents consumption and trade of energy in the aggregate
- represents known reserves and ultimate resources of the fossil fuels
- portrays changing capital costs of each energy type with technological change as well as with draw-downs of resources
- is a partial equilibrium model in which energy stocks buffer imbalances between production and consumption and determine price changes
- overrides the energy sector in the economic module unless the user chooses otherwise

The two **socio-political** sub-models:

Within countries or geographic groupings

- represents fiscal policy through taxing and spending decisions
- shows six categories of government spending: military, health, education, R&D, foreign aid, and a residual category
- represents changes in social conditions of individuals (like fertility rates or literacy levels), attitudes of individuals (such as the level of materialism/postmaterialism of a society from the World Value Survey), and the social organization of people (such as the status of women)
- represents the evolution of democracy
- represents the prospects for state instability or failure

Between countries or groupings of countries

- traces changes in power balances across states and regions
- allows exploration of changes in the level of interstate threat
- represents possible action-reaction processes and arms races with associated potential for conflict among countries

The implicit **environmental** model:

- is distributed throughout the overall model
- allows tracking of remaining resources of fossil fuels, of the area of forested land, of water usage, and of atmospheric carbon dioxide emissions

The implicit **technology** model:

- is distributed throughout the overall model
- allows changes in assumptions about rates of technological advance in agriculture, energy, and the broader economy
- explicitly represents the extent of electronic networking of individuals in societies
- is tied to the governmental spending model with respect to R&D spending

## IFs Background

International Futures (IFs) has evolved since 1980 through three "generations," with a fourth generation now taking form.

The first generation had deep roots in the world models of the 1970s, including those of the Club of Rome. In particular, IFs drew on the Mesarovic-Pestel or World Integrated Model (Mesarovic and Pestel 1974). The author of IFs had contributed to that project, including the construction of the energy submodel. IFs consciously also drew on the Leontief World Model (Leontief et al. 1977), the Bariloche Foundation's world model (Herrera et al. 1976), and Systems Analysis Research Unit Model (SARU 1977), following comparative analysis of those models by Hughes (1980). That generation was written in FORTRAN and available for use on main-frame computers through CONDUIT, an educational software distribution center at the University of Iowa. Although the primary use of that and subsequent generations was by students, IFs has always had some policy analysis capability that has appealed to specialists. For example, the U.S. Foreign Service Institute used the first generation of IFs in a mid-career training program.

The second generation of International Futures moved to early microcomputers in 1985, using the DOS platform. It was a very simplified version of the original IFs without regional or country differentiation.

The third generation, first available in 1993, became a full-scale microcomputer model. The third generation improved earlier representations of demographic, energy, and food systems, but added new environmental and socio-political content. It built upon the collaboration of the author with the GLOBUS project, and it adopted the economic submodel of GLOBUS (developed by the author). GLOBUS had been created with the inspiration of Karl Deutsch and under the leadership of Stuart Bremer (1987) at the Wissenschaftszentrum in Berlin.

The third generation has produced three editions/major releases of IFs, each accompanied by a book also called International Futures (Hughes 1993, 1996, 1999). The second edition moved to a Visual Basic platform that allowed a much improved menu-driven interface, running under Windows. The third edition incorporated an early global mapping capability and an initial ability to do cross-sectional and longitudinal data analysis.

The fourth generation has been taking shape since early 2000. It has been heavily influenced by the usage of the model in an increasingly policy-analysis mode by several important organizations. First, General Motors commissioned a specialized version of IFs named CoVaTrA (Consumer Values Trends Analysis) with a need for updated and extended demographic modeling and representation of value change. An alliance was established with the World Values Survey, directed by Ronald Inglehart, to create that version. Second, the Strategic Assessments Group of the Central Intelligence Agency commissioned a specialized version named IFs for SAG. The work involved in preparing that greatly extended and

enhanced the socio-political representations of the model, both domestic and international. Third, the European Commission sponsored a project named TERRA which has led to a specialized version named IFs for TERRA. IFs for TERRA work led to enhancements across the model, including improved representation of economic sectors, updated IO matrices and a basic Social Accounting Matrix, GINI and Lorenz curves, and preparing for extended environmental impact representation (drawing upon the Advanced Sustainability Analysis framework of the Finland Futures Research Center).

