STRATAGEM, A personal computer-based management training game on energy-environment interactions

Meadows, D.L.; Biesiot, W.; Benders, R.M.J.; Berger, M.; Louwes, M.

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2000

STRATAGEM

STRATAGEM

A personal computer-based management training game
on energy-environment interactions
Version 4.0

D.L. Meadows, W. Biesiot,
R.M.J. Benders, M. Berger, M. Louwes

CONTENTS

1. INTRODUCTION

1.1 History

STRATAGEM is an operational game specifically designed for use with corporate and public managers and with university students. The game was originally developed to educate government officials responsible for energy and environment programs in Latin America. It offered them the opportunity to gain experience in making decisions required to achieve balanced growth in the capital stocks influencing their country's population growth, material standard of living, economic output, international trade, environmental quality, and energy use. However, it has also been used by officials with similar responsibilities in industrialized countries in East and West.

Several hundred university students in North America, Eastern Europe, and Western Europe have also successfully used the game. STRATAGEM works equally well with groups from different economic systems, because players may decide for themselves exactly how to determine the crucial investment allocation decisions. The game has been played by over 1000 people from more than 30 nations, and it is being adopted for use in many universities and management training centers. IVEM has incorporated this game in its annual students' training program in environmental sciences since 1986.

STRATAGEM employs a technology for gaming that was developed by Dennis Meadows in 1984 at the International Institute for Applied System Analysis (IIASA) near Vienna, Austria. The game itself was developed by Dennis Meadows, Donella Meadows, Ferenc Toth, and Norman Marshall. The approach incorporates three elements:
-   a sophisticated simulation model of the system represented by the game,
-   a personal computer which makes the computer model easily available for use, and which serves as an accounting device and
-   a playing board, with associated pieces, that serves as an accounting device, aids in communication, and helps the players visualize the important interconnections in the model.

In 1985 the BASIC-implementation of STRATAGEM was translated into PASCAL by Mark Geerts and Wouter Biesiot at IVEM. The input and output formats were changed at the same time and several features were added. The game required a 128 kB personal computer with operating system MS-DOS 2.1 (or higher), a monochromatic VDU (24*80 characters), at least one 360 KB disk- drive or a hard disk-unit, and a printer (80 columns).

Since 1985 minor modifications have been made in the PASCAL version of the code. In 1994 a more thorough revision became necessary, and the MSDOS version has been upgraded by Roel Zantinge, René Benders and Wouter Biesiot. In 1999 we decided to make an upgrade to the windows95/98 platform. This new version contains more operator-friendly features, like pull-down menus and multi-color graphics. It requires now a standard Pentium PC with MS-Windows 95/98. At the same time the 1996 manual has also been slightly revised into the current version by R. Benders.
The current version of the game contains sufficient complexity to tax the analytical and management skills of any participant. It serves in its present form to illustrate a number of important guidelines that are easily overlooked in practice when investment programs are developed to enhance the productivity of a region's energy, environmental, and human resources. The game may be used alone or as the basis for a 3-5 day course on the dynamics of regional development and the determinants of long-term natural resource productivity.

1.2 Set-up of this manual

The set-up of this manual follows more or less the steps in using the STRATAGEM game.
Chapter 2 contains the description of the game in general terms.
Chapter 3 describes the general state of affairs in the starting situation for the playing team, and contains also

the role descriptions for the various ministers of the national cabinet. Per role description also the relevant parts of the output form are reproduced in order to get acquainted with the way the results of the decisions taken are formulated, and with the input requirements that follow from the decisions that are made for the next period in the game.

In chapter 4 the anatomy of a typical STRATAGEM session is described.

Chapter 5 is concerned with the way the game operator has to brief the participants on the purpose of the game and the relevant procedures. Depending on the mode in which the game is played it may be necessary to brief the participants on the caveats that are present in the various parts of the game and in the different phases of the play. This chapter also provides the necessary information for that purpose.

Chapter 6 contains a description of the steps that are to be followed in setting up the game.

In chapter 7 a guide to the debriefing of the game is offered.

Chapter 8 focuses on the manual for the operator of STRATAGEM. It outlines the computer system requirements for the program, and the procedure to install and set-up the program. Next to that all the steps in running the program are outlined in detail.

In chapter 9 the initial stocks in the game are described. Several sets of these stocks are presented. Each of them corresponds to a different grade of complexity in playing the game. When starting as a developing nation, the teams can be offered four versions: simple, standard, tough, very hard to reach a sustainable state within two generations. In order to present examples of successful development paths two sets of high equilibrium situations are discerned that vary in the way the available resources have been used in the game: a development based upon an abundant supply of resources and a version that has used the available resources in an optimal way. Both versions contain enough strategic issues to make them interesting for advanced players of STRATAGEM.

A few appendices have been added to this manual.

Appendix A describes the materials that are required for playing the game.

Appendix B presents a picture of the STRATAGEM game board.

Appendix C contains the causal loop diagrams of STRATAGEM which serve to illustrate the different relationships that exist within the set-up of the game.

Appendix D provides the coordinates for the graphs that are presented in the role descriptions. This offers the opportunity to produce bigger (poster format) representations of the essential relationships in STRATAGEM. The various graphs are also reproduced at A4 size in this appendix. The information in appendix D is also useful in the context of further development of grades of complexity and/or focus as it facilitates changes in the game.

Appendix E contains equivalents of the figures 5.1-5.12 in Dutch language.

Appendix F contains a Dutch version of the five role descriptions that are presented in chapter 3 in an English version.

Appendix G contains a full description of the different sets of initial values that correspond with the various grades of complexity that are available now.

Appendix H details a regression test that can be used by the operator of the game as a check on the correct functioning of the computer code.

Appendix I contains the print-out of the READ.ME file that is present on the diskette that accompanies this manual. It also describes the different available files that are needed for playing the game plus useful addresses (for requisites of the game, for consultation on details or in case of malfunctioning, etc). The authors of this manual also want to encourage users of STRATAGEM to send comments and/or interesting development paths to these addresses.

2. GAME DESCRIPTION

2.1 Introduction to STRATAGEM

STRATAGEM simulates in a simplified form the national economy of a country that has reached a stage of development like that found widely in Latin America. The game covers a time span of two generations (60 years). This is split in 12 periods of five years. Per five year planning period a series of decisions (concerning production and consumption of food, goods and energy and concerning investments and trading) must be taken that are used as input into the computer. The PC serves here as an accounting device, that presents the effects of the decisions taken in the form of a description of the situation at the end of the last planning period. A full cycle of the game thus consists of one set of decisions by the team (the input parameters) and a description of the newly calculated state of affairs at the end of that planning period (the output parameters).

Five different role are implemented in the game. Each role can be played by one or two participants. So a team of five to ten persons is required for playing STRATAGEM.
Players are free to implement a wide range of social and economic decisions. Their actions must be carefully designed to be consistent with the cause-effect relationships that govern the behavior of the society if they want to reach a high level of development.

A group of more than 10 persons can be divided into separate teams of about 5-10 players. Approximately 8 groups (maximum number: 10) can be handled by one computer-printer combination, and a game-operator with an assistant. In this way the results of all the teams can be compared with each other. There are no interactions between the teams.

During the game there are twelve sets of decisions to be taken - each influencing the development of the region over a five-year cycle. Each set is divided into 5 sectors which are managed by at least one person:
1) population & household consumption
2) energy production & energy efficiency
3) food production & environment
4) goods production & human services
5) international financing.

Per cycle of the game each of these sectors is supplied with an output form from the computer which indicates
a) the actual situation as derived by processing inputs from previous cycles
b) the decisions to be taken for the current cycle.
The international banking sector is supplied with a form on which all the decisions must be written. This form should be handed to the game operator who will feed the data into the computer. After calculation of the results by the computer this sequence will be repeated 11 times, so the game spans 60 years.

The game is normally played in one 4-8 hour period without interruption. However, STRATAGEM is also suited for part-time use over several weeks or more. For example, students in a university course might play the game over the entire semester - submitting the decisions for one cycle each week. This approach gives much more time for reflection, negotiation, and the development of sophisticated strategies. It also permits the professor to integrate the principal lessons of the game with the schedule for the course.

2.2 Goals and strategies

A cardinal aspect of the game is that players collectively have all the information about cause-effect relationships that govern the success of their decisions. There are no exogenous influences (unless an oil price increase is implemented), no random influences, and no unknown relationships. Consequently, if a team does well, it can assume full credit. If it does poorly, there are no "outside" influences to blame. All of the information about the cause-effect relationships is contained in the role descriptions. Thus, before playing the game it is best for each player to read through all of them, paying special attention to the description of the sector he or she will manage.

The goal of STRATAGEM is to reach a stable, sustainable, high productivity society. A not uncommon outcome however, is stagnation, with growth in population offsetting all gains in the economy. It is even possible to "crash" the society. If players let debt rise out of control, environment deteriorate too far, labor productivity slip, energy shortages mount, or population grow too high, the economy of the region can spiral downward out of control.

To avoid this each team has to make a set of important policy decisions. Will it borrow to the limits of its credit or not? Will it raise standard of living of the population quickly, even though that reduces the goods available for investment, or will it let population grow rapidly for the first few cycles while attempting to achieve high growth rates in the economy's capital stocks?

Will the team pursue balanced development, or will it emphasize growth in one sector - hoping that the surplus items from that sector can be exported to pay for needed imports in other commodities? What balance of investments in energy production and energy conservation does it wish to maintain? At what point does investment in environmental protection, energy efficiency, and other important sectors reach the point of diminishing return - the point where the next unit of investment costs more than it produces?

Several different strategies can give an attractive development path, but each team must work out their own strategy with a careful understanding of the many delays and cause-effect relationships that govern the behavior of the country. It is an important first step in the game to let the team discuss on the course to follow, in order to reach a high level, sustainable state.

There are several insights that can improve the effectiveness of policies. Among the useful guidelines five are of particular value:
1) Notice the difference in the lifetime of the capital stocks. All else equals, it is more cost effective to invest in the capital stocks that have longer lifetimes.
2) Notice the difference in energy requirements and environmental impacts of the investment alternatives.
3) Do not invest in any capital stock beyond the point of diminishing returns. At some point every capital stock costs more to increase than it produces in marginal output.
4) Note that many investments impose related "hidden" costs on the country. Whenever a team invests in goods production capital, for example, it must also add to the stock of energy production capital and to the stock of environmental protection capital in order to maintain balance in the system.
5) Be aware of long delays in the system. For example, money invested in energy production capital raises the energy available only two cycles later.

2.3   Starting conditions

The country has a modest population, just 200 people. The standard of food consumption is fair (2 in a range of 0-5), so that death rates are low (18/1000/year in the simple and standard version of the game). However, the material standard of living is low (2 in a range of 0-15), so that the population birth rate is high (41/1000/year). As a consequence the population growth rate is 2.3 percent per year - giving a doubling time of about 30 years (that is only 6 cycles in the game!). This growth rate is quite standard in Third World countries, where also values up to 4 percent per year can be found. Though the nutrition levels could be raised substantially, the country currently exports food in order to obtain the funds that are required to import energy.

No investments have been made in energy efficiency, so that each unit of food production capital and goods production capital uses three times as much energy as it would, if maximum investments had been made in energy saving capital. Last cycle part of the about 15000 units of energy available have been imported; still the country lacks the energy required to operate all current food and goods capital. The national sources of domestic energy behave like waterpower: they cannot be depleted. In the early cycles of the game, the country receives appreciable returns on investments in energy production capital. Later seriously declining returns to scale will be encountered. These become so serious that it may be impossible to produce all the energy required domestically. However, a team may find itself with excess energy. This can be exported to earn money for imported food or goods. It may also be carried over - that is: left in the TOTAL ENERGY AVAILABLE box -

for use in subsequent cycles of the game.

It is important to note that the energy sector plays a crucial role in the game. It requires a great deal of capital, creates an impact on the environment, and often produces energy shortages that force capital to be idle in the food and goods sector.

There are five ways to reduce or eliminate energy shortages:
1) A team can invest in more energy production capital. However, this gives increased energy supply only two cycles after the investment is made.
2) A team can allocate money to energy imports. This gives increased energy supply in the next cycle, but it may be very expensive.
3) A team can invest in energy efficiency capital. This reduces energy requirements in the next cycle already.
4) A team can shift investment away from energy-consuming capital stocks (food and goods production) and into human service capital or environmental protection capital, which consume no energy.
5) Finally, a team can reduce goods allocated to the population, so that less energy needs to be allocated to the population. This last strategy is rather weak in the first cycles of the game, since the population's demand for energy is rather small then. However, it is the only approach that becomes effective in the same cycle.

Even though the country is initially exporting food, the agricultural sector operates at much lower productivity than it might. The government has let your environment deteriorate seriously, and has not invested much in the food production capital. Environmental degradation currently reduces food output considerably, and maximum investments in production capital could raise food output by about six folds (ultimately constraint by available land and maximum land productivity).

There is also substantial room for increased productivity in the goods sector. Labor productivity is only one-ninth of what could be attained through maximum investments in goods production capital and human service capital.

The output form for the first cycle indicates whether or not the team starts with a debt of 1000 units. If there is no debt, the cabinet may borrow money for only 10 percent per year. One earns 1 money unit for each unit of energy, food, or goods that you export. One must pay 1.1 money unit for each unit of food or goods that are imported. Therefore, it is not a good strategy to export a commodity, for example goods, and then use the money to import the same commodity. The cabinet loses 10 percent and one cycle's use of the commodity in such exchange. One pays 1.0 money unit for each unit of energy imported.

Terms of trade will shift against the country, if its debt rises too high relative to average exports. In that event, all imports rise in cost and the annual interest rate on debt rises too. Additionally, the energy price may be doubled for two cycles during the game by an OPEC action, implemented by the game operator.

3.   ROLE DESCRIPTIONS

It is useful to start by reading the following general remarks. Your country has a modest population, just 200 people. The standard of food consumption is moderate (2 in a range of 0-5), so that death rates are neither high nor low (18/1000/year). However, the material standard of living is low (2 in a range of 0-15), so that the population birth rate is high (41/1000/year). As a consequence your population growth rate is 2.3 percent per year - giving a doubling time of about 30 years (that is only 6 cycles in the game!). Though your nutrition levels could be raised substantially, you currently export food to obtain the funds that are required to import energy.

You have not made any investments in energy efficiency, so that each unit of food production capital and goods production capital uses three times as much energy as it would, if maximum investments had been made in energy saving capital. Last cycle you imported part of the about 15000 units of energy available to you; you still lack the energy required to operate all your food and goods capital. Your sources of domestic energy behave like waterpower: they cannot be depleted. In the early cycles of the game, you receive appreciable returns on investments in energy production capital. Later you will encounter seriously declining returns to scale. These become so serious that it may be impossible to produce all the energy required domestically. However, you may find yourself with excess energy. This can be exported to earn money for imported food or goods. It may also be carried over - that is: left in the TOTAL ENERGY AVAILABLE box - for use in subsequent cycles of the game.

It is important to note that the energy sector plays a crucial role in the game. It requires a great deal of capital, creates an impact on the environment, and often produces energy shortages that force capital to be idle in the food and goods sector.

There are five ways to reduce or eliminate energy shortages:
1)   You can invest in more energy production capital. However, this give you increased energy only two cycles after the investment is made.
2)   You can allocate money to energy imports. This gives increased energy in the next cycle, but it may be very expensive.
3)   You can invest in energy efficiency capital. This reduces energy requirements in the next cycle already.
4)   You can shift investment away from energy-consuming capital stocks (food and goods production) and into human service capital or environmental protection capital, which use no energy.
5)   Finally, you can reduce goods allocated to the population, so that less energy needs to be allocated to the population. This last strategy is rather weak, since the population's demand for energy is rather small in the first cycles of the game. However, it is the only approach that becomes effective in the same cycle.

Even though you are initially exporting food, your agricultural sector operates at much lower productivity than it might. You have let your environment deteriorate seriously, and you have not invested much in your food production capital. Environmental degradation currently reduces food output considerably, and maximum investments in production capital could raise food output by about six folds.

There is also substantial room for increased productivity in the goods sector. Labor productivity is only one-ninth of what could be attained through maximum investments in goods production capital and human service capital.

Your output for the first cycle indicates whether or not you start with a debt of 1000 units. If you have no debt at present, you may borrow money for only 10 percent per year. You earn 1 money unit for each unit of energy, food, or goods that you export. You must pay 1.1 money unit for each unit of food or goods that you import. Therefore, it is not a good strategy to export a commodity, for example goods, and then use the money to import the same commodity. You loose 10 percent and one cycle's use of the commodity in such exchange. You pay 1.0 money unit for each unit of energy imported.
Terms of trade will shift against your country, if its debt rises too high relative to average exports. In that event, all imports rise in cost and the annual interest rate on debt rises. Additionally, the energy price may be raised even more during the game by an OPEC action, implemented by the game operator.

The goal of your team is to realize a fast transition of your country from its present state of development towards a society with a stable population at a high level of welfare and a rich environment, without over-exploiting the natural resources assets. In other words: *the goal is to devise a sustainable development route*.

As an example, the text below contains real-world equivalents in the opening scenario.

Typical real-world equivalents of the situation described in the starting situation are as follows:
Food*:*
    A bowl of rice and beans three times a day.
Type of goods in individual households*:*
    A primitive wood-burning or kerosene stove, perhaps made out of a discarded piece of corrugated metal; a radio in more affluent homes, TVs only for the rich; few goods in stores and the cost of imported products puts most of them out of the reach of average citizens; most people walk, take public transport, or ride bicycles; very few private cars on the road.
Services*:*
    Few schools, poorly equipped; boys encouraged to attend, girls to stay at home and help with the family; one hospital to serve 250.000 people; most never see a dentist (teeth pulled rather than filled).
Energy source and quality*:*
    Hydroelectricity for use primarily in downtown business and government areas; frequent brownouts. Some imported oil for transport.
State of food production*:*
    Productivity declining as land is being exhausted by over-cultivation and single-crop farming techniques.
State of the environment*:*
    Soil erosion and frequent mud slides; no currency for reforestation or land reclamation; serious sewage, industrial waste and air pollution problem in built up areas.
Type of industry*:*
    Basic commodity manufacturers in large cities attract flocks of low-wage earners.
State of financial affairs*:*
    International demand for food exports provides some financial stability but export earnings must be used to buy energy and basic goods.

3.1   Role description STRATAGEM sector 1, population and household consumption

Goal

Your objective is to obtain a stable population with a high standard of food and goods consumption and a high level of human services.

Initial conditions

You have 200 people. Food consumption standards are moderate - 2 units of food per person per year (= **10 units food per person per cycle!**). The maximum possible in the game is 5 units per year.
Material standards are low - 2 units of goods per person per year, where 15 units of goods per person per year is possible.
Nor are human services (health and education) well developed. Currently the ratio of human service capital to population is only 2.25; 20 is possible.
As a consequence your region is experiencing a very high birth rate, 41 per 1000 people per year and a rather low death rate, 18 or 22 per thousand per year (depending on starting conditions).

Though your population is not richly fed, you don't presently consume everything you grow. The extra food was exported to earn money for your energy imports. During the last cycle you exported 1000 units of food.

Goods may also be exported. However, you have not been exporting goods. All goods not used by the population have been invested inside your region. Your most important problem is to allocate enough goods to consumption, so that the material standards will rise enough to reduce birth rates, without at the same time lowering investment so far that economic growth stagnates.

Decisions: (the numbers refer to the numbers on the game board)

1)   Allocate Total Food Available to:
- Food for Population
- Food for Export
2)   Allocate Total Goods Available to:
- Goods for Population
- Goods for Export
- Goods Available for Investment

Your actions indirectly affect:
-      the birth and death rates, thus the size of the population, hence the size of the labor force,
-      the energy required for the population, hence the energy that is available to the agricultural and goods production sectors,
-      export income, and
-      import requirements.

The cause-effect relationships of interest to you include:

a)   BIRTH RATE

The normal birth rate depends on the average goods consumption per year. Actual consumption of goods per person per year is averaged over three cycles to obtain the average consumption (it starts at 2.0 in the range 0-15). The normal birth rate can vary from 10 to 30 per 1000 people per year. This relationship is shown in Figure 1. Its actual value is given in the output form.

Figure 1: Normal Birth rate

The actual birth rate is a product of the normal birth rate and the birth rate multiplier from human services, a multiplier reflecting the level of health and education services. This multiplier ranges from 1 to 1.5; it depends on the ratio of human service capital to the total population (which can vary between 0 and 20). It is shown in Figure 2. Its actual value is given in the output form.
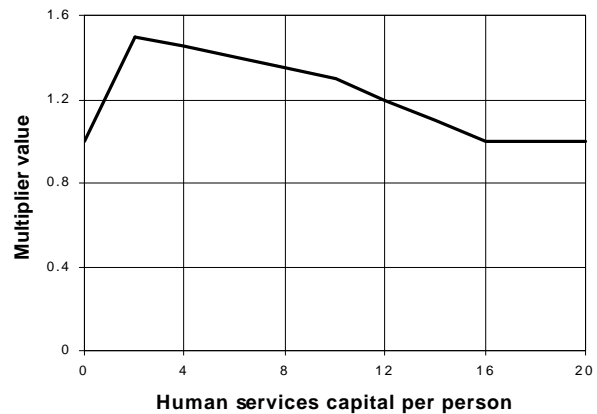
Figure 2:   Birth rate multiplier as a function of human services

b)   DEATH RATE

The normal death rate (ranging from 10 to 60 per 1000 people per year) is determined by food consumption per person per year (which can range from 0 to 5). The influence of food consumption per capita on the normal death rate is shown in Figure 3. Its actual value is given in the output form.

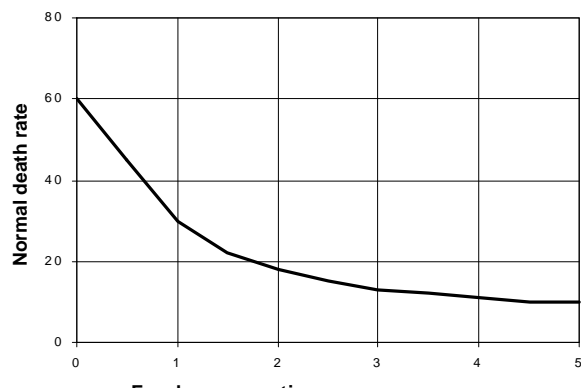**Figure 3:**   Normal death rate as a function of food consumption per year per person

The actual death rate is the product of normal death rate and the death rate multiplier from quality of the environment, a multiplier (ranging from 1 to 1.75) that depends on the quality of the environment. Quality of environment is 1.0 when everything is perfect and 0 under the worst possible ecological circumstances. This multiplier is illustrated in Figure 4. Its actual value is given in the output form.
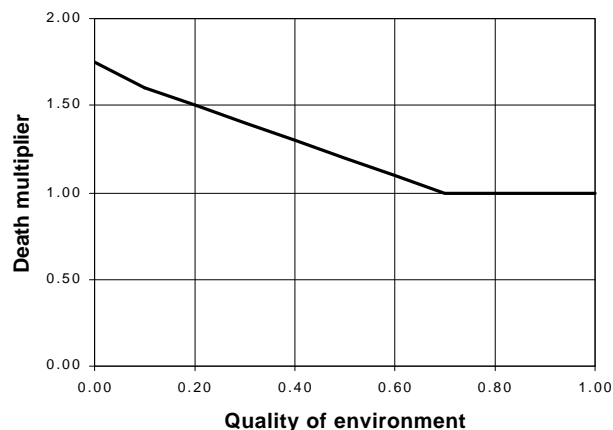
Figure 4:   Death rate multiplier as a function of the quality of the environment

PLEASE NOTE:

- For each unit of goods you allocate to goods for population your colleague(s) in the energy sector must allocate 0.2 units of energy to energy for population. This demand has absolute priority over other allocations of energy like carryover, exports, or to support production in the agricultural and industrial sectors.
- The allocation of food and goods made at the beginning of each cycle determines the rate of population growth during that cycle.
- Significant reductions in per capita food or goods consumption from one cycle to the next will lower production in the corresponding sector. The relationships are shown in two curves that are included in the role descriptions for the food and the goods sectors (Figures 7 & 11).

Date :   time :
Country : SHOW, Status at the start of period : 0 - 4, the year : 0

 POPULATION AND HOUSEHOLD CONSUMPTION

 The population is 200, resulting from a growth rate of 11.5% .
 This percentage is based on :
   an annual birth rate of 1.49 * 27   => 41 per 1000;
   an annual death rate of 1.00 * 18   => 18 per 1000.
 Last period each person received per year:
   Food: 2.00 (range: 0-5); Goods: 2.00 (range: 0-15).
 Human services capital per person was: 2.25 (range: 0-20).

 Available for use in this period:
 FOOD :   3300, of which ..... is for consumption, and ..... for export;
 GOODS: 3500, of which ..... is for consumption, ... is for export, and
. .... for investment (total depreciation was 430).

3.2   Role description STRATAGEM sector 2, energy production and energy efficiency

Goal

Your primary objective is to ensure that there is enough energy to operate the goods consumed by the population and to operate the stocks of food production capital and goods production capital. You can reach this goal by requesting energy imports, by investing in energy production capital, or by reducing energy requirements through investments in energy efficiency capital. A secondary goal may be to export energy for funds that can finance food or goods imports.

Initial conditions

Your region has made no investments in energy efficiency, so that energy use by each unit of food production capital and goods production capital is high. The energy required to operate each unit of food production and the energy required to operate each unit of goods production capital is over three times greater than it would be with maximum investment in energy efficiency capital.

Domestic energy production does not cover your domestic needs.

Last cycle you imported energy, a serious drain on your export earnings, and still you do not have enough energy available during the first cycle to provide full capacity utilization of the food production and goods production capital stocks.

Decisions: (the numbers refer to the numbers on the game board)

3)   Allocate Total Energy Available to:
  - Energy for Population (= 1/5 of 'goods for population')
  - Energy for Export
  - Energy carried over to Next Cycle
  - Energy Available for Production
4)   Allocate Energy Available for Production to:
  - Energy for Food Production
  - Energy for Goods Production
5)   Allocate some portion of the Goods Available for Investment to:
  - Energy Production Capital under Construction
 - Energy Efficiency Capital under Construction

---

Your actions indirectly affect:
-    energy import requirements
-    the goods available for investment in the other capital stocks
-    the capacity utilization in the agricultural and the industrial sectors
-    funds available for imports or debt repayment
-    the quality of the environment

The cause-effect relationships of interest to you include:

a)   ENERGY PRODUCTION

Energy production depends only on the amount of energy production capital. The energy sector is modeled in analogy to hydropower capacity, a renewable energy resource. There is no depletion, but there are diminishing returns to investment. This means that if you maintain your energy production capital at a constant level, it will produce the same amount of energy each year forever (achieving this will, however, require enough investments each cycle to offset depreciation). However, each further addition to the energy production capital stock produces a smaller and smaller additional amount of energy. (In your output form this is reflected in a diminishing value of the average energy output per unit energy production capital stock). The relationship between energy production capital and energy production is shown in Figure 5. There is a **high** and **low** output version of this relationship depending on the starting conditions.
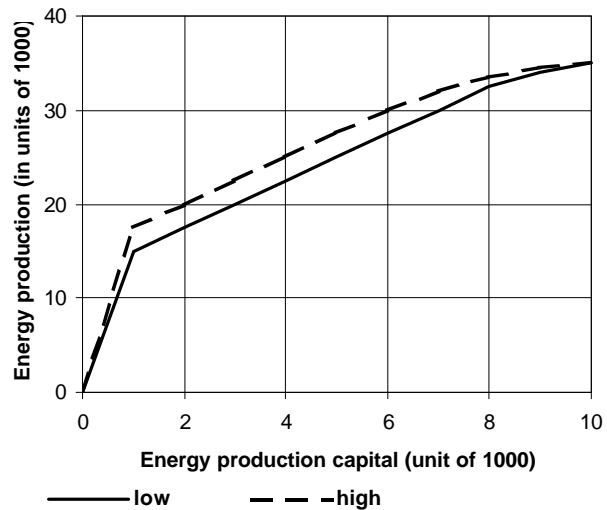
Figure 5:   Energy production per cycle as a function of energy production capital (in units of 1000's)

PLEASE NOTE:

•   In each cycle you must allocate 1 energy unit to the population for each 5 units of goods they receive in that cycle. This is implemented in the computer code, so Energy for Population is not an independent input decision.

•   The lifetime of energy production capital and of energy efficiency capital is 25 years. Thus one-fifth of these capital categories is removed from production at the end of each cycle, after the production for that cycle has been calculated.

•   When you have surplus energy, you may export the energy at the rate of one money unit for each energy unit sold. Alternatively, you may simply leave the surplus units in the box, TOTAL ENERGY AVAILABLE, and carry it over to the next cycle. Thus the energy available at the beginning of each cycle is the sum of last cycle's production, plus imports, plus energy carried over.

•   Money allocated to energy imports in one cycle does not serve to reduce an energy deficit during that same cycle. Money spent on energy import purchase energy that only shows up in the stock of Total Energy Available at the beginning of the next five-year cycle.

•   Your allocations of energy to food and goods production determine the Capacity Utilization (CU) of the respective capital stocks. Capacity utilization is defined as:

$$\text{Capacity Utilization} = \frac{\text{energy allocated}}{\text{energy required for full capacity utilization}}$$

•   Since energy efficiency capital investments can only work on **new capital**, you are limited in the rate at which you can invest in energy efficiency capital. In each cycle the maximum possible investment in energy efficiency capital is equal to the sum of two investments (food production capital investment + goods production capital investment) made during the same cycle. So:
    ENERGY EFFICIENCY INVESTMENT ≤ FOOD Prod.Cap.Inv. + GOODS Prod.Cap.Inv.
This variable is referred to as respectively CUF (food) and CUG (goods). It may vary from 0 to 1.1. Any

energy in excess of that required providing both sectors with 110% capacity utilization is wasted. Note that by allocating up to 10% more energy than is required for full use of a production capital stock, you can effectively enlarge your capital stock by up to 10% above its actual level.

b)   ENERGY EFFICIENCY

Each unit of food or goods production capital requires an amount of energy that is calculated as the product of the energy consumption multiplier and the normal energy required per unit of food or goods production capital. The values for the normal energy requirements per 5-year cycle are: 12.5 units of energy for a unit of food production capital, and 20 units of energy for a goods production capital unit. Investments in energy efficiency capital will lower the energy consumption multiplier (range: 0.3 - 1). One unit of energy efficiency capital will achieve full energy savings for one unit of capital. The relationship is shown in Figure 6.
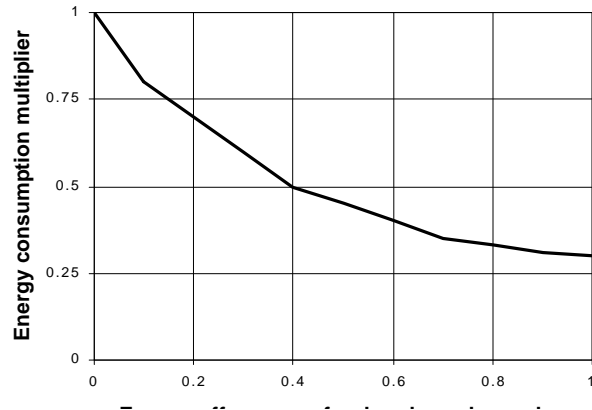
Figure 6: Energy consumption multiplier as a function of energy efficiency capital per unit of total capital in food and goods production

Date :   time :
Country : SHOW, Status at the start of period : 0 - 4, the year : 0

ENERGY PRODUCTION AND EFFICIENCY

Last period 12000 energy units were produced. The import was 1500;
carried over were 1000 units. So 14500 energy units are available.
This will be used as follows :

    domestic energy use   (.....)   (400 was required last period)
    food production   .....   (10000 is required for full capacity)
    goods production   .....   (6000 is required for full capacity)
    export   .....   (last period you exported 0)
    carry-over   .....   (last period you carried over 1000)

The average energy consumption multiplier is 1.00 this period (range: 0.3-1),
so for one period you need :

    12.5 units of energy to operate one food production capital unit,
    20.0 units of energy to operate one goods production capital unit.

This period 12000 energy units will be produced by 800 capital units (an
average of 15.00 units of energy per unit energy production capital stock).
From this capital stock 160 will be depreciated at the end of this period,
leaving 640 units, unless you make new investments.

The energy efficiency capital is 0 of which 0 is depreciated
at the end of this period, leaving 0 capital units, unless you make
new investments.

In this period you will place under construction :
    .... units of energy production capital,
    .... units of energy efficiency capital.

3.3   Role description STRATAGEM sector 3, food production and environmental protection

Goal
Your objective is to produce the food required to feed your population and support the necessary exports. This should be done in a way that maintains the environment at a high level of quality (max = 1.0).

Initial conditions
You have made no investments in environmental protection yet; thus the quality of the environment has deteriorated drastically. See for the actual value the output sheet. Thus you are losing significant part of the productive potential of your agricultural capital. In other words, your food production is significantly lower than it would be if the environmental quality were 1.0.
Nevertheless, you remain a net exporter of food. Your population still has only moderate food consumption levels, and is growing rapidly. Because the energy sector has made no investments in energy efficiency, it is still comparatively expensive to fulfil the energy demands of your sector.

Decisions: (the numbers refer to the numbers on the game board)

5)   Allocate some portion of the goods available for investments to:
     - Food Production Capital Under Construction and
     - Environmental Protection Capital under Construction

Your actions indirectly affect:
-      the goods remaining for investment in the other physical capital stocks,
-      export income,
-      quality of the environment,
-      the death rate of the population,
-      total energy requirements in the region.

The cause-effect relationships of interest to you include:

a)   FOOD PRODUCTION
Food production is the product of arable land AL (constant at 1000 hectares) and the land productivity per unit of area ALP.
The land productivity ALP is a function of several parameters:
ALP   =   ALPN * MFC * MFP * QE

ALPN =   normal land productivity per year per unit of area (constant at 1.25);
MFC   =   the multiplier calculated from changes in the population's food consumption per capita from the last cycle to this cycle. (range: 0.4-1.0, as shown in fig. 7);
MFP   =   the land output multiplier from food capital, which depends on the ratio of active food production capital to agricultural area. The relationship is shown in figure 8. Active food production capital is the product of currently producing capital and the capacity utilization factor for food capital during the cycle (CUF, ranging from 0.0 to 1.1). Energy shortages will reduce the active food production capital correspondingly.
QE   =   quality of the environment, ranging from 0 to 1. It is governed both by regeneration and degeneration whose behaviors are described below.
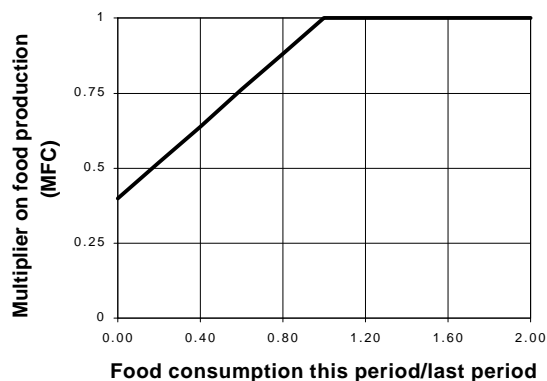
Figure 7: Multiplier on food production as a function of the ratio of food consumption this cycle to the last
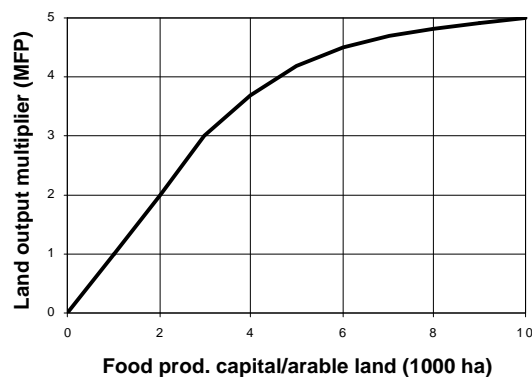
Figure 8: Multiplier on food production as a function of the active food production capital per unit of area (MFP)

PLEASE NOTE:

- The energy required each cycle to support full food production is the product of food production capital, normal energy use (a constant equal to 12.5 in this version of the model), and the energy consumption multiplier (which ranges from 0.3-1.0).
- The lifetime of food production capital is 25 years, Thus one-fifth of the food capital is removed from production at the end of each cycle, after the production for that cycle has been calculated.
- In the output form a formulae for the "expected food production" is given:

    EXPECTED FOOD PRODUCTION = Constant * MFC * MFP * QE

  where the Constant equals AL * ALPN * 5 = 6250 (the cycle length is 5 years).

  The expected production is calculated using a default value for MFC (=1) assuming enough energy for full use of the production capital stock. In the calculations after your decisions this quantity is replaced by its actual value. The actual food production then equals this expected value times the capital utilization factor CUF.

b)   ENVIRONMENTAL PROTECTION

The environment is degenerated by energy production capital, goods production capital, and food production capital. The negative influences of these capital stocks can be offset by investments in environmental protection capital. Each unit of environmental protection capital will offset the impact of 3.0 units of production capital. That means: the damage equals the quantity

(AFC + AGC + EC) - 3 x EnvPC, where

AFC   =   Active Food production Capital
AGC   =   Active Goods production Capital
EC   =   Energy production Capital
EnvPC   =   Environmental Protection Capital.

The relationship governing degeneration is shown in figure 9. Note that food production capital and goods production capital are multiplied by their respective capacity utilization factors to determine their impact on the environment. This simply indicates that if energy shortages prevent some production capital from being used during one cycle, the unused capital does not affect the environment during that cycle.
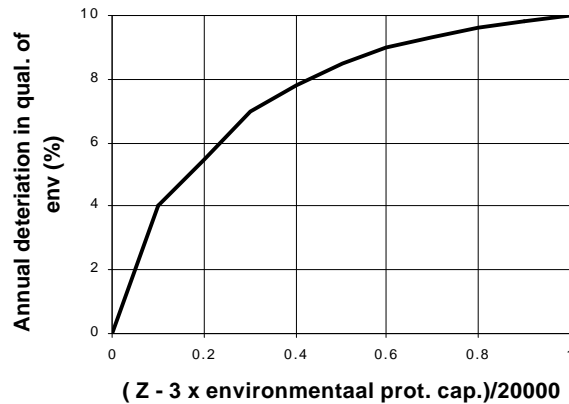
(Z - 3 x environmentaal prot. cap.)/20000

Figure 9: Annual percentage of environmental degradation as a function of the sum of differences of active production capital (Z) and environmental protection capital, scaled to 20,000. Z = AFC + AGC + EC

The environment can regenerate itself. The annual regeneration percentage depends on the current quality of the environment, which ranges from 0 to 1. The relationship is depicted in figure 10. Note, when quality of environment equals either 0 or 1, there is no regeneration.

Quality of the environment
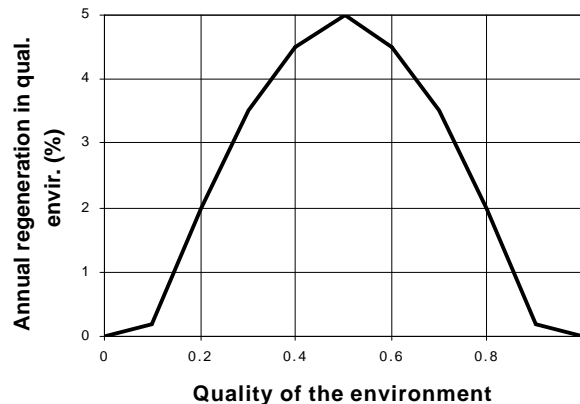
Figure 10: Annual percentage of environmental regeneration capacity as a function of quality of the environment

PLEASE NOTE:

- The lifetime of environmental protection capital is 30 years, thus one-sixth of the environmental capital stock is removed from production at the end of each cycle, after the production for that cycle has been calculated.
- In practice the value of the quality of the environment lies in the interval 0.05–0.95, due tot the decreasing regeneration power and minor effects of rounding procedures in the balance of deterioration and regeneration.

Date :   time :
Country : SHOW, Status at the start of period : 0 - 4, the year : 0

FOOD AND ENVIRONMENT

Food production last period was 3300,
the import was 0, so 3300 units of food are available.
Last period the capacity utilization in the food industry was 1.00
and the consumption multiplier on food production was 1.00

The food capital stock is 800, of which 160 will be depreciated
at the end of this period, leaving 640 capital units, unless you make
new investments.

The environmental protection capital is 0 of which 0 will be
depreciated at the end of this period, leaving 0 capital units,
unless you make new investments.

Expected food production =	constant	*	MFC	*	MFP	*	QE
3450	6250.00		1		0.80		0.69
(ranges:)			(0.4-1)		(0-5)		(0-1)

In this period you will place under construction :
 .... units of food production capital,
 .... units of environmental protection capital.

3.4   Role description STRATAGEM sector 4, goods production and human services

Goal

Your principal objective is to produce sufficient goods to satisfy the consumption needs of the population, the investment needs of the economy, and the requirements for export income from goods. You should also raise the health and education standards of the population, which in their turn will raise labor productivity and reduce the birthrate, by investing in human service capital.

Initial conditions

Productivity per capita of the labor force is low, about 1/9th of what could be attained by maximum investment in goods production capital and human service capital. Your region's labor force is not receiving a very high standard of living - that is, the goods allocated for the population during the previous cycle were low. They equaled only 2 units per person per year (= **10 units per person per cycle**), 15 units per year is the maximum. Similarly, human services (health and education) are also low. Presently the ratio of human service capital to population is only 2.25; a maximum of 20 is possible.

Decisions: (the numbers refer to the numbers on the game board)

5)   Allocate some portion of the Goods Available for investment to:
      - Goods Production Capital Under Construction and
      - Human Services Capital under Construction.

Your actions indirectly affect:
-    the amount of goods available for investment in the other physical capital stocks,
-    the quality of the environment,
-    the productivity of labor,
-    the birth rate.