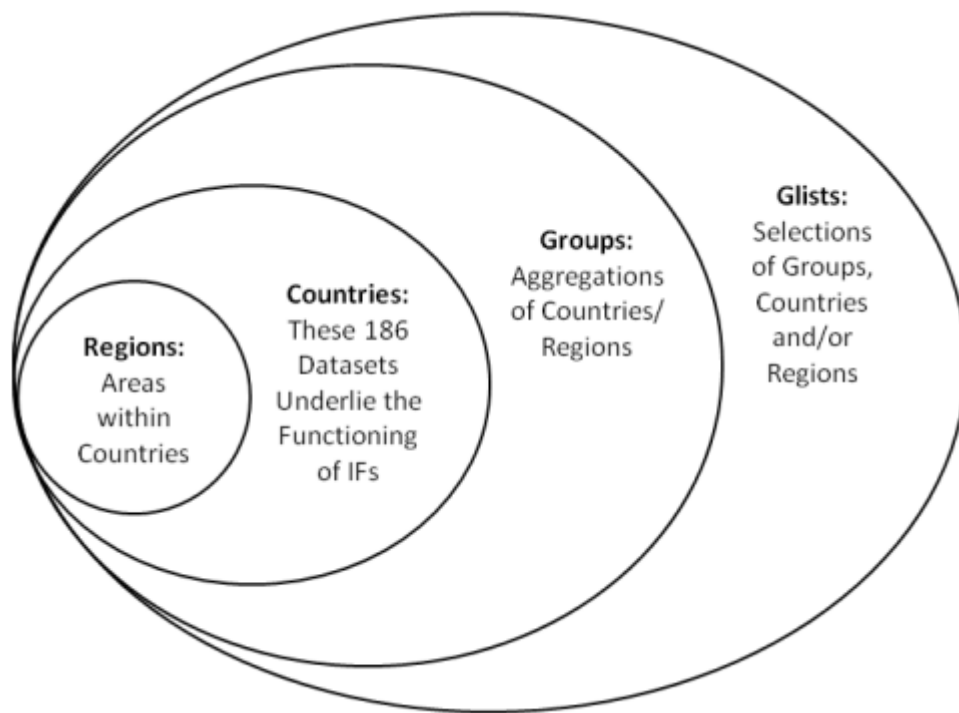
Throughout this emergence of a fourth generation IFs (incorporating all of the above elements for additional users) there has been also a heavy emphasis on enhanced usability. Ideas from Robert Pestel in the TERRA project led to the creation of a new tree-structure for scenario creation and management. Ideas from Ronald Inglehart led to the development of the Guided Use structure and a somewhat more game-like character within that structure. Inglehart also help arrange funding to support the programming of Guided Use through the European Union Center of the University of Michigan.

The fifth version of IFs is currently in use and represents broad strides to improving the model and its usability. It is the first version of this software to be placed online due to the help of the National Intelligence Council (<http://www.ifs.du.edu>). Also, usability has been increased as Packaged Displays and Flex Packaged Displays were introduced that allowed for the creation of very specific lists of countries/regions, groups or Glists. A new education model has also been incorporated into the broader IFs model. New scenarios were created for UNEP (focusing on environmental change) and Pardee (focusing on poverty). Finally, one of the largest changes made was incorporating 182 countries into the Base-Case scenario used by IFs. Previous versions of IFs used broader regions to forecast global trends. This change also did away with the Student and Professional versions.

## **Geographic Representation of the World**

186 countries underpin the functioning of IFs and these countries can be displayed separately or as parts of larger groups that users can determine.

*Below is a visual representation of how different entities are organized into Countries/Regions, Groups or Glists:*



Visual representation of IF's definition of regions/countries/groups/glists

*\*Note: In older versions of IFs, Regions were used as intermediaries between Countries and Groups. In the future, they, or some similarly named unit, will be a sub-unit of Countries. Regions, acting as a sub-unit of Countries, are currently not a feature of IFs. See the image located at the bottom of this Help topic.*

When using IFs, there are many occasions where the user is asked whether or not they would like to display their results as a product of single countries, or larger groups. This is typically a toggle switch that moves between Country/Region and Groups, however, it might be a three-way-toggle that includes Country/Region, Group and Glist.

Countries/Regions are currently the smallest geographical unit that users can represent. The ability to split countries down into smaller regions, or states, is under development. There are 186 different countries/regions that users can display.

Groups are variably organized geographically or by memberships in international institutions/regimes. You can find out who is represented in each group and add or delete members by exploring the Managing Regionalization function.

Glists merge both Groups and Countries/Regions. These lists are mostly geographically bound. In the future, the Glist distinction will become more important as some users may want to place, for example, both the Indian state of Kerala in a Glist with Sri Lanka and Nepal.

Users may also want to create their own groups or explore what countries are members of what groups.

# IFs Time Horizon

**Future Forecasts.** IFs begins computation with data from 2000 and can dynamically calculate values for all variables annually through 2100.

**Historical Analysis and "Forecasts."** IFs also includes an extensive and growing historical data base starting in 1960. The data basis allows analysis of relationships among variables across countries and across time.

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