The cause-effect relationships of interest to you include:

a)   GOODS PRODUCTION and
b)   HUMAN SERVICES

The production of goods each cycle is the product of the labor force LF (always 25% of the population) and the labor productivity per capita LP (expressed in goods per laborer).
The labor productivity is a function of several variables: LP = LPN * MGC * MGP * MHS

LPN   =   the normal labor productivity per year (constant at 1.155 in this version of the model);
MGC   =   the multiplier calculated from changes in the population's goods consumption per capita from the last cycle to this one (range: 0.4-1.0 as shown in fig. 11);
MGP   =   the multiplier from goods production capital, which depends on the ratio of active goods production capital to the labor force. The relationship is shown in figure 12. Active goods production capital is the product of currently producing capital and the capacity utilization factor for goods capital during the cycle (CUG, ranging from 0.0 to 1.1). If there are energy shortages, the active goods production capital during the cycle will be reduced, and output will be correspondingly lower. The capacity utilization factor CUG is the ratio of the energy allocated to goods production and energy required for full production of the capital stock.
MHS   =   the multiplier from human services capital which depends on the ratio of human services capital per capita. The relationship is shown in figure 13.

Figure 11: Multiplier on goods production as a function of the ratio of goods consumption this cycle to the consumption last cycle (MGC)
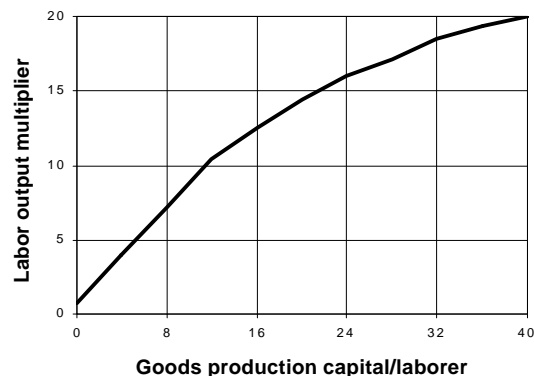
Figure 12: Multiplier on goods production as a function of the active goods production capital per laborar (MGP)
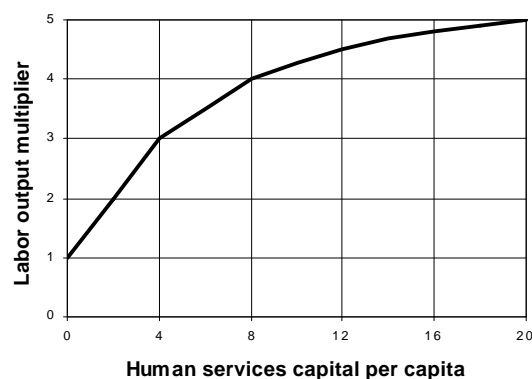
Figure 13: Multiplier on goods production as a function of the ratio of human services capital per capita (MHS)

PLEASE NOTE:

• The energy required to support goods production is the product of full goods production capital, normal energy use per cycle (a constant equal to 20 in this version of the model), and the energy consumption multiplier (ranging from 0.3 to 1.0).

• The average lifetime of goods production capital is 25 years, and the average lifetime of human services capital is 45 years. Thus one-fifth of the goods production capital stock and one-ninth of the human services capital stock are removed from producing capital at the end of each cycle after the cycle's production has been calculated.

• In the output form a formulae for the "expected goods production" is given:

    EXPECTED GOODS PRODUCTION = constant * LF * MGC * MGP * MHS

where the constant equals LPN * 5 (= cycle length) = 5.775.

The expected production is calculated using a default value for MGC (=1) assuming enough energy for full use of the production capital stock. In the calculation after your decisions, this quantity is replaced by its actual value. The actual goods production then equals the expected production times the capital utilization factor CUG.

Date :   time :
Country : SHOW, Status at the start of period : 0 - 4, the year : 0

GOODS PRODUCTION AND HUMAN SERVICES,

Goods production last period was 3000.
The import was 500, so 3500 units of goods are available.
Last period the capacity utilization in the goods industry was 1.00
and the consumption multiplier on goods production was 1.00

The goods capital stock is 300, of which 60 will be depreciated
at the end of this period, leaving 240 capital units, unless you
make new investments.

The human service capital is 450 of which 50 will be depreciated
at the end of this period, leaving 400 capital units, unless you
make new investments.

Expected goods production =	constant	*	LF	*	MGC	*	MGP	*	MHS
3450			5.775		50		1	5.60	2.1
(ranges:)							(0.4-1)	(0-20)	(0-5)

In this period you will place under construction :
 .... units of goods production capital,
 .... units of human services capital.

3.5 Role description STRATAGEM sector 5, international finance, exports, imports and debt

Goal
You handle the region's foreign trade. You convert exports into their money equivalents, manage its debt, and allocate money to imports. Your objective is to manage the country's trade, so that there are enough goods, energy and food to attain satisfactory consumption and investment levels, while avoiding unbearable interest payments and preventing serious erosion in the terms of trade. In the financial world the GNP (Gross National Product) and the GNP per capita are important parameters of the economic well being of a region. Growth of these parameters indicates economic growth and will improve your prestige in the international financial world.

Initial conditions
You start with a slight surplus of exportable food and you may have a debt (depending on de starting conditions) to the international banks. Your interest rate is 10 percent, much lower than the return you can earn on many investments in productive capital. The Gross Domestic Product (GDP) of your country is measured as the sum of the output of the goods production and food production sector. Its initial value is indexed at 100. It's current value and its growth or decline will be printed on your output form. Next to that a value of the GDP per capita will be presented in order to show the implications of population growth.

DECISIONS: (the numbers refer to the numbers on the game board)

6) Collect Foreign Aid, if any, and convert Energy for Export, Food for Export, and Goods for Export into money Available for Exports.
7) Borrow money if you wish to provide for greater imports (possible if your Maximum Loan is greater than 0).
8) Repay part of your Debt if you wish to reduce interest charges and lower the price of imports.
9) Allocate Money Available for Imports to one or more of the three possible imports: energy, food and goods.

Your actions indirectly affect:
- the amount of energy, food, and goods available in the next cycle,
- the interest rate, hence the interest charges, paid on your region's debt,
- the price of purchased energy, food, and goods, and
- a possible IMF intervention.

The cause-effect relations of interest to you include:

a) FOREIGN AID
Foreign aid is an exogenous input to the game, determined by the game operator. Typically there is no foreign aid.

b) IMF INTERVENTION
If your debt rises above 1/2 of your Gross Domestic Product (approximated here by the sum of total food and total goods production) 10% of your total goods production at the start of the next cycle will be used for repayments due to IMF intervention.
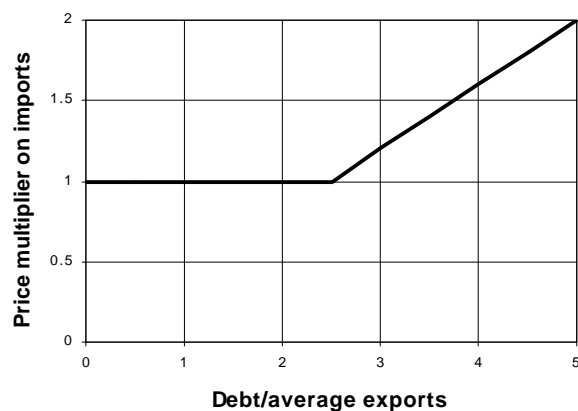
c) EXPORTS
The export price of food, energy and goods is constant at 1.0. Total exports are averaged over three cycles to determine your maximum debt and your interest rate.

d)   IMPORTS

Imported materials are not available for use in the cycle during which money is allocated to them. They first show up in the stocks of available food, goods and energy at the beginning of the next cycle.

The possibility to invest money in technology imports is indicated on the board. This is not used in this version of the game.

The terms of trade will deteriorate, if your debt rises above average exports. The import prices of food and goods are normally 1.1. The normal price of energy imports is 1.0. These prices are multiplied by the import price multiplier, which grows from 1 to 2, if the ratio of debt to average exports rises to 5. The relationship governing the price multiplier on imports is shown in figure 14. An OPEC OIL EMBARGO may also be activated by the game operator to raise oil prices temporary; normally this factor is not employed in the game.

Figure 14: Multiplier on import prices as a function of the ratio of debt to the average exports

e)   DEBT

The interest rate paid on your debt each cycle depends on the ratio of debt to average exports. It rises from 10% per year (that is **50% per cycle**) to 20% per year, if debt rises to 5 times the average exports. The relationship is shown in figure 15.

You are not allowed to increase your debt with new loans, if the current debt is greater than your region's average exports. Of course your debt may rise above average exports, if your exports fall or if interest charges accumulate.

If you have excess money, you can "repay" more debt than you actually owe. In that case you will earn interest on the loan at the prevailing rate.
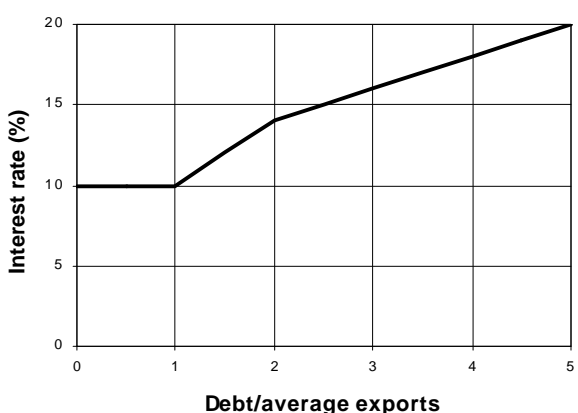
Figure 15: Interest rate as a function of the ratio of debt to the average export

PLEASE NOTE:

•   The last part of the output form summarizes the decisions taken per cycle. Please fill out this form after your team has made all the decisions, and hand it over to the game operator.

Date :   time :
Country : SHOW, Status at the start of period : 0 - 4, the year : 0

TRADE AND INTERNATIONAL FINANCE

At the start of this period the debt is 1000, the interest rate 10 %/yr.
Last period you paid 300 for interest charges.
The maximum loan in this period is 0.
Your GDP growth was 0 so your GDP index is now 100.
The GDP per capita index is 100.0

Your balance sheet:
money from energy export: (.....)
money from goods export: (.....)
money from food export: (.....)
money from foreign aid   .....   (determined by game operator)
new loans: .....
                                    ---------- +
SUM OF THESE: (.....)
repayments: .....
                                    ---------- -
AVAILABLE FOR IMPORTS   (.....)   divided as follows:

 for energy   .....   (the import price is 1.00)
 for food   .....   (the import price is 1.10)
 for goods   .....   (the import price is 1.10)

Date :   time :
Country : SHOW, Status at the start of period : 0 - 4, the year : 0

INPUT-SHEET STRATAGEM

After your team has made all decisions for the next period, please fill
out the form below. The game-operator will use that form to enter the data.
All entries should be multiples of 10. Please check this!

ALLOCATIONS		INVESTMENTS		INT. TRADE	
Food domestic	:......	food prod	:......	foreign aid	:......
exports	:......	env. protect	:......	new loans	:......
Goods domestic	:......	goods prod.	:......	repayments	:......
exports	:......	humservices	:......		
investm.	:......	energyprod	:......		
Energy		energyeff	:......	IMPORTS	
foodprod	:......			for energy	:......
goodsprod	:......			for food	:......
exports	:......			for goods	:......
carryover	:......				

4.   ANATOMY OF A TYPICAL SESSION

In the game between 5 and 10 players are needed to make up the team required to operate one country, represented by one complete board. A single instructor, with an assistant who enters the data into the computer, can monitor 4-8 boards.

Gather the players together in a group for a brief lecture on the different purposes of operational gaming, the specific goals of the present session, and the history of STRATAGEM (see next chapter). This may take between 5 and 90 minutes depending on the total time available for the whole session and the prior preparation of the participants.
If at all possible, distribute the game description to each player in advance of the game, so that he or she may study the general goals and rules of the game before the briefing.

Next assign each person to a specific board and particular sector (population, energy, agriculture & environment, industry & human services, and international). This permits each person to focus special attention on those parts of the instruction that especially affect the sector he or she will manage.

Then explain the purpose of the different items of the game:
-      the function of the board, the markers, and the computer
-      the character of the five different flows on the board (population, energy, food, goods, and money)
-      the steps of play
-      the function of the data sheets.

Subsequently, go quickly over the basic cause-effect relationships that will govern the behavior of each sector during the game. All of this can most effectively be accomplished through reference to a set of slides or overhead projection sheets of the figures that are described in chapter 5.

The next step is to ask the members of a team to think about their playing strategy. What will be the developing strategy for their country, what will be the goals to be reached? Thinking about these questions will help the players to understand the relations in the game and to speed up playing the game. Take about 15-30 minutes for this. Let the team also decide on their country name as the first act in the group decision making process. This name must subsequently be fed into the computer in order to generate the correct starting values.

Then sit the participants at their respective boards and sectors and tell them precisely how to make the first four decisions in the first cycle. This acquaints them with the cycle of play and familiarizes them with the movement of the markers and the function of the data sheets. Next, ask each team to make decisions #5 through #9 for themselves. They must allocate their investment capital among the six capital stocks and decide what to do about loans and imports. It is important during this period to make sure that the players record their decisions properly. By listening to the discussions it is often possible to detect serious mistakes in some individuals or group's understanding of the rules or the underlying cause-effect mechanisms. These should be corrected immediately without mandating any particular decision.
If total gaming time allows for it let the teams take their decisions for a test cycle. Confronted with the resulting output form they have the choice of either continuing the track chosen or going back to the starting situation. If the latter case occurs, choose for that country the corresponding option in the computer menus (see chapter 8).

At this point the groups are ready to go through the remaining cycles more or less on their own. If you want to avoid congestion before the operator's desk, use timers to stagger the groups, so that each group delivers its data sheet to the computer operator at a different time. It typically takes about 3-5 minutes to check the internal consistency of decisions written on the data sheets, to enter the data, and to print out the resulting inputs for one group's subsequent cycle.

Initially it may take 30 minutes for a group to get through the decision cycle. By reducing the time setting on the timer each occasion the computer results are handed back, it is generally possible to reduce the cycle time to 15 minutes after three or four rounds, unless the team has to face serious planning problems.

If one group is especially slow, ask them to change the way they decide how much to invest in each of the six capital stocks. Instead of making the decision by consensus let them make decision #5 by distributing the goods available for investment equally among the players managing each of the five sectors. If 5–10 minutes of discussion does not produce a group consensus on the allocation of that capital, each sector's players are then free to decide individually how they wish to allocate their share of the goods for investment among the six capital stocks. This speeds the game considerably.

It is crucial to have at least 60 minutes to discuss the game and reflect on its lessons after the play (see chapter 7). Even 2-3 hours may be fruitfully used for this purpose, if it is available. The operator can make use of the options to display and/or print the resulting tables and graphs for this purpose. It may be of help to incorporate into the results also the outcome of the example runs described in chapter 9 of this manual. Chapter 8 contains the necessary instructions for this operation.
Schedule constraints may sometimes require that the game be terminated before the full twelve cycles are played. This is very undesirable, since some lessons only become clear over the full period of play. However, most principles illustrated by the game may be observed from the game's behavior over as few as 7-8 cycles.
An alternative consists of starting the game in round 4 or 5. The teams can thus be confronted with the legacy that corresponds with the first few cycles of the example runs that are available for every level of complexity of the game. This can be realized by inserting in a new game the appropriate example run, deleting the last cycles until the required starting position is reached, changing the name into that of one of the teams, and repeating this procedure until all participating countries are covered.
The session is ended upon conclusion of the debriefing.

The description above applies to the occasions when the game is played in one period without interruption. However, STRATAGEM is also suited for use over several weeks or more. For example, students in a university course might play the game over the entire semester - submitting decisions for one cycle each week. This approach gives much more time for reflection, negotiation, and the development of sophisticated strategies. It also permits the professor to integrate the principle lessons of the game with the schedule for the course.

5.   BRIEFING THE GAME

Before the game starts, it is essential to brief the team members on STRATAGEM. Depending upon the time available, this may take 5 to 90 minutes. The following steps are suggested for this purpose (an * indicates a topic that can be skipped under time constraints):

-    (see sheet 1) Some essentials concerning the history of the game (see the starting chapters for details) and the way the present version has been developed.

-    (see sheet 2) Some characteristic differences between the World-3 model and STRATAGEM should be explained.

*   (see sheet 3) Setting STRATAGEM in the world of gaming: it is a simulation game and not a play with fixed roles; it is interactive (through the use of cycles) in contrast to "clock-like" games; the teams don't play against the computer which is used here only as an accounting device; the teams do their job without coupling between countries and starting with the same situation and with full knowledge of the relations in the model (a surprise-free context); group processes are important in decision making concerning setting of goals, formulation of strategy and implementing tactics; the game operator does not act as a manager because his role is restricted to that of resource person and facilitator.

-    (see sheet 4) Introduce the starting situation: a fast growing population with a high birth rate (because of low consumption levels and low quality human services) and a high death rate (because of malnutrition and a low environmental quality) that is threatened by energy shortages and a rising foreign debt - in short, the situation of many countries in the Third World of today.

-    (see sheet 5) Explain the overall goal of STRATAGEM: reach a high quality sustainable state with a minimal use of resources.

*   (see sheet 6) Within the overall goal mentioned, there are many other learning goals that are worth mentioning, like:
     exponential growth and decline, and the role of feedback
     the role of delays of different sizes
     dealing with depletion, diminishing returns, absolute limits, and depreciation
     deterioration and the balancing with regeneration capacities
     the presence of direct effects and indirect influences, both with either fast reactions or delayed responses
     implementation of short terms tactics within long term strategies

-    (see sheet 7) Explain the gaming: a team of 5 different and contrasting roles per country; the time span subdivided in 12 planning periods; all model relations are contained in the 5 role descriptions available; will there be an energy crisis ahead or not?

-    (see sheet 8) Detail the scheme of a full cycle: starting situation, decisions for the period in question, followed by a description of the resulting situation, that acts as the start of the new cycle, etc.

-    (see sheet 9) Explain the simplified way in which the flows and stocks have been modeled:
     a grain warehouse that becomes filled at the end of the previous cycle; the contents must be divided over population and export
     a storehouse that becomes filled at the end of the previous cycle with all kinds of goods; the contents must be divided over the categories consumption by the population, capital investments and export
     a set of hydro reservoirs that are constructed in period x, filed in period x+1, while the hydro electricity can be consumed or exported in period x+2

- (see sheet 10) Explain the money flows: exporting food, goods and/or energy generates export income that can be used for different purposes. The debt can be repaid (partially), or the team can decide to import food, goods and/or energy (imports become available in the next cycle of the game). The calculation of the new debt must be explained here: (old debt - repayment) is the debt at the start of a cycle; after addition of the interest results the new debt.

* (see sheet 11) Discuss the relations that govern the production of goods and food, and indicate the ranges of improvement

- (see sheet 12) Explain the depreciation procedure

- (see sheet 13) Explain the basics of the demographic transition, that acts as the driving force in the initial stages of STRATAGEM

* Discuss the various relations present within the model, using the figures that are given in the role descriptions

The sheets 1-13 are also available as a file on the diskette that accompanies this manual. Dutch versions can be found in appendix E.

STRATAGEM

a pc-based management training game on energy-environment-population interactions

- **1985: developed from the WORLD-3 model by prof.dr. Dennis Meadows**

- **1987, 1995: translated into PASCAL, 2000: into a windows version and modified by IVEM (Center for Energy and Environmental Studies) of the University of Groningen**

WORLD-3 vs STRATAGEM

WORLD-3:

- **Model of the world economy**

- **Complex model with many variables**

- **Extrapolation of trends:**

    - **natural resources**

    - **economy**

    - **social dynamics**

- **Time span of 200 years**

STRATAGEM:

- **Model of a developing country**

- **Simplified model with 16 variables**

- **Interactive**   **- feed backs**

    - social dynamics

- **Time span of 60 years: 2 generations**

STRATAGEM and GAMING

- **operator facilitated, surprise-free, independent, team-centered, computer-assisted, complex, interactive simulation gaming**

- **simulation game *versus* play with fixed roles**

- **interactive character *versus* clockwork-like games**

- **complex interactions *versus* simple modeling**

- **accounting by computer *versus* playing against a computer (simulating the environment and/or competitors) *or* computer-based learning**

- **the game is played in teams consisting of 5-10 participants that must decide on strategies and tactics *versus* individual exercises**

- **the teams are functioning independent *versus* a game with coupling between countries**

- **the teams don't encounter surprises during the game *versus* stochastic or performance-related occurrence of surprises**

- **the operator acts as facilitator and resource person *versus* the operator as a participant or as a manager**

STARTING SITUATION

- **fast growing population**

- **little food / capita, so a high death rate**

- **few goods / capita**

- **energy shortages**

- **bad environmental quality**

- **low level of human services**

- **high foreign debt**

PURPOSE OF STRATAGEM

REALISE a fast transition of a developing country towards a society without population growth, with a high welfare level and a sophisticated environment, and

REACH this goal without much squandering of natural resources

IN OTHER WORDS: design a sustainable development mode for this country

LEARNING GOALS

- **system dynamics: actors, roles, relations, boundaries, environment**

- **stocks and flows**

- **delays of different sizes**

- **exponential growth/decline, feedback**

- **depletion, diminishing returns, absolute and relative limits, depreciation**

- **deterioration and balancing by regeneration**

- **direct and indirect effects**

- **fast reactions and delayed responses**

- **implementation of short-term tactics**

- **coherence in long-term strategy**

- **sustainability and quality of life**

- **group dynamics**

HOW THE GAME WORKS

FIVE ROLES (CABINET MEMBERS) PER TEAM:

- **population and household consumption**

- **energy production and energy efficiency**

- **food production and environmental protection**

- **goods production and human services**

- **international finance, trade and debt**

SIMULATION PERIOD: 12 planning cycles of 5 year (2 generations)

per cycle the nine steps indicated on the game board must be followed

STRATAGEM GAME STRUCTURE

CYCLE		CYCLE		CYCLE	
Input	Output	Input	Output	Input	Output

DECISIONS   DECISIONS
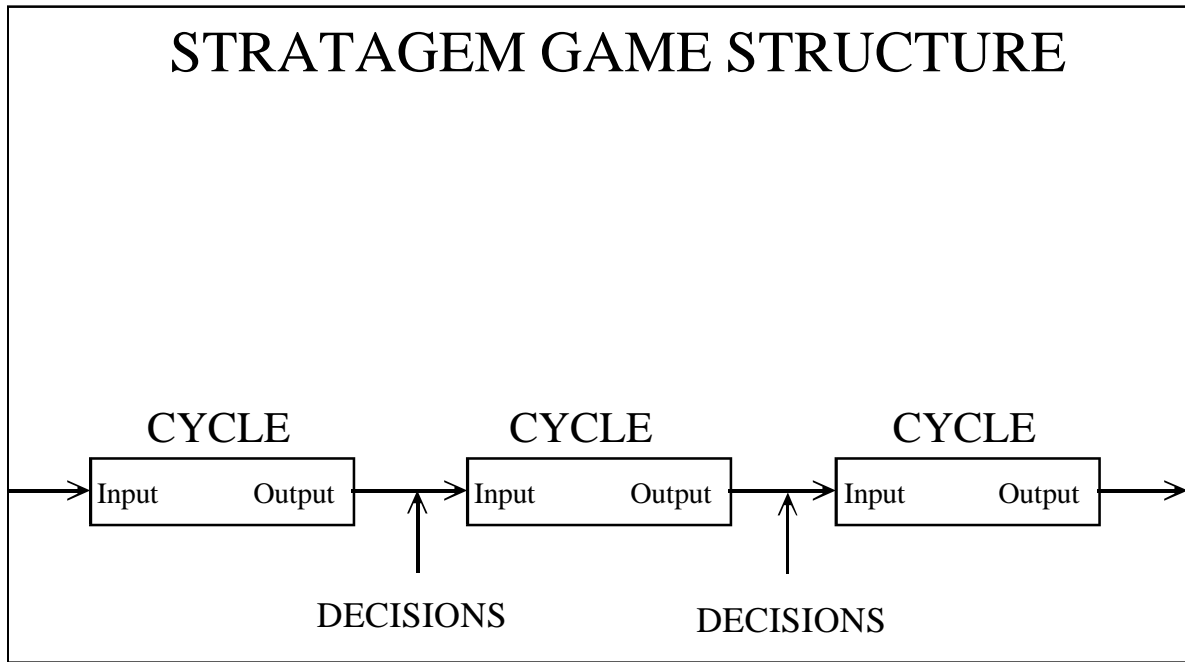
SIMPEL MODELING

FOOD:

Grain warehouse becomes filled at the end of last cycle;

content is divided over population and export

GOODS:

Storehouse with goods becomes filled at the end of last cycle;

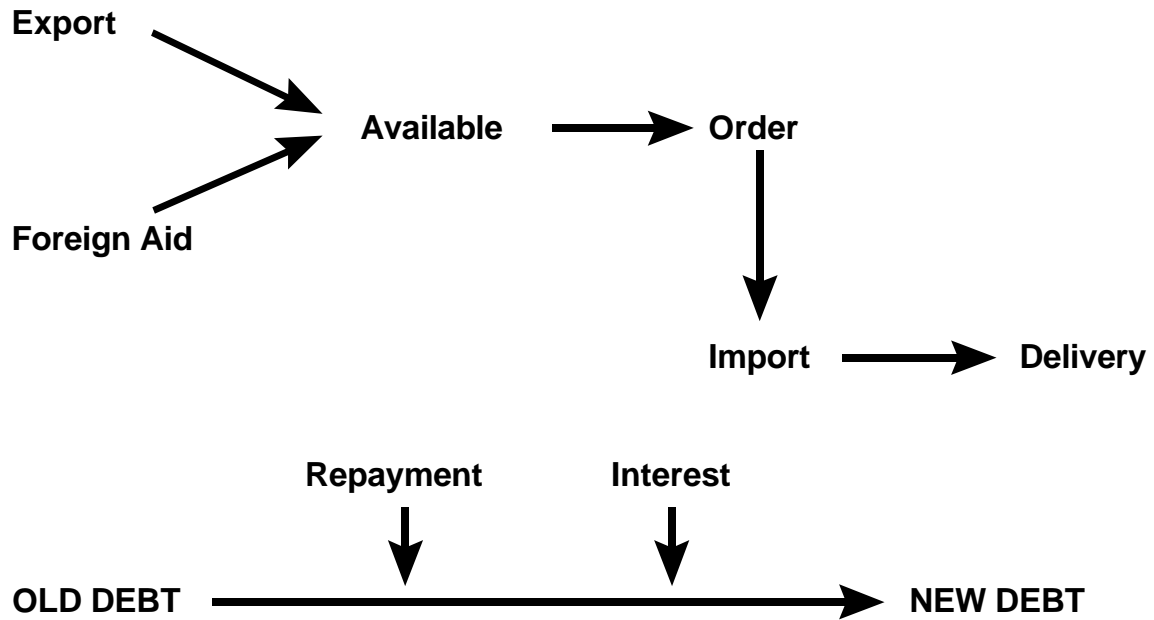**content is divided over population, export and investments.**

ENERGY:

Hydropower reservoirs become filled during the last cycle;

electricity production is divided over households, food and goods industry and export, or water is left over

MONEY FLOWS

Export

Available → **Order**

Foreign Aid

Import → **Delivery**

Repayment   **Interest**

OLD DEBT ——————————→ **NEW DEBT**

EXPECTED PRODUCTION

expected food pr. = const. * MFC * MFP * QE

2500	**6250**	**1**	**0.80**	**0.50**
(ranges)			**(0.4-1)**	**(0-5)**	**(0-1)**

exp. goods pr. = const. * LF * MGC * MGP * MHS

3030	**5.775**	**50**	**1**	**5.00**	**2.1**
(ranges)			**(0.4-1)**	**(0-20)**	**(0-5)**

DEPRECIATION

ACTIVE CAPITAL = productive in this cycle

DEPRECIATED CAPITAL = part of the active capital that will be depreciated at the end of this cycle
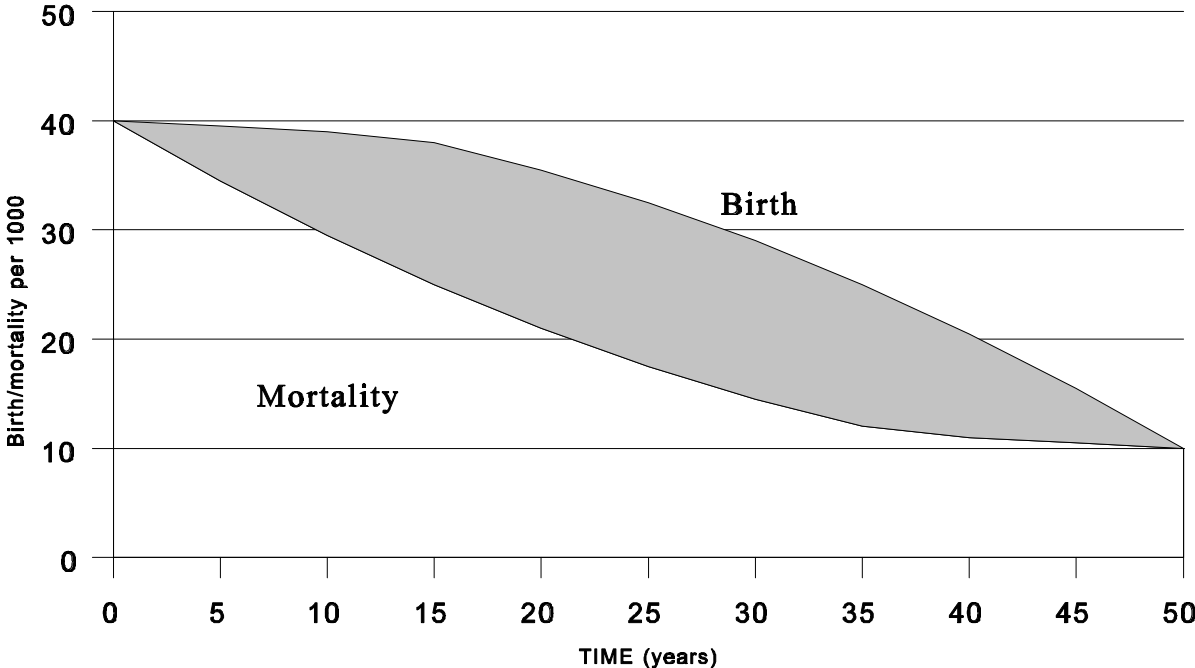
CAPITAL UNDER CONSTRUCTION = capital that remains under construction in this cycle, and will become active capital in the next cycle

SO:

CAPITAL ACTIVE IN THE NEXT CYCLE = capital under construction in this cycle + capital active in this cycle - capital depreciated at the end of this cycle

DEMOGRAPHIC TRANSITION

6. SETTING UP THE GAME

It takes about 30-40 minutes to set up the games. Be sure to leave time enough to complete this step fully before arrival of the participants.

If the teams will play the game in the same room as where you give the briefing and debriefing, lay out the boards so that all are arranged in the same way, for example with the population sector on the north side of the table. Make this alignment correspond with the orientation of the overhead projector slide of the game board that you use during introduction. It is best to finds tables that leave 8" to 15" of clear space around edges of the board, although this is not absolutely essential. It is convenient if the players can have this space for their papers. Tables should be placed far enough apart that the conversations of one team do not disrupt the discussions of teams nearby. A distance of 2-3 meters is normally sufficient.
More uncoupling is possible if the teams are seated in separate rooms and if they only meet at the computer desk.

In the center space of the board put:
- a timer if needed,
- a tray holding the extra markers segregated at least into three categories (e.g. 10 & 50, 100 & 500, 1000 & 5000).
- one marker of each category located on the appropriate place on the denomination key to indicate its numerical value.

In the INTERNATIONAL BANKS area put the money in separate piles by denomination or in the form of the markers used in the game.

Then initialize population, all the capital stocks, and available food, goods, and energy. Put into each square the amount specified in chapter 9 according to the grade of complexity chosen. It is generally more convenient to put a number of smaller denominations of pieces representing some factor such as "TOTAL ENERGY AVAILABLE" in the square (for example five 10's and one 50 rather than one 100). This makes it more convenient for the players to make their subsequent allocations of that factor.

Put the role descriptions next to their corresponding sectors. Lay down their participants nametags as well, if you wish to have your participants wear labels that designate their team number and their sector.

Set up the computer at some convenient place, and make sure that it is producing results consistent with the initial conditions. Be certain that your batteries will last through the entire session, if your computer is not connected to the main electricity grid. Be sure that you have enough computer paper. Have a knife or scissors next the printer for use in cutting the printout into separate pieces for each sector.
Enter the different country names and produce the specific starting conditions for the first cycle. Put these on the corresponding playing tables, divided by sector.

STRATAGEM © IVEM University of Groningen 2000

7. DEBRIEFING THE GAME

7.1 General remarks

The 30-60 minutes period spent on debriefing the game is essential, if the participants are to take away any lessons that will be of relevance to them back in their own organizations. The precise form of the debriefing depends on the size of the group, the length of time available, and the extent to which the lessons of the game will be brought out in subsequent course materials. In any event, however, the purpose of debriefing is to:
-   give players the opportunity to 'unwind' from the tension of the game,
-   give all players an opportunity to express any personal feelings and opinions they have from the play,
-   teach each player about the general guidelines, heuristics, or principles he or others in the game used as the basis for successful decision making within the game,
-   teach each player about the serious errors he or the others in the game committed during the play,
-   demonstrate that the game model shares many essential features with the real-world system,
-   suggest that the keys to success in playing the game therefore also have potential utility for actual decisions that govern long-term economic development and natural resource productivity,
-   help the participants decide what changes in their day-by-day decisions are justified by the lessons of the game and secure from them a public commitment to making those changes, and
-   give the operator constructive feedback on the operation and the design of the game, so that both may be improved.

An extremely important part of the debriefing is the list of insights that result from playing the game. Below are listed a number of such insights:

-   Exponential growth in population and capital exhibits certain relationships between each stock and its associated rate of increase - for example, the effect of growth rate on a stock's doubling time. The doubling time equals 72 year/% growth, implying that e.g. a 3% annual growth rate doubles the associated stock in 24 years - and the conceptual and practical difference between rate of growth and absolute increase (the first may be declining steadily while the second is still growing larger with each cycle).

-   The determinants and the magnitudes of a population's birth and death rates pass through certain characteristic phases during the course of the demographic transition.

-   Capital investments impose significant delays on the system. Once placed in one sector, capital normally cannot be moved; once it is put in place, an investment continues to impact on the system (for example, by degrading the environment or raising energy demands) for the capital's full lifetime, often 25-35 years or more.

-   The cost of measures to protect the environment are generally much lower if the measures are taken early before great damage has already been done. When the quality of the environment in STRATAGEM increases (above 0.5), the regenerative capacity will decrease (see the corresponding figure in chapter 3). This stresses the necessity to avoid deterioration by appropriate investment in environmental protection capital in order to reach a clean environment.

-   There are several short-term long-term tradeoffs in the game. Investments in environmental protection do deprive the society of some immediate consumption, but they raise the level of production from the food sector over the long term. By diverting goods to the population early in the game, investments are reduced, and growth in output is lower than it might otherwise have been. However, early increments in the material standard of living lower population growth rates and mean that the total output in later cycles need not be distributed among as many people.

-   Some environmental processes, for example pollution of ground-water, may involve enormous (25-75 year) delays, posing very difficult problems of environmental management, since the harmful consequences of

pollution must be borne for a long time after their level has grown high enough to stimulate corrective actions.

- A gap between what is needed and what is produced may be eliminated either by producing more or by needing less. For example, energy deficits may be solved through greater amounts of energy (from imports or domestic production) or through investment in energy efficiency measures. The latter is quicker and cheaper.

- Regeneration of renewable resources involves several quite general relationships among growth, fertility, harvest, death, the resource's sustainable yield, and its standing stock (or population).

- The marginal productivity of investments typically declines with increasing intensity of exploitation of a resource. The returns on investments in e.g. energy production capital are high at first, but eventually they decline to levels that make further investments uneconomic.

- The short-term results of a resource policy may be opposite in direction from the long-term results of that policy. By denying capital to environmental protection, more may be invested in agriculture. The result is higher food production in the short term. However, the longer-term consequence is erosion of environmental quality and, therefore, reduced agricultural production.

- Interconnections among resources can often mean that measures taken to increase the utilization of one resource will raise or lower the productivity of others. For example, capital invested to raise energy production can erode the quality of the environment and thus reduce the productivity of the agricultural land.

- One must carefully consider the influence of a capital stock's average lifetime and the cost of maintaining it. The benefits associated with a capital stock typically depend on its magnitude; in contrast, the costs associated with a capital stock typically depend on the rate at which investments flow into it. Consider, for example, a capital stock with lifetime of 20 years. To maintain the stock at 1000 units requires an investment of 50 units/year or 250/cycle. If the capital stock had an average lifetime of 50 years it would take only 20 units/year or 100 units per cycle to maintain it at that constant level.

- One must be careful to weigh all costs of each policy. Often a decision that seems quite attractive when viewed only from the perspective of one sector will be found to impose significant costs on other sectors. For example, it seems relatively inexpensive to achieve increased goods production through investments in goods production capital. But each unit of goods production capital imposes indirect costs on both the energy and the food sectors of the system. For each new unit of goods production capital one must add additional energy production capital or energy efficiency capital. Further, each unit of goods production capital imposes indirect costs on the food sector. Either new investment must be made in environmental protection or there will be losses in food output because of declining quality of the environment.

- Some measures may actually be more productive than they appear, just because they have different indirect benefits. For example, investments in human service capital do not normally add to goods production as quickly as do investments in goods production capital. However, associated with additions to goods capital the indirect costs are listed just above. Human service capital does not require additional energy and it does not burden the environment. In addition, human services capital investments help reduce the population growth rate, so that higher material standard can ultimately be achieved with lower total output.

- The overall strategy aims at reaching a high level sustainable state of affairs. This however does not imply that the decision rules (the policy to be pursued) remain constant over the game period. In different phases of the game (opening, mid phase, concluding part) specific and contrasting measures must be taken in order to reach the overall goal. This makes it also important to time the policy switches accordingly. See also chapter 9 for relevant examples.

7.2 Examples

In order to illustrate in the debriefing session different and contrasting ways to reach a stable and high productivity society, the program diskette contains a set of three examples of possible game trajectories for each of the grades of complexity of the game (SIMPLE, STANDARD, TOUGH and VERYHARD): OPTIMAL (using minimal amounts of resources), INSTABIL (a crashing society) and HEAVYIND (characterized by a massive build-up of production capacity, followed by increasing consumption). These are stored on the files with the extension .RES and can be inspected by starting RUNSTRAT.EXE and choosing the option to play an already existing game (SIMPLE.RES, STANDARD.RES, TOUGH.RES or VERYHARD.RES). These files also require the presence of the corresponding .INI and .RS2 files. More details and a full description of the policies followed are given in chapter 9.

In case of the OPTIMAL and HEAVYIND approach the Equilibrium State is reached by minimal use of capital and resources. This illustrates the potential of productivity raising in STRATAGEM by an appropriate investment policy. Within the computer program these demonstration runs can be plotted separately. One can also insert the .RES files into the actual gaming file that contains the results of the countries in use in your game. This approach gives the opportunity to reproduce the results of teams in the same graphs and/or tables as the demonstration results.

STRATAGEM © IVEM University of Groningen 2000

8.   STRATAGEM MANUAL FOR THE OPERATOR

This manual describes how to operate the simulation game STRATAGEM. It starts with the system requirements for the program and how to install and setup the program.

When the program is up and running correctly, this manual gives a description of a typical STRATAGEM session. You learn how to start a game, give your input to the machine and how to access the available information about the countries.

Finally, a complete overview of all menu options is given. This can be used as a reference while playing the game.

In the STRATGEM program you cam move around by using Buttons, Menus and Keys. In this manual these are depicted as follows:

Button   [**Close**]
Menu   **File**
Keys   <**Tab**>

8.1   System requirements

This version of STRATAGEM runs under Windows 95 or higher. STRATGEM needs a resolution of 800 * 600 and 2Mb of hard disk space.

The printer installed under your windows version can be used.

8.2   Installation

STRATAGEM comes on a diskette that can be copied to hard disk to speed up performance. To play the game, the following files are necessary:

-    Stratagem.exe   Main program
-    Stratagem.cfg   configuration file
-    simple.ini   game variant 1
-    standard.ini   game variant 2
-    tough.ini   game variant 3
-    veryhard.ini   game variant 4
     Higheq.ini   game variant 5
-    Dec Sheet English.dsh   Decision sheet text in English
-    STRAT_UK.rtf   General information in English
-    STRAT_NL.rtf   General information in Dutch
-    STRAT_De.rtf   General information in German
-    STRAT_Esp.rtf   General information in Spanish
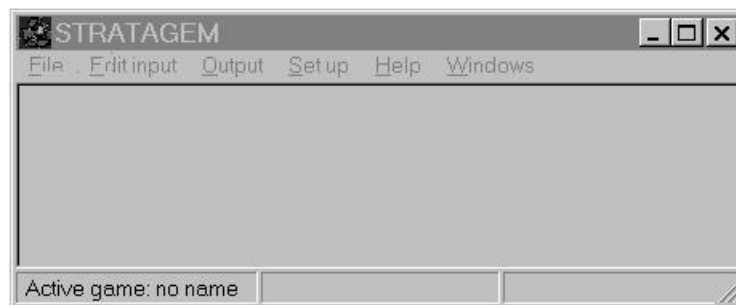
8.3   Starting STRATAGEM

To start the game double click on the STRATGEM icon. The game starts with an information screen (see Figure 16)
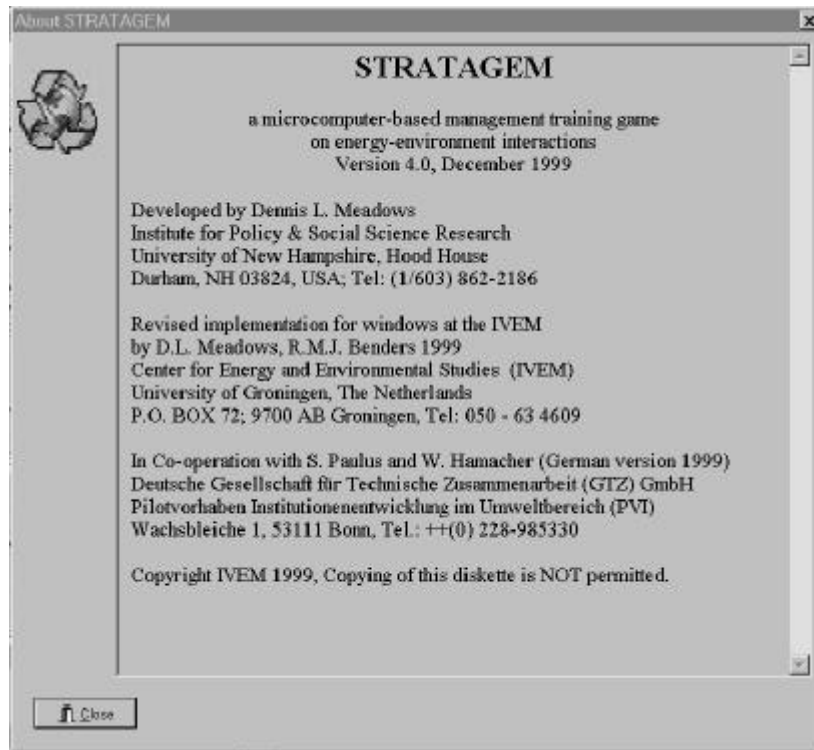
Figure 16: STRATGEM general information and copyright

Click on the [**Close**] button or use the hotkey <**Alt**><**C**> to enter the program. You will encounter the screen in figure 17.

Figure 17: STRATAGEM main menu

This screen is the main menu of STRATAGEM. All options can be accessed via this menu. The following objects are visible on the screen:

- Main menu: the horizontal bar on top of the screen. The main menu contains six sub menus.
- Submenu: the vertical menus just below the main menu. A complete description of all the options is given in the last section.

- Status bar: the horizontal bar on the bottom of the screen, divided in three parts. The status bar contains information about the active directory, game and ini file.

To access the different menu items and buttons you can use the mouse and the hot keys. A hot key is often an underlined character in a menu option or on a button in combination with <**Alt**> (press <**Alt**><**F**> to open the **File** submenu). The <**Tab**> key is used to move around within input or output screen. By pressing the <**Enter**> key you confirm the item in the screen which has the focus. If the [**OK**] button has the focus pressing the <Enter> key will close the active window.

At the start of the game, many menu items are disabled. Later on in this manual you will see how to activate all functions. First we focus on setting up the program correctly.

8.4 Setting up STRATAGEM

Setting up STRATAGEM consists of setting up the language.

Select program language
The operator is offered the option to choose the language used in the program (English, Dutch and German). Role descriptions are available in these languages as well (see chapter 3 and appendix F). Select in the submenu **Set up** and then choose **Program language**. Here you can select English, Dutch. or German.

Select Decision sheet Language
The operator is offered the option to choose the language file used in the Decision output screen (**Output**, **Decision**). One file is present (English) but other language files can be created.

The selected set up options will automatically be saved.

8.5 A typical STRATAGEM session

In this chapter a new game is started and played for one round. You learn how to give your input to the machine and how to view your results and graphs and finally how to print all this information.

Start a new game
After your copy of STRATAGEM has been setup properly, you can start playing!
Select submenu **File** and menu-item **New Game**.
Now a dialog is started with a number of questions, presented in the next four figures:

Figure 18: Select the ini-file you want to use for this game

Figure 19: Enter a name for your results.

Figure 20: Enter the number of countries in the new game

Figure 21: For every country you are asked for a name

1) Select the ini-file you want to use for this game. The different game variants are described in previous chapters about STRATAGEM.
2) Enter a name for your results. This name has a maximum of eight characters.
3) Enter the number of countries in the new game. Every country corresponds with one team. The maximum countries are 10. If necessary, extra countries can be added or deleted later on.
4) For every country you are asked for a name. All names in a game must be unique.

After this dialog, you can see that the names in the status bar are changed. They should display the names of your ini-file and your result name.
For every country the first status report is calculated. In the **Output, Reports** submenu you can choose if you want to see them on screen and send them to printer.
We have now started a game and you can give the first round of input.

Enter your input
After a team has read the status report of its country, it can start to think about its decisions for the next round. When these decisions are completed, they are filled out on an input form, and handed over to the operator of STRATAGEM.

Entering input for a certain country is located at the submenu **Edit input** under the option **New input**. Select this option and you will see the following screen:

Figure 22: STRATAGEM input screen, the [**OK**] button will be enabled if the inputs are finished

The input screen has a number of input fields divided in three columns. Normally you fill in these fields from to top to bottom and from left to right. Any time you want to abort the input screen, press <**Esc**>, click on C̲ancel or use the hot key <**Alt**><**C**>.

Down in the middle of the screen the remaining maximum input value is displayed (the minimum is always zero). Type in an integer and confirm it with <**Tab**> or by a mouse click on the next input field. The <**Shift**><**Tab**> key combination jumps to the previous input field, instead of the next. With the <**Shift**><**Tab**> key combination you can go back and correct erroneous input values. After a number has been confirmed it is checked to various constraints. For example every number must be a multiple of 10. Also the total amount for various columns must be used.

When you have entered the last integer, the [OK] and [Next team] buttons become enabled, By selecting one of these buttons a confirmation of your input is asked. After you confirm the input the next state is calculated and you can view and print the results.
We have now played our first round!
The next section takes a further look at our results.

Extra operator options

Two input fields require special attention. The first one is FOREIGN AID. If the game operator estimates insurmountable problems to be present in a certain country, he/she can choose to supply that country with foreign aid. This (positive amount of) money becomes available directly: for repayments and/or for imports. The second entry is termed SANCTIONS. The game operator can fill in a positive number here in case a team persists in a strategy or tactic that makes them circumvent the real challenges of the game (e.g. starvation + acquiring enormous amounts of goods and/or energy over more than five cycles - in reality a coup d'etat would have taken place). A sanction leads to an increase in the debt of that cycle. This form of sanction should not be confused with the IMF SANCTION that is automatically effected once the ratio of foreign debt to export volume exceeds a certain value.

The game operator can choose to activate an oil crisis during the game. This means that for two consecutive cycles the oil price will be doubled. The operator has to decide on this issue before starting the game, because it requires an off-line change (with an ASCII editor) in the .INI file: the value for "oil crisis year" has to be changed into e.g. 4 if one wants to activate the oil crisis in the cycles 4 and 5.

Viewing your results

After you have played at least one round for at least one country, you will probably want to know how the countries are performing. All status information is placed under the third submenu **Output** and contains five parts, namely **Graphs**, **Fact, Report, Summary** and **Decisions**:

Graphs

This option leads to the following screen (Figure 23):
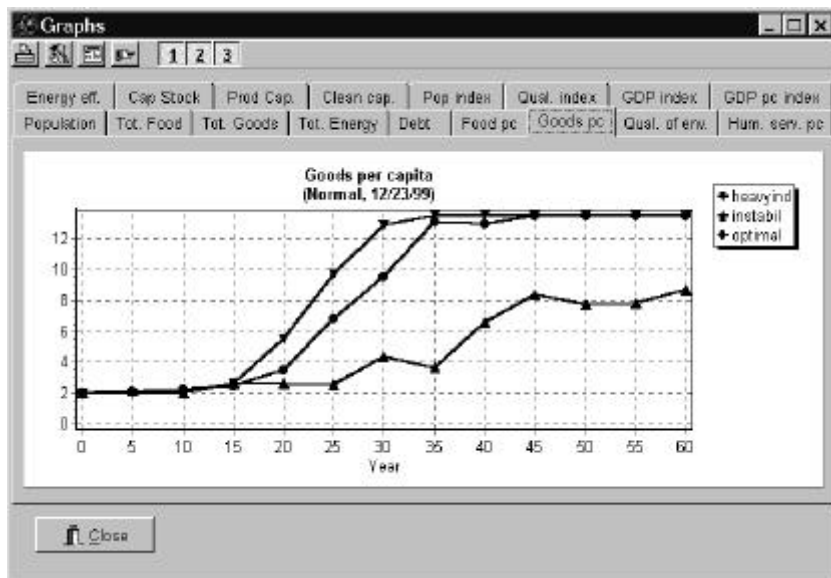
Figure 23: Example of graphical output: Goods per capita for a predefined game (Normal).

This screen can be operated with the arrow keys or by clicking with the mouse on the tab of the desired variable. Try it out and view the various graphs.

If you want to print the current graph press the [print] button. To check the current printer settings click on the [Printer set up] button. It is advised to check these settings once before you give STRATAGEM the command to print. This is to avoid fatal errors that can occur when the program starts printing with the wrong printer setup. In this screen you also can adjust the graph on a few points. You can choose between colors black/white, you can select the size of the graph and you can select either you print to printer, to WMF file (Windows Meta File) BMP file (Windows Bitmap File). By printing to WMF or BMP file you can use these files to be imported in Text processor.

Making a selection:

In the button bar right of the [**Graph set up**] button you can make a selection of countries that you want to see by clicking on the buttons numbered from [**1**] to the number of countries. When moving the mouse cursor over these buttons a hint with the country name is showed. At first all countries are selected. By clicking on these buttons you can select and deselect the countries to be shown

Facts

This submenu item displays the most essential facts describing the state of each country.

This screen can also be operated with the arrow keys or by a mouse click on the desired output variable. Try it out and view the various results.

Figure 24: Example of table output: GDP per capita index for a predefined game (Normal).

The results shown in the Fact screen can be printed by clicking on the print button in the top left of the window.

Report
This item gives you a renewed look at the status report of a country you select on the printer and/or the screen. The status report is a big chunk of text that you can scroll through by using the scroll bar or by pressing <**Up**>, <**Down**>, <**PgUp**> and <**PgDn**> after you give the text field the focus by pressing <**Tab**> (a cursor occurs). Abort the status report clicking the [**Close**] button, use the hot key <**Alt**><**C**> or press the <**Tab**>. Key until the [**Close**] button gets the focus then press <**Enter**>.

Printing your results
The three kinds of results return in the submenu **Print**. You can see **Graphs**, **Facts** and **Report**. **Graphs** and **Facts** produce different overviews of all countries; **Report** provides info for one country at a time. The output of these three options must be quite clear after reading the previous section.

The two remaining items are **Input form** and **Last input**. Printing the input form requires a country name to put on top of the input form. If you want print the last inputs a team has given, you are also asked for the country name. This option works only for the last inputs of a country and is not available when you have just loaded a game from file or when you have deleted the input for a country.

You now have the means to generate all kinds of output, describing the state of all countries. Use this to make your future decisions and play on.

How to play on (and on)
Now that you have seen how a typical STRATAGEM session works, you can go on playing with the different teams, viewing the results and printing whatever results you want. This is a repeating process going through **New input**, **Output** and **Print**. After a while you will see how the different teams, with different strategies run into the various difficulties of the game. These results can be very instructive and interesting for others to see. Therefore being able to save and load a game to and from disk is very useful.

Saving and loading your games
At the start of a game you have already given a name for your res-file. This file is automatically updated after each round. So if the program crashes, you still have your latest results. Saving a game is therefore only necessary if you want to save it under a different name in a different directory.

Select **Save game as...** under **File** and then:
1)   Give a directory where your res-file must be created.
2)   Give the name for your res-file (without extension).
3)   Confirm your save action.
This way you can make as many copies of your game as you like.

When you start STRATAGEM and want to pick up where you left the last time, select **Load game** under **File** and, select your res-file and confirm your load action (Click on the [**Open**] button).

When you can not load a game from an older version of STRATAGEM (the dos version)
Notice how the status view displays the changed ini- and res-names.

This completes the story of how to play a typical STRATAGEM session. With this information you can start playing and learning all about STRATAGEM. For an overview of all functions of the program refer to the next section.

8.6 STRATAGEM reference

In this section each menu option is shortly described.

Submenu: File
New game
To start the simulation game STRATAGEM, two filenames are required. The initialization file that determines the model relations and start conditions. And a result file that is used to store the results.
Load game
To load an existing game from disk you can select a previous played game. The current game and its countries is overwritten by this action.
Save game as ...
The current game data is automatically saved in a RES-file. This is the currently active RES-file. Here you can change the filename of the current RES-file. Enter a new name for this file.
Quit STRATAGEM
The RES-file is automatically saved, so you can leave anytime without losing your results but the last inputs are not saved. Pay attention to the configuration file, which is not automatically saved.

Submenu: Edit input
New Input
This option leads to the input screen. When a game is started you can start giving input for your countries in this screen. After your input is completed, a new round is calculated and output can be given.
Undo Input
When the input for a country was wrong or not satisfying, you can undo your input.

Add Country
If you want to add a new country during a game, you can use Add Country. You can not start a new simulation with this option. The maximum number of countries can not be exceeded. The country has to have a unique name.
Delete Country
During the game you can delete countries. This can be useful if you want to make room to add another game.
Change Name
If you want to change a name during the game you can use this option. This can be useful if you want to add another game that contains an overlapping country name.

   Submenu: **Output**
Graphs
View the status graphs of a country. These graphs make comparison easier and give a better view of the data. In the status graph screen you can select and deselect countries (by clicking on the buttons) and then print the graph by clicking on the print button. You have the possibility to shape the graph choose between colors and black/white choose between output to printer or to file. These settings can be found under the Graph set up button
Facts
View the status facts of a country. This screen contains a table with the essential facts of all countries. You can also print these tables (see print facts).
Report
View the status report of any country (by clicking on the tabs). A status report is a text describing the state of a country. You can also print this text by clicking on the print button. You can make a selection what to be printed: input form, the script report and the last inputs.

Summary
View the summary report of any country (by clicking on the tabs). A summary report is a short describing the state of a country. You can also print this text by clicking on the print button.
Decisions
View the results in table form of any country (by clicking on the tabs). This table has to be filled in by the users on their decision sheets. You can also print this text by clicking on the print button.

   Submenu: **Set up**
Program Language
Here you can select the language (English, Dutch or German) which will be used in the program.
Decision sheet Language
Here you can select the file, which will be used to display the text in the Decision output screen (**Output**, **Decision**). One file is present (English) but other language files can be created.

The selected set up options will automatically be saved in the stratagem.cfg file.

   Submenu: **Help**
About...
Some general information about STRATAGEM, concerning version number, copyright and addresses.
   Submenu: **Windows**
Here you can select how the windows are arranged (**Cascade**, **Tile horizontal**, **Tile vertical**) on the screen or selecting an already open window.

STRATAGEM © IVEM University of Groningen 2000

9. INITIAL STOCKS AND EXAMPLE RUNS

9.1 Initial stocks for normal use of STRATAGEM

Several sets of initial values for population, physical capital stocks, available food, goods and energy, etc. are available as .INI files. The operator has to choose between them when the game is set up on the computer. At that stage the sets of initial values are indicated on the screen by the keywords used below. The main characteristics are given below. The details of the .INI files can be found in appendix E.

SIMPLE.INI
```
  available food / goods / energy  : 3300 / 3500 / 15000
         energy production graph  : high
            environmental quality  : 0.69
                            debt  : 0
                   maximum loan  : 1000
```

STANDARD.INI
```
  available food / goods / energy  : 3300 / 3500 / 14500
         energy production graph  : low
            environmental quality  : 0.69
                            debt  : 1000
                   maximum loan  : 0
```

TOUGH.INI
```
  available food / goods / energy  : 3300 / 3500 / 14500
         energy production graph  : low
            environmental quality  : 0.60
                            debt  : 1000
                   maximum loan  : 0
```

VERYHARD.INI
```
  available food / goods / energy  : 3000 / 3500 / 14500
         energy production graph  : low
            environmental quality  : 0.50
                            debt  : 1000
                   maximum loan  : 0
```

Some parameters are common in the different variants:
```
                       population  : 200
        energy production capital  : new   640 ; depreciation   160
        energy efficiency capital  : new     0 ; depreciation     0
          food production capital  : new   640 ; depreciation   160
  environment. protection capital  : new     0 ; depreciation     0
         goods production capital  : new   240 ; depreciation    60
           human services capital  : new   400 ; depreciation    50
```

9.2 Example runs

The various sets of initial values represent four different grades of complexity in playing STRATAGEM. One of these has to be chosen by the game operator at the start of the game. This choice must be based upon an estimate of the capacity of the team members to handle and tackle complex decisions under time constraints. The range of complexity varies considerably from the SIMPLE version to the VERYHARD variant. Nevertheless all

complexity variants can be played successfully with the same set of coordinated strategies in order to reach to ultimate goal of sustainability. The precision in implementing the right tactics will be higher as the level of complexity is raised (by choosing the appropriate set of initial values). A small mismatch in the allocation of capital investments in the first few cycles of the game may render great difficulties in pursuing the goal of the game, although recovery always remains possible - at the price of long time delays.

In order to illustrate this, for each of the four levels of complexity a set of three example runs has been developed. Every set is based upon the same set of coordinated strategies (or lack thereof). The difference in the related tactics is reflected in the differences in the numerical values for the various decision parameters.

A set of example runs consists of the following three development paths:

- OPTIMAL, a country that follows a policy of optimal development of all sectors in an effort to maximize the quality of life while using a minimum of material resources. In the opening phase of the game a fast growth of the clean capital categories (environmental protection, human services and energy efficiency) is realized until levels that will suffice for a sustainable state. The foreign debt is only paid back after a number of cycles as the money is needed more for investments. The per capita consumption of goods and food is raised continuously from the first cycle onwards. In the mid phase of the game extra goods production is realized in order to import energy. In some cases money has to be borrowed in order to acquire enough energy to let the industry run. In the final phase of the game the capital stocks are reduced to levels that are required in the final Equilibrium State, and the last energy problems are solved.

- INSTABIL, a country that runs periodically into trouble after investing too little (by consuming too much) in the first few cycles of the game, and that does not reach the ultimate goal of the game within the time frame set. In this country all capital stocks show growth without special emphasis on clean or production capital categories. In the mid phase of the game serious and persisting energy problems arise. These are solved only in a cyclical way, and this dominates the occurring pattern. In the final phase too much money has been borrowed and the foreign debt grows out of control.

- HEAVYIND, a country that follows a track that closely resembles that of many Central European countries in the period 1950-1990: emphasis on a fast growth of the heavy industry as the generator of future welfare while postponing an increase in consumption levels and neglecting the need for proper investments in environmental quality. It pursues a strategy that resembles that of OPTIMAL in terms of investment priorities. The main difference concerns the consumption levels. Here food and goods consumption per capita is maintained at the initial level for three to four cycles. In the meantime production has been boosted to such levels that a very fast growth of consumption and thus a sharp decline in population growth can be realized.

For all four levels of complexity a corresponding set is available on the diskette containing the STRATAGEM files. The resulting graphs for the STANDARD version are shown in this chapter, while the (rather closely resembling) results for the other versions are shown in appendix F.

The POPULATION graph shows the overall results for the three countries described. The population grows from the initial value of 200 to some 300 for the country with the fastest transition (HEAVYIND), to some 350 in a more balanced approach (OPTIMAL), while the growth still remains unchecked in the country INSTABIL. The reasons are shown in the graphs of the per capita development of goods, food and human services: a successful transition requires a fast growth to the maximal values of these parameters. This does not necessarily require massive investments in all sectors, as is illustrated in the TOTAL FOOD graph: the output does not vary much over the three countries. However, the way this is reached differs appreciably in terms of investments in the various production capital categories. OPTIMAL and HEAVYIND lay emphasis on investments in environmental protection capital, while INSTABIL puts its money on food and energy production capital.

The TOTAL GOODS graph shows that not so much the amount of goods available counts as does the timing of the availability. INSTABIL produces in the final phase the highest amount of goods, but that level does not suffice for checking population growth. The same conclusion holds for TOTAL ENERGY. Due to energy efficiency measures OPTIMAL and HEAVYIND can allow the indigenous energy production to fall in the opening phase of the game, and do only marginally (but crucially!) rely on energy imports in the mid phase of the game, while INSTABIL tries - in vain - to solve the problems by maintaining and enhancing the local energy production.

INSTABIL tries to reduce the foreign debt in the first few cycles, but has to resort to the international banking system a few times in the following cycles. In the end the debt grows out of control. The other countries wait for a few cycles before they repay their debts (thus using the money for productive investments in the crucial opening phase). They end with a huge surplus (negative debts are possible in STRATAGEM).

The development of PRODUCTION CAPITAL (food + goods + energy production capital) only diverges in the second half of the game, with INSTABIL showing a doubling in that phase. The other countries have no need for this because the demographic transition is mostly done by then. The "trick" behind this is shown in the CLEAN CAPITAL graph which shows a fast build-up of this capital category in the first cycles of the game for OPTIMAL and HEAVYIND. INSTABIL reaches ultimately the same level of investments, but only at the end of the game and with that capital being divided over many more people.

The influence of a proper investment policy for the category ENERGY EFFICIENCY is shown in the corresponding graph. Adequate investments in ENVIRONMENTAL PROTECTION CAPITAL can lead to a fast recovery of the environmental quality. Both upper curves in that graph follow an optimal path that is dictated by the regeneration rate of the environment (in fact these curves follow the inverse of the bell-shaped curve of regeneration rate *versus* environmental quality). Improper investments in this category lead to losses in the agricultural production and excess deaths, as is shown in the INSTABIL case.
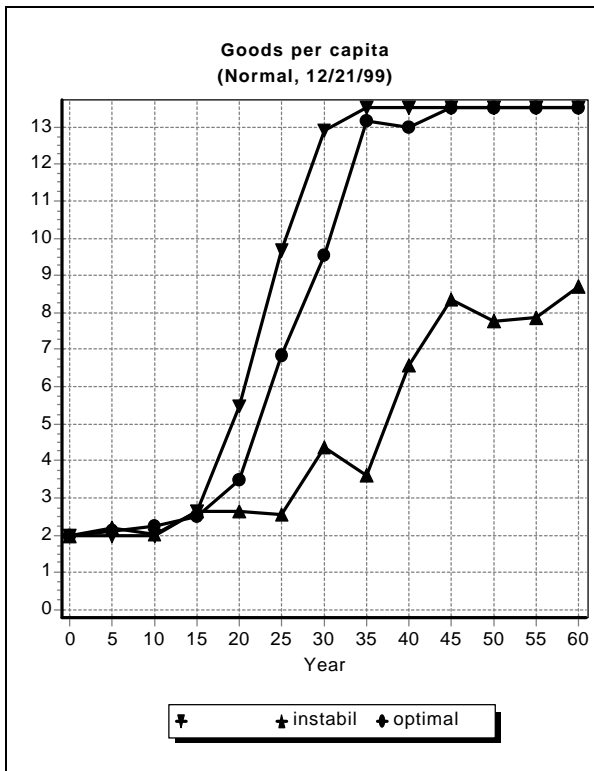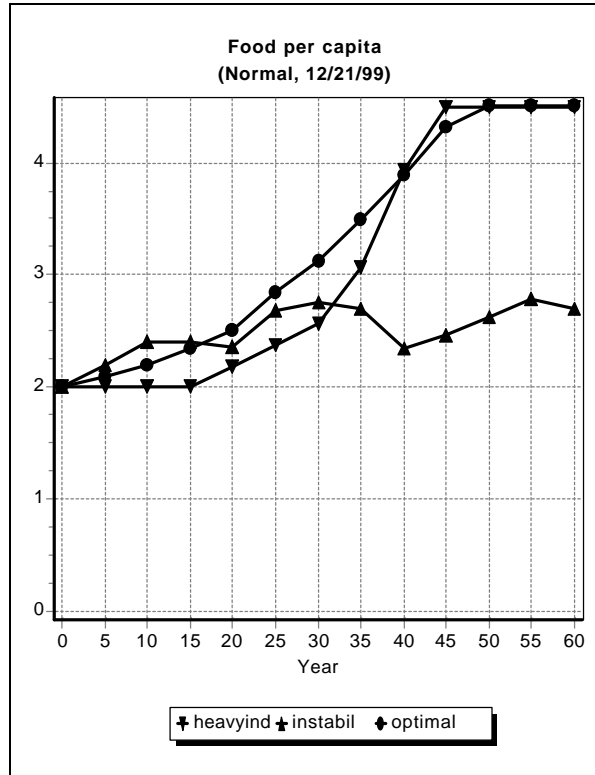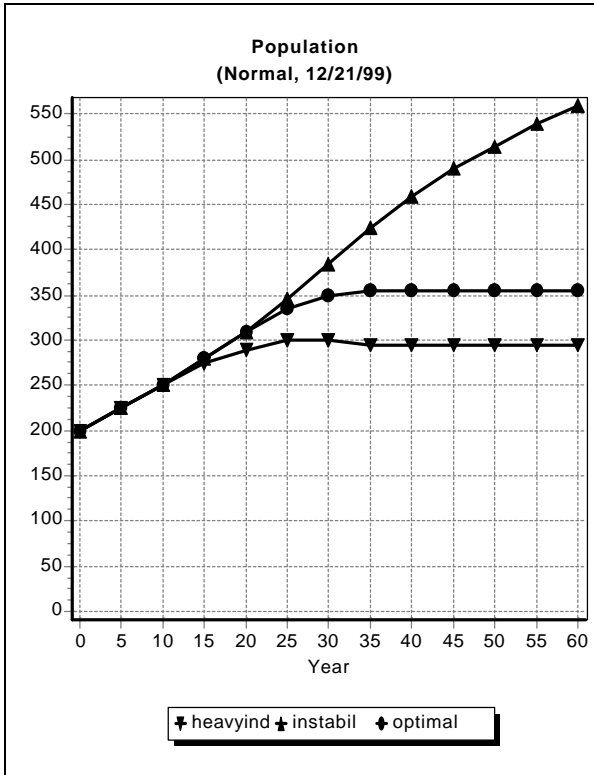
The game operator is supplied with four indices that display different aspects of the performance of the teams (all indices are indexed to an initial value of 100). These are shown in the last four graphs. The GDP index illustrates the development of industrial production (sum of the output of the goods and food production sectors). Also the per capita GDP is calculated. Differences may occur in case of a fast growing population.
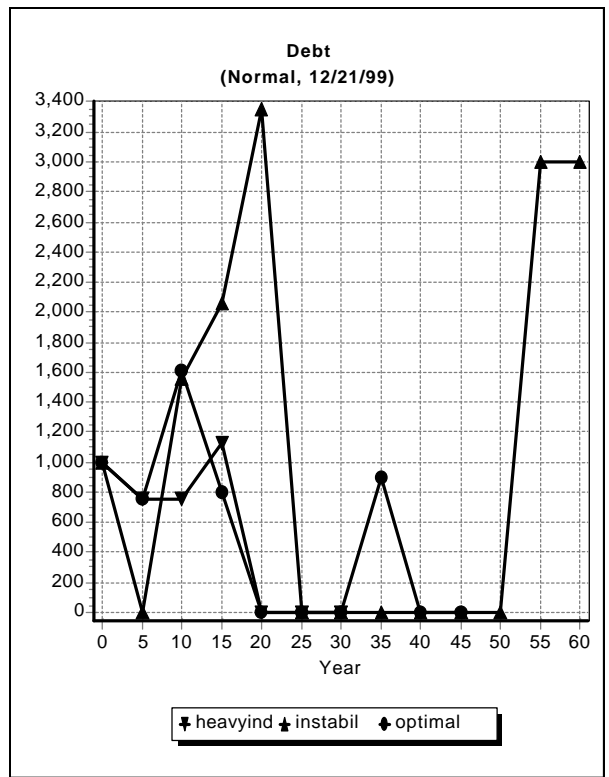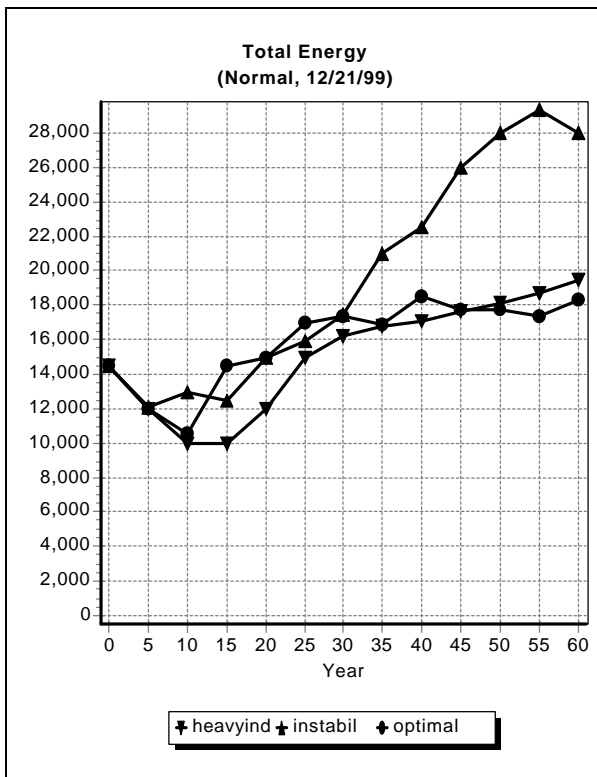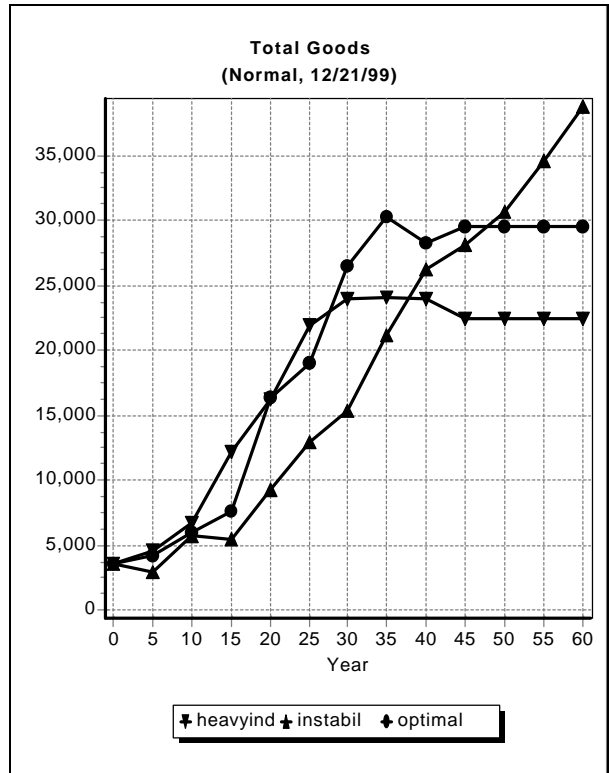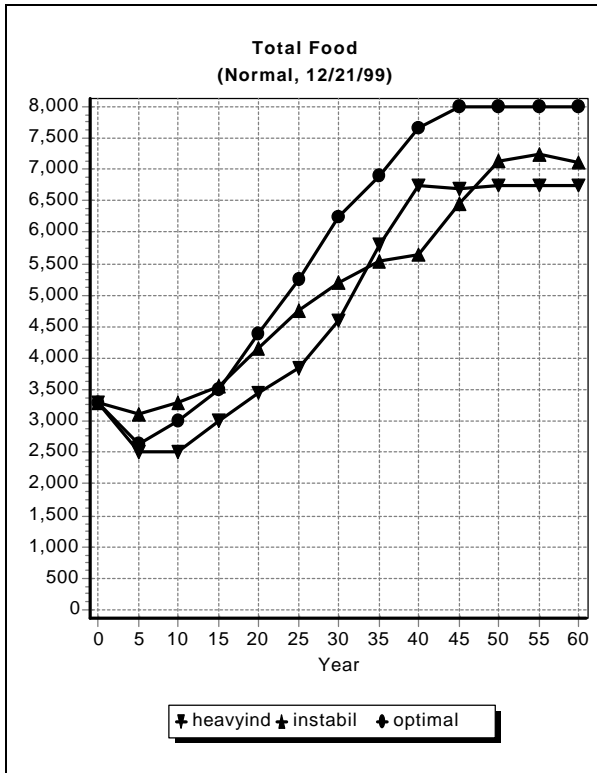
The population index is inversely proportional to the product of birth rate and death rate, and thus focuses on the demographic transition. The quality index not only incorporates the latter aspects but also the environmental quality and the energy efficiency. In this way the quality of life becomes more or less visible in this index.
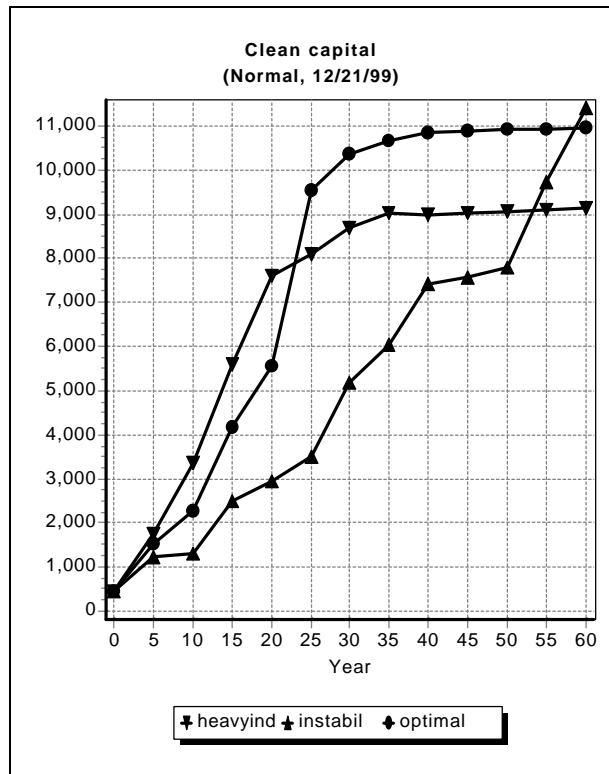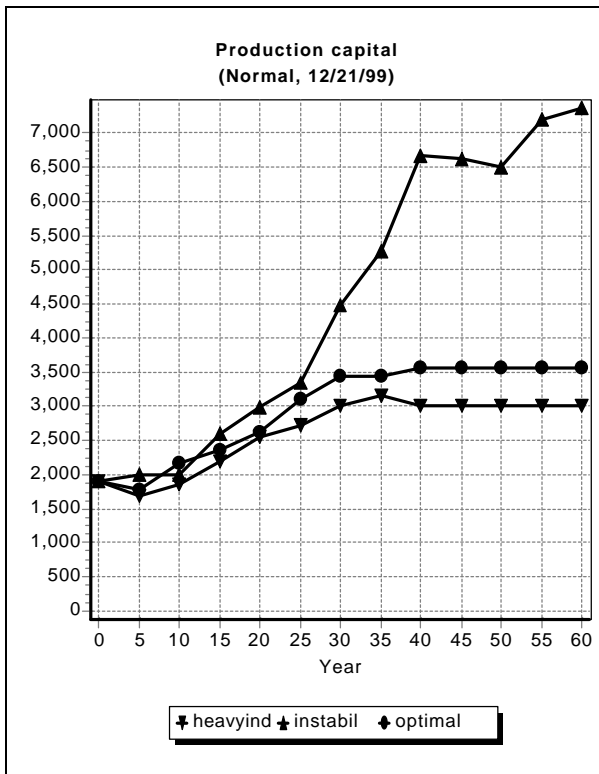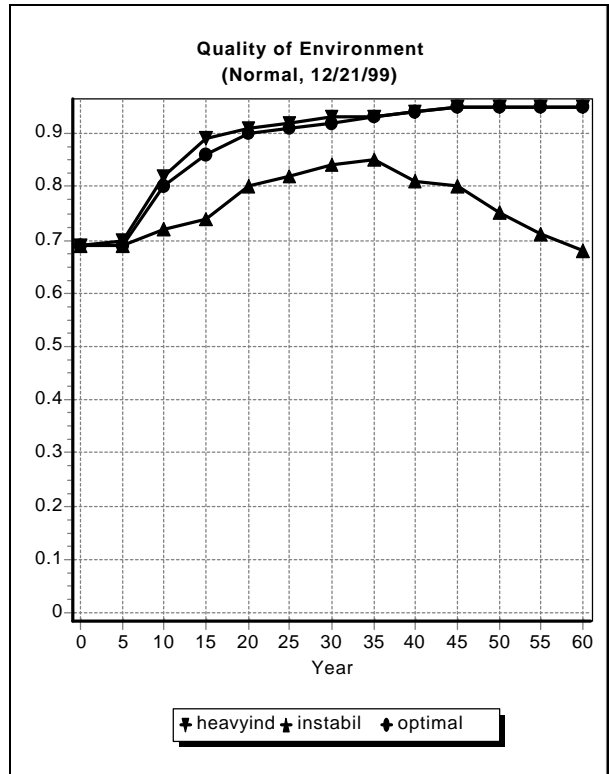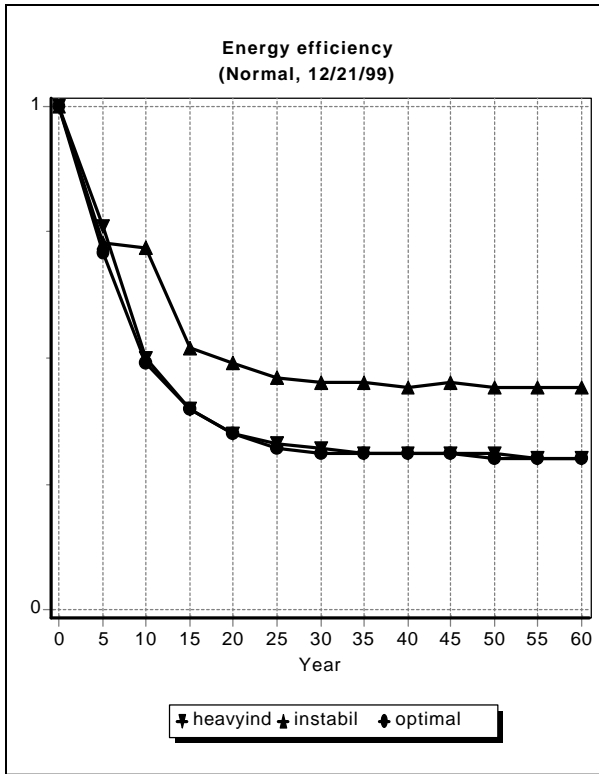
The performance of the teams differs and is different when evaluated in terms of the various indices. INSTABIL shows a continuous and sharp rise in terms of GDP and GDP per capita. Nevertheless, sustainability is still far away when one inspects the development on the other indices. OPTIMAL and HEAVYIND show a more or less even development, on all indices. The population and quality index continue to rise even after the economy is stagnating when measured in terms of GDP or GDP per capita. The close resemblance in development of both countries suggest that a "successful" strategy not necessarily must be based upon a "heavy industry" approach, but that more balanced strategies can be equally fruitful, thereby consuming less resources.

Resulting graph's for the example with the 'NORMAL' initial data.

Population
(Normal, 12/21/99)

heavyind · instabil · optimal

Food per capita
(Normal, 12/21/99)

heavyind · instabil · optimal

Goods per capita
(Normal, 12/21/99)

instabil · optimal

Human Services per capita
(Normal, 12/21/99)

heavyind · instabil · optimal

Total Food
(Normal, 12/21/99)

Total Goods
(Normal, 12/21/99)

Total Energy
(Normal, 12/21/99)

Debt
(Normal, 12/21/99)

Energy efficiency
(Normal, 12/21/99)

Quality of Environment
(Normal, 12/21/99)

Production capital
(Normal, 12/21/99)

Clean capital
(Normal, 12/21/99)

Population Index
(Normal, 12/21/99)

Quality index
(Normal, 12/21/99)

GDP index
(Normal, 12/21/99)

GDP per capita index
(Normal, 12/21/99)

9.3 High equilibrium states

In the preceding sections of this chapter some examples of STRATAGEM results have been shown in order to illustrate the different grades of complexity in playing the game, and to outline the consequences of various (un)sustainable development strategies. Those who have played the game a few times often wonder to what extent the end point reached after 12 cycles can be maintained forever (so the question is: is the end point really a sustainable state within the rules of the games or not?). In order to let them find out the answers by themselves, another version of starting values has been developed that is described in this section.

This version reflects the end point of a high equilibrium development path that resulted in a stable population at high levels of welfare, realized through efficient use of resources, although a better performance is still feasible. The LOW energy curve is used here.

The challenge is now to counter the consequences of oil price hike that turn out to last for 10 years (that is: two cycles in the game). Don't inform the players over the length of the oil crisis period if you want them to extract the major lessons. The relationships in the game are the same as for those who start with a developing nation situation. The main differences in starting position can be seen from the following parameter values in comparison with those given in section 9.1:

```
available food / goods / energy  : 9000 / 38530 / 35400
      energy production graph  : low
        environmental quality  : 0.80
                       debt    : 5000
               maximum loan    : 5000


                  population  : 400
     energy production capital  : new  4000 ; depreciation  1000
     energy efficiency capital  : new  1160 ; depreciation   290
       food production capital  : new  1280 ; depreciation   320
  environment. protection capital : new  1650 ; depreciation   330
      goods production capital  : new  1600 ; depreciation   400
        human services capital  : new  5690 ; depreciation   710
```

Appendix G contains a full listing of the .INI file. This set of initial values has been used to generate three sustainable development paths (that is: three countries with different strategies) that differ appreciably in their outcome:

The country SUSTAINABLE manages to keep all relevant indicators at more or less their initial values: birth and death rate, consumption of food and goods. It even improves in terms of labor productivity through enhancement of the amount of human service capital per capita and in terms of environmental quality and energy efficiency. In the early cycles of the game it has to resort to imports; the corresponding debts can be repaid (from export of excess energy) before their level starts to threaten the economy.

The country HALFSTABLE tries to counter the oil crisis primarily by investing more in indigenous energy production (to reach a lasting solution) and by taking maximum loans (to solve the short term problems). The foreign debt problems become so acute that welfare levels drop (in terms of food and goods per capita) and the environmental quality falls. This IMF type of policy works out and the country recovers in the second part of the game. It ends with all indicators back at their initial high levels or better.

The country INSTABLE follows the same strategy as HALFSTABLE in the opening cycles of the game. The debt grows out of control because the budget cutbacks come too late, and a serious decline in living standards occurs (food per capita halves; goods per capita falls from 15 to 4 - and recovers in the last cycles to about 6; environmental quality drops to about 0.5 and recovers thereafter). The amount of human services capital per capita declines as a result of budget cutbacks and as the consequence of growth in the population (triggered by the drop in welfare and environmental quality). After massive foreign assistance (up to 6 times the local GDP!) the foreign debt is lowered to levels that can be handled by the economy. The reconstruction of the economy in order to reach a high welfare level sustainable state takes considerably more time than the 12 cycles of the game - if the government has learned its lessens adequately.

The three countries don't differ much in the performance on the GDP indicator. HALFSTABLE shows the best results on the GDP per capita indicator.
Again the big difference in strategy shows up in the PRODUCTION capital graph: SUSTAINABLE only needs 50% of the amount of production capital required for the other countries, and has a better performance.

The results of this run of STRATAGEM for these three countries are presented in appendix G.

APPENDIX A: DESCRIPTION OF REQUIRED MATERIALS

Each game requires the following materials and equipment. Those items marked with an asterisk '*' may be obtained from Meadows, and those with a double asterisk '**' from IVEM (see addresses in appendix I). To administer a session with one or more boards, the operator should have:

*/** a version of the STRATAGEM computer program in a form which can be loaded onto the computer that will be used in the game. Since each program can monitor several boards simultaneously (up to 10), only one computer and program are normally required for each gaming session.

- a computer with screen and printer compatible with the program (IBM compatible, running under MS or PC DOS version 3.0 or higher). When more than one group plays the game, the printer speed should preferable be 100 characters per second or faster; 80 columns are necessary.

- an electrical socket adapter or a special power supply, if those are required to operate your printer and computer in the host country.

- an operating manual for the computer.

- sufficient paper to produce all the printouts required during the game (about 60 sheets per country in the standard mode of operation).

* a copy of the official STRATAGEM playing board with a denomination key suited to the pieces that represent capital in the game. This board is about 30"x40", and it is imprinted with a denomination key suited for the pieces normally distributed with the game.

- small containers (clear plastic cups or glasses) for the supply of each denomination of markers.

* a 30-minute clock timer with bell to pace the cycles (a spring-driven timer designed for use in the kitchen works well).

* 10 or more pieces of each denomination of money used in the game - typically these are 10's, 50's, 100's, 500's, 1000's, and 5000's.

* goods/food markers differentiated by size and color to represent the different denominations of physical capital - typically six denominations are used: 10, 50, 100, 500, 1000, and 5000 (the amounts required vary between 25 and 100 of each marker). Mostly pieces of three different sizes (8mm, 12mm, and 16mm) are used in two contrasting colors.

*/** five different role descriptions sheets, each 3-5 pages in length (provide one of these to each player). These role descriptions are included on the program diskette (see chapter 3 of this manual).

- a wall chart showing all the principle graphical relationships (optional). This simply provides in one place all the graphs provided in the role descriptions.

- supplies that are useful for the operator but not mandatory include tape (for holding down the boards or taping together two tables so the surface is big enough to work on), pencils, and a few pocket calculators for use by the players.

*/** a set of overhead projection slides that are designed to facilitate the introduction and debriefing.

- an overhead projector, if you intend to use overhead projector slides. This should come with a spare projector bulb and a plug that matches the style of electrical outlet found in the host country.
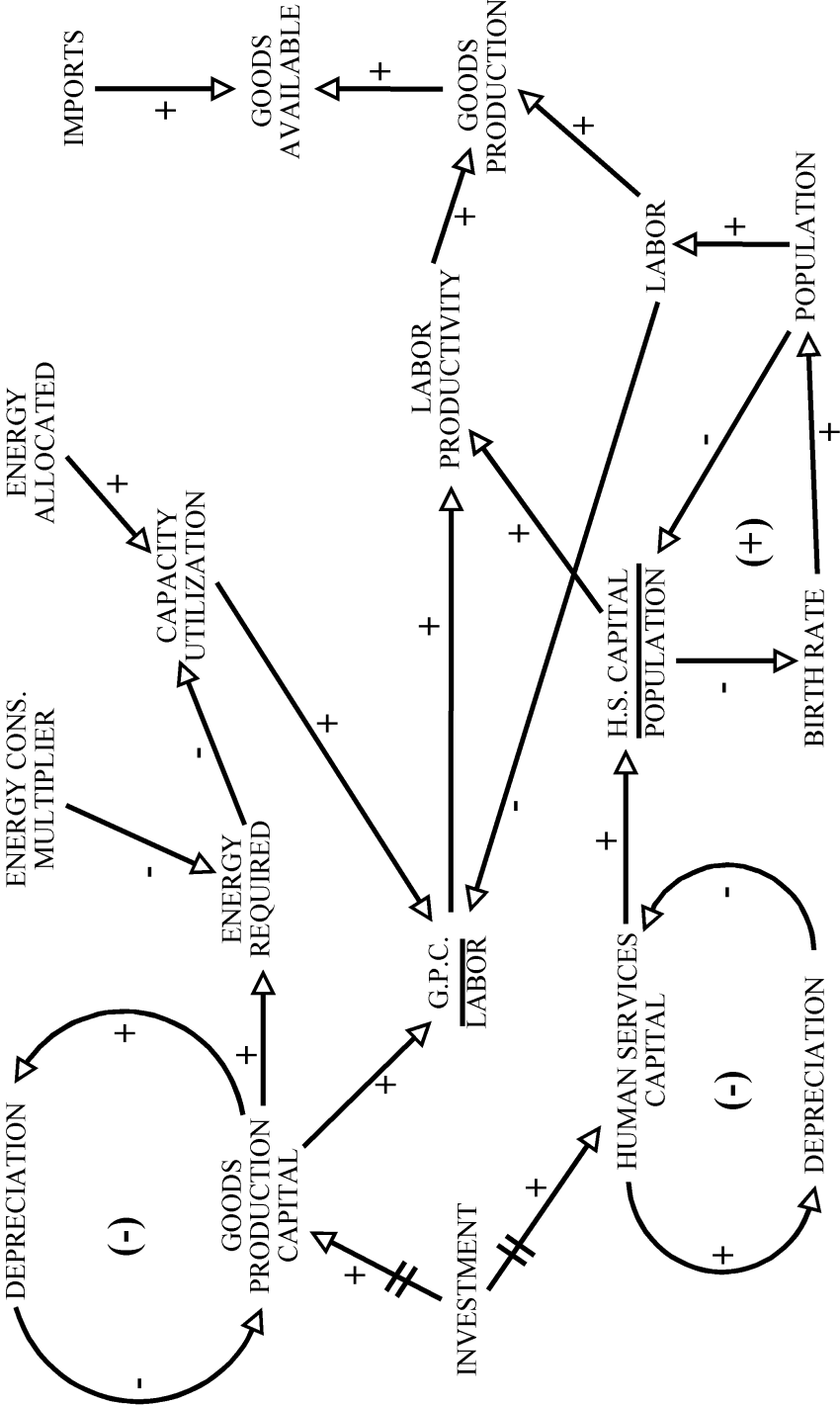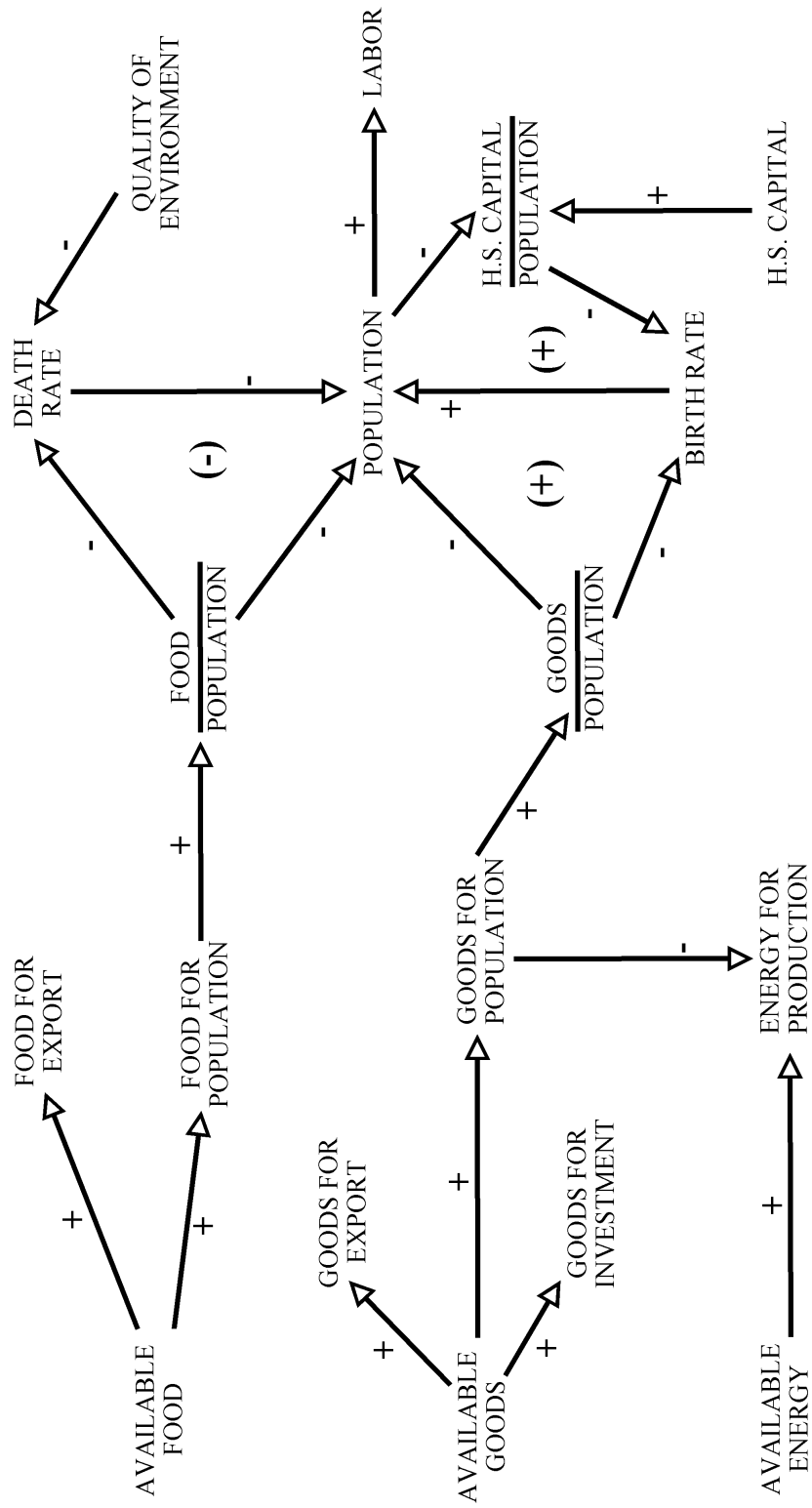
APPENDIX B: ILLUSTRATION OF THE GAME BOARD
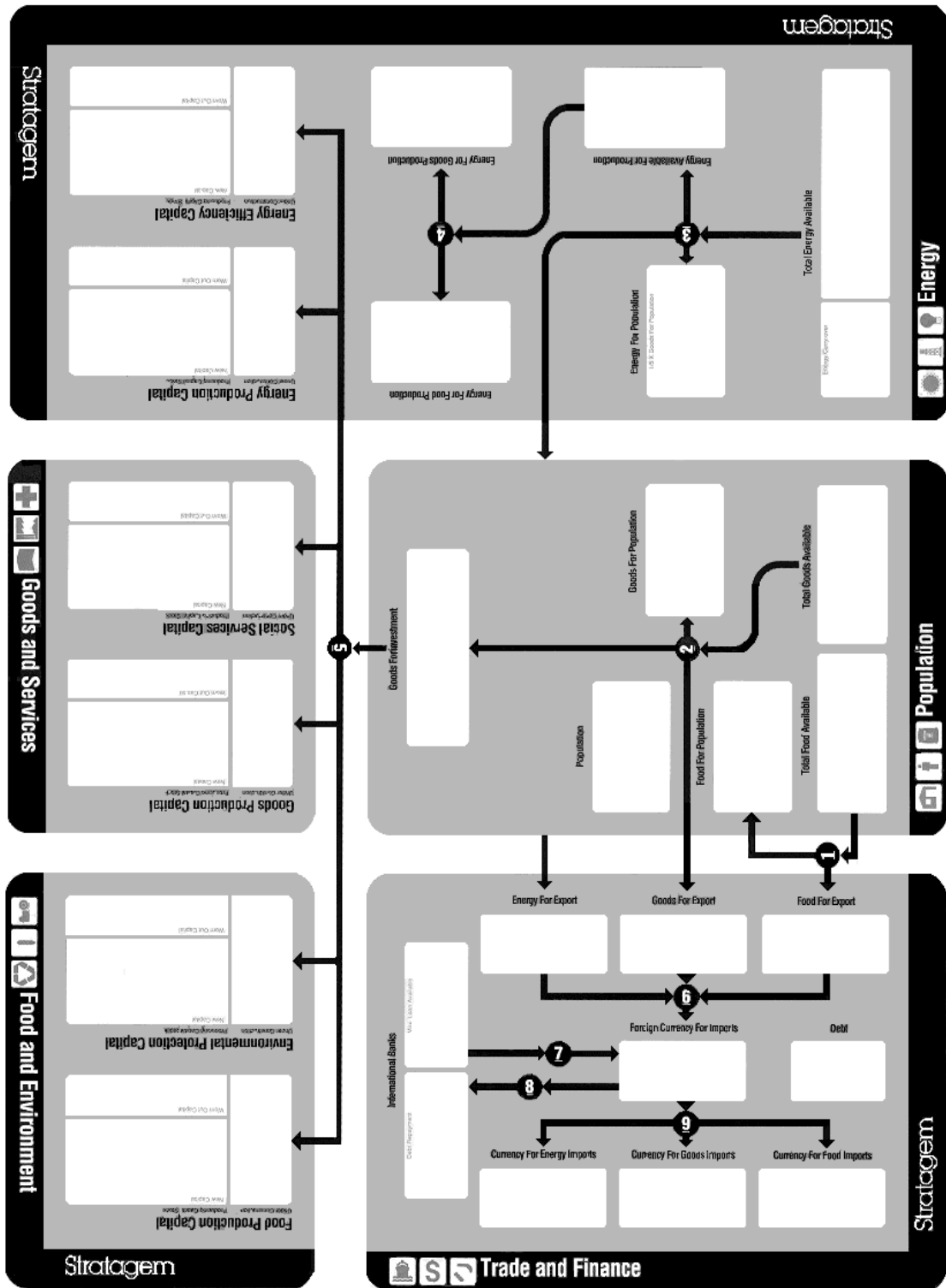
APPENDIX C: THE CAUSAL LOOP DIAGRAMS
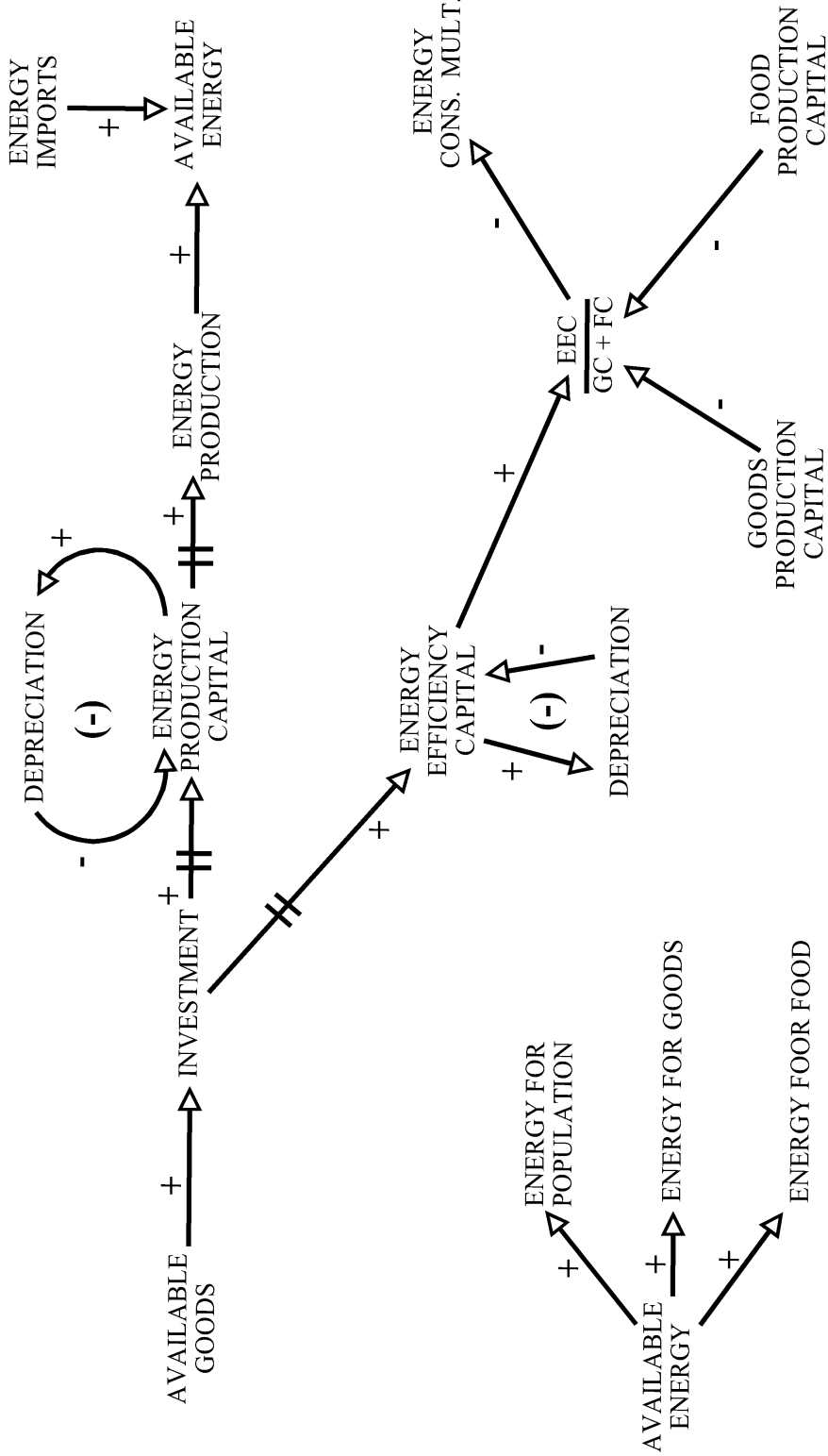
FOOD AND ENVIRONMENT

GOODS PRODUCTIONS AND HUMAN SERVICES

POPULATION AND HOUSEHOLD CONSUMPTION

ENERGY PRODUCTION AND ENERGY EFFICIENCY

APPENDIX D: GRAPHS FOR ROLE DESCRIPTIONS

Below are given the data points and X- and Y-axis texts for the graphs used in the role descriptions of STRATAGEM. These can be used to plot them in figures. For each figure 11 data points (x-axis, y-axis) are given. The points should be interpolated linearly.

Figure 1: **Normal birth rate as a function of average good consumption per year per person (averaged over the last three cycles).**
Data points: (0,0.030) (1.5,0.028) (3,0.026) (4.5,0.024) (6,0.022) (7.5,0.019) (9,0.016) (10.5,0.013) (12,0.011) (13.5,0.010) (15,0.010).

Figure 2: **Birth multiplier as a function of human services capital per person.**
Data points: (0,1.0) (2,1.50) (4,1.45) (6,1.40) (8,1.35) (10,1.30) (12,1.20) (14,1.10) (16,1.00) (18,1.00) (20,1.00).

Figure 3: **Normal death rate as a function of food consumption per year per person.**
Data points: (0,0.060) (0.5,0.045) (1.0,0.030) (1.5,0.022) (2.0,0.018) (2.5,0.015) (3.0,0.013) (3.5,0.012) (4.0,0.011) (4.5,0.010) (5.0,0.010).

Figure 4: **Death multiplier as a function of the quality of the environment.**
Data points: (0.0,1.75) (0.1,1.60) (0.2,1.50) (0.3,1.40) (0.4,1.30) (0.5,1.20) (0.6,1.10) (0.7,1.00) (0.8,1.00) (0.9,1.00) (1.0,1.00).

Figure 5a: **Energy production per cycle as a function of energy production capital (both in units of 1000's) (high version).**
Data points: (0,0.0) (1,17.5) (2,20.0) (3,22.5) (4,25.0) (5,27.5) (6,30.0) (7,32.0) (8,33.5) (9,34.5) (10,35.0).

Figure 5b: **Energy production per cycle as a function of energy production capital (both in units of 1000's) (low version).**
Data points: (0,0.0) (1,15.0) (2,17.5) (3,20.0) (4,22.5) (5,25.0) (6,27.5) (7,30.0) (8,32.5) (9,34.0) (10,35.0).

Figure 6: **Energy consumption multiplier as a function of energy efficiency capital per unit of total capital in food and goods production.**
Data points: (0.0,1.00) (0.1,0.80) (0.2,0.70) (0.3,0.58) (0.4,0.50) (0.5,0.42) (0.6,0.40) (0.7,0.35) (0.8,0.33) (0.9,0.31) (1.0,0.30).

Figure 7: **Multiplier on food production as a function of the ratio of food consumption this cycle to the last cycle (MFC).**
Data points: (0.0,0.40) (0.2,0.52) (0.4,0.64) (0.6,0.76) (0.8,0.88) (1.0,1.00) (1.2,1.00) (1.4,1.00) (1.6,1.00) (1.8,1.00) (2.0,1.00).

Figure 8: **Multiplier on food production as a function of the active food production capital per unit of area (MFP).**
Data points: (0,0.0) (1,1.0) (2,2.0) (3,3.0) (4,3.7) (5,4.2) (6,4.5) (7,4.7) (8,4.8) (9,4.9) (10,5.0).

Figure 9: **Annual percentage of environmental degeneration as a function of the sum of differences of active capital (E, F, G) and environmental protection capital, scaled to 20000.**
Data points: (0.0,0.0) (0.1,4.0) (0.2,5.5) (0.3,7.0) (0.4,7.8) (0.5,8.3) (0.6,9.0) (0.7,9.3) (0.8,9.5) (0.9,9.7) (1.0,10.0).

Figure 10: **Annual percentage of environmental regeneration capacity as a function of the quality of the environment.**
Data points: (0.0,0.0) (0.1,0.2) (0.2,2.0) (0.3,3.5) (0.4,4.5) (0.5,5.0) (0.6,4.5) (0.7,3.5) (0.8,2.0) (0.9,0.2) (1.0,0.0).

Figure 11: **Multiplier on goods production as a function of the ratio of goods consumption this cycle to the consumption last cycle (MGC).**
Data points: (the same as of figure 7).

Figure 12: **Multiplier on goods production as a function of the active goods production capital per labourer (MGP).**
Data points: (0,0.8) (4,4.0) (8,7.2) (12,10.4) (16,12.5) (20,14.4) (24,16.0) (28,17.2) (32,18.5) (36,19.4) (40,20.0).

Figure 13: **Multiplier on goods production as a function of the ratio of human services capital to the total population (MHS).**
Data points: (0,1.0) (2,2.0) (4,3.0) (6,3.5) (8,4.0) (10,4.3) (12,4.5) (14,4.7) (16,4.8) (18,4.9) (20,5.0).

Figure 14: **Multiplier on import prices as a function of the ratio of debt to the average exports.**
Data points: (0.0,1.0) (0.5,1.0) (1.0,1.0) (1.5,1.0) (2.0,1.0) (2.5,1.0) (3.0,1.2) (3.5,1.4) (4.0,1.6) (4.5,1.8) (5.0,2.0).

Figure 15: **Interest rate as a function of the ratio of debt to the average export.**
Data points: (0.0,10) (0.5,10) (1.0,10) (1.5,12) (2.0,14) (2.5,15) (3.0,16) (3.5,17) (4.0,18) (4.5,19) (5.0,20).
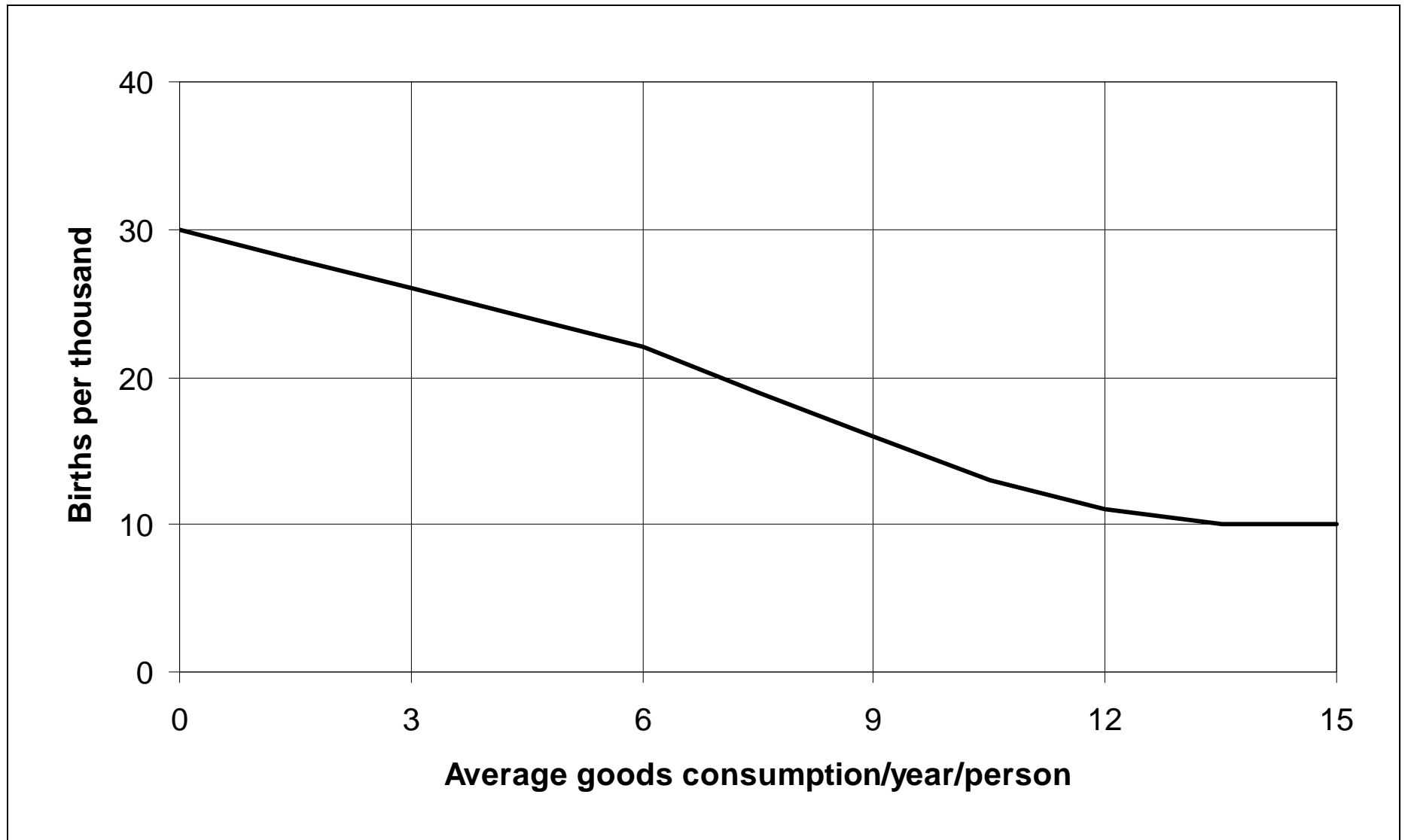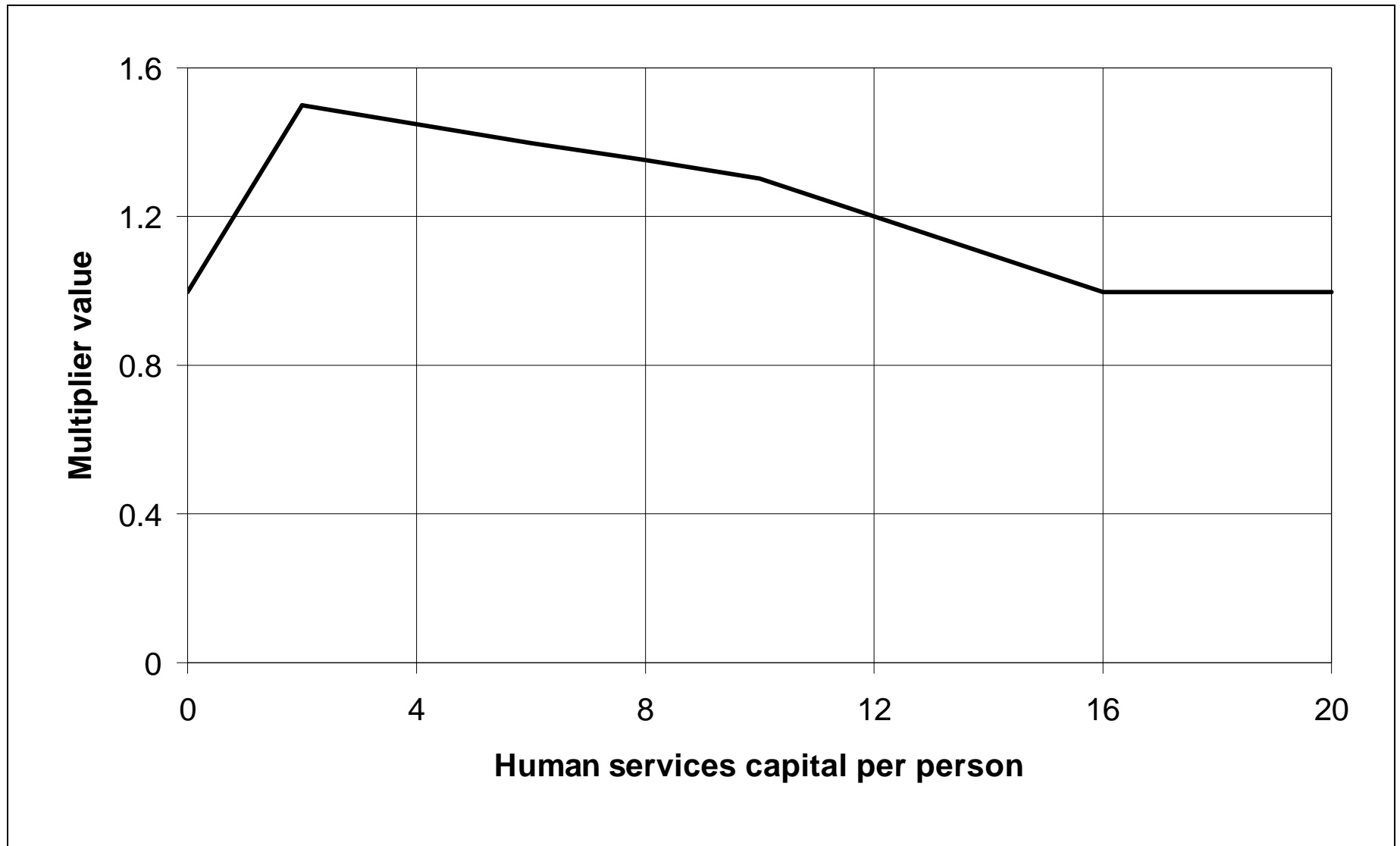
Figure 1: Normal birth rate

Figure 2: Birth rate multiplier as a function of human services capital per person
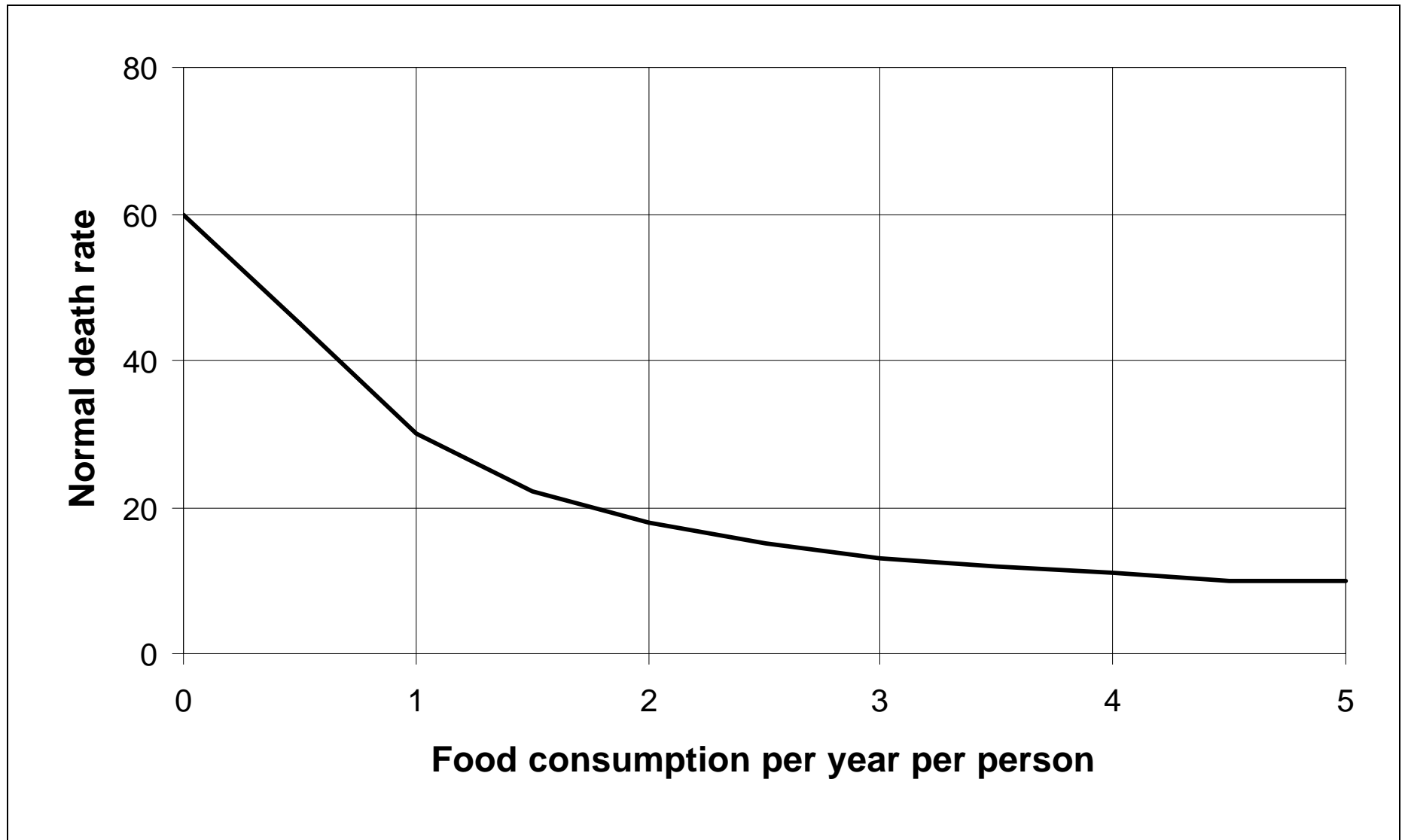
Figure 3: Normal death rate as a function of food consumption per year per person
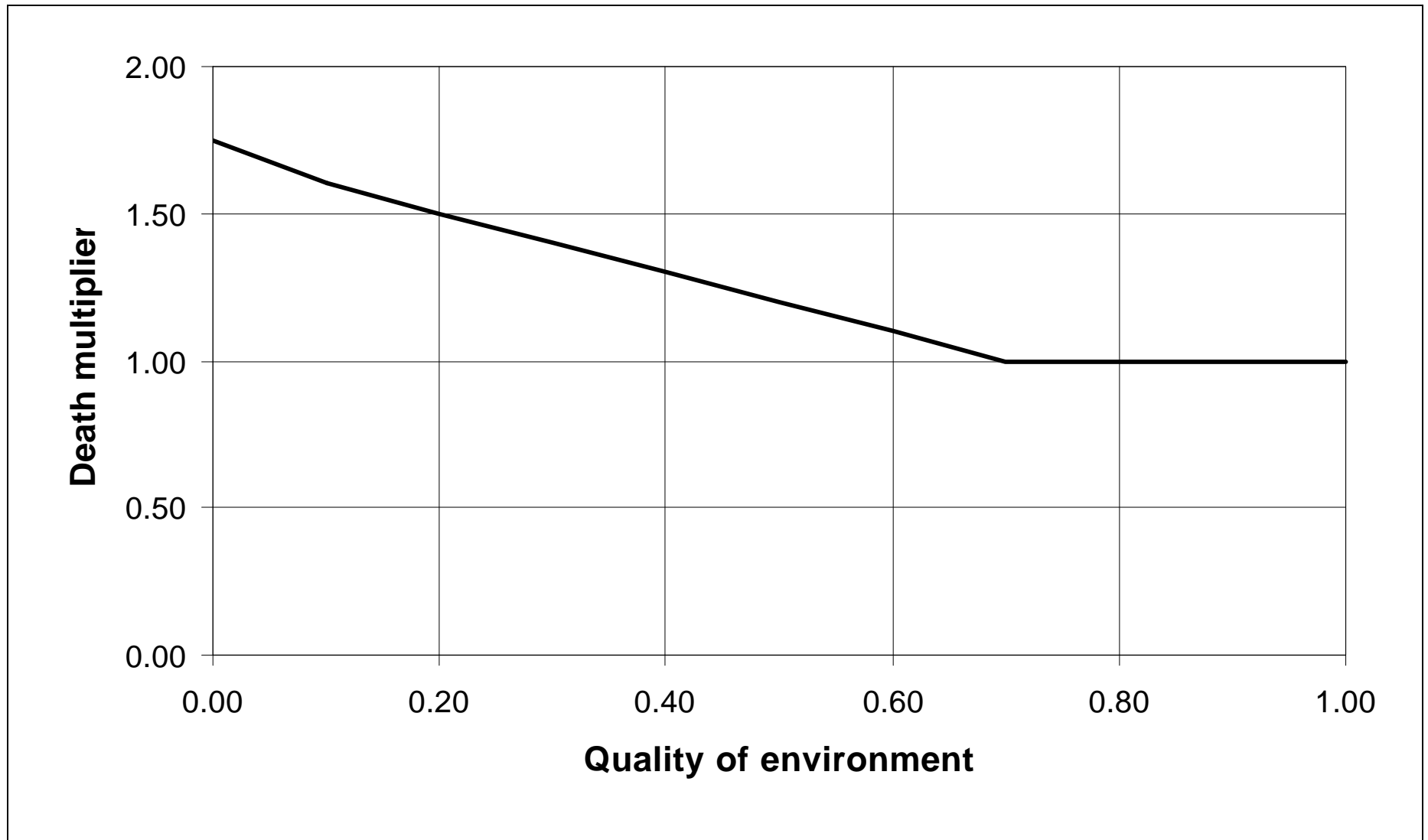
Figure 4: Death rate multiplier as a function of the quality of the environment
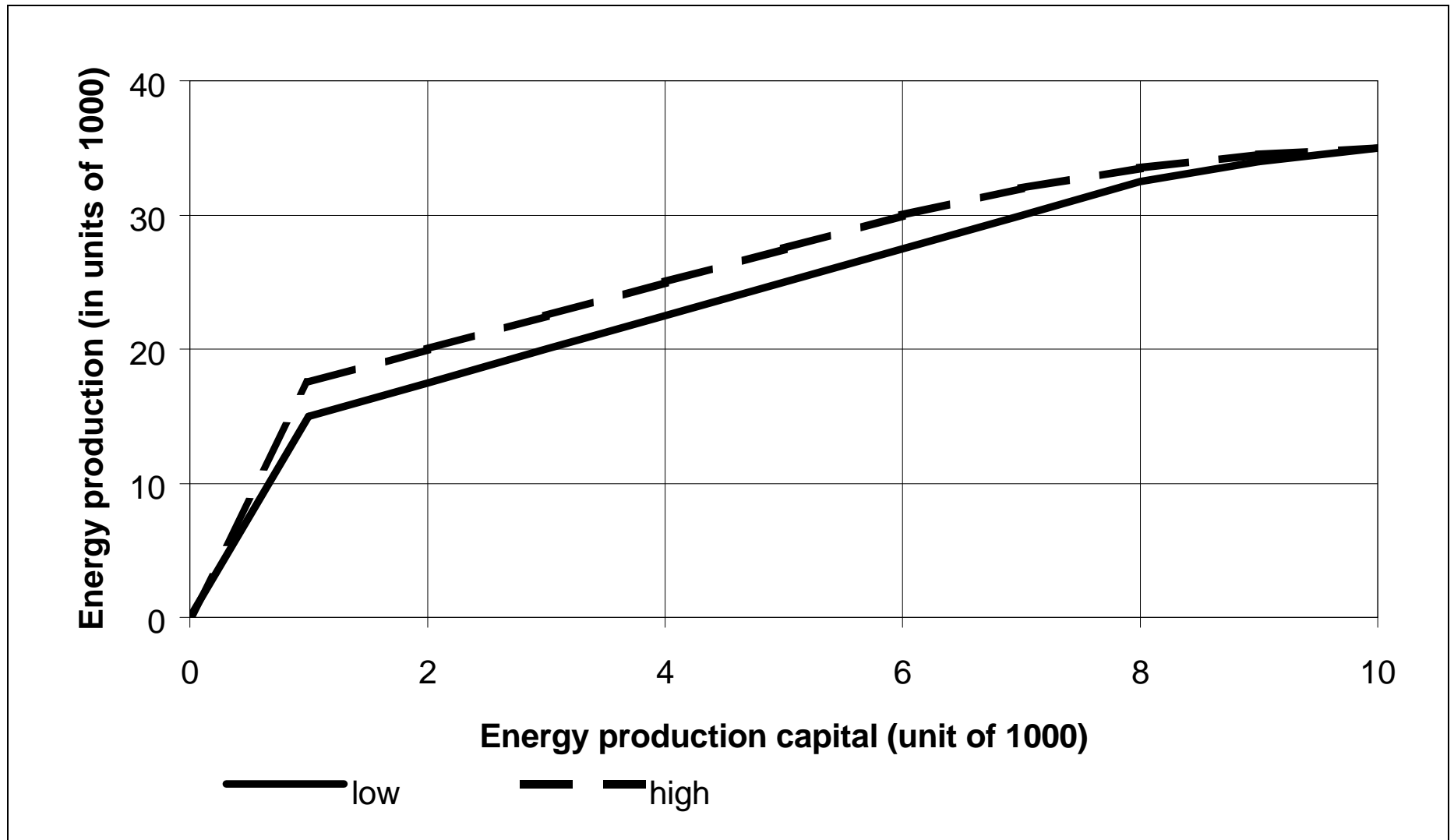
Figure 5:   Energy production per cycle as a function of energy production capital (in units of 1000's)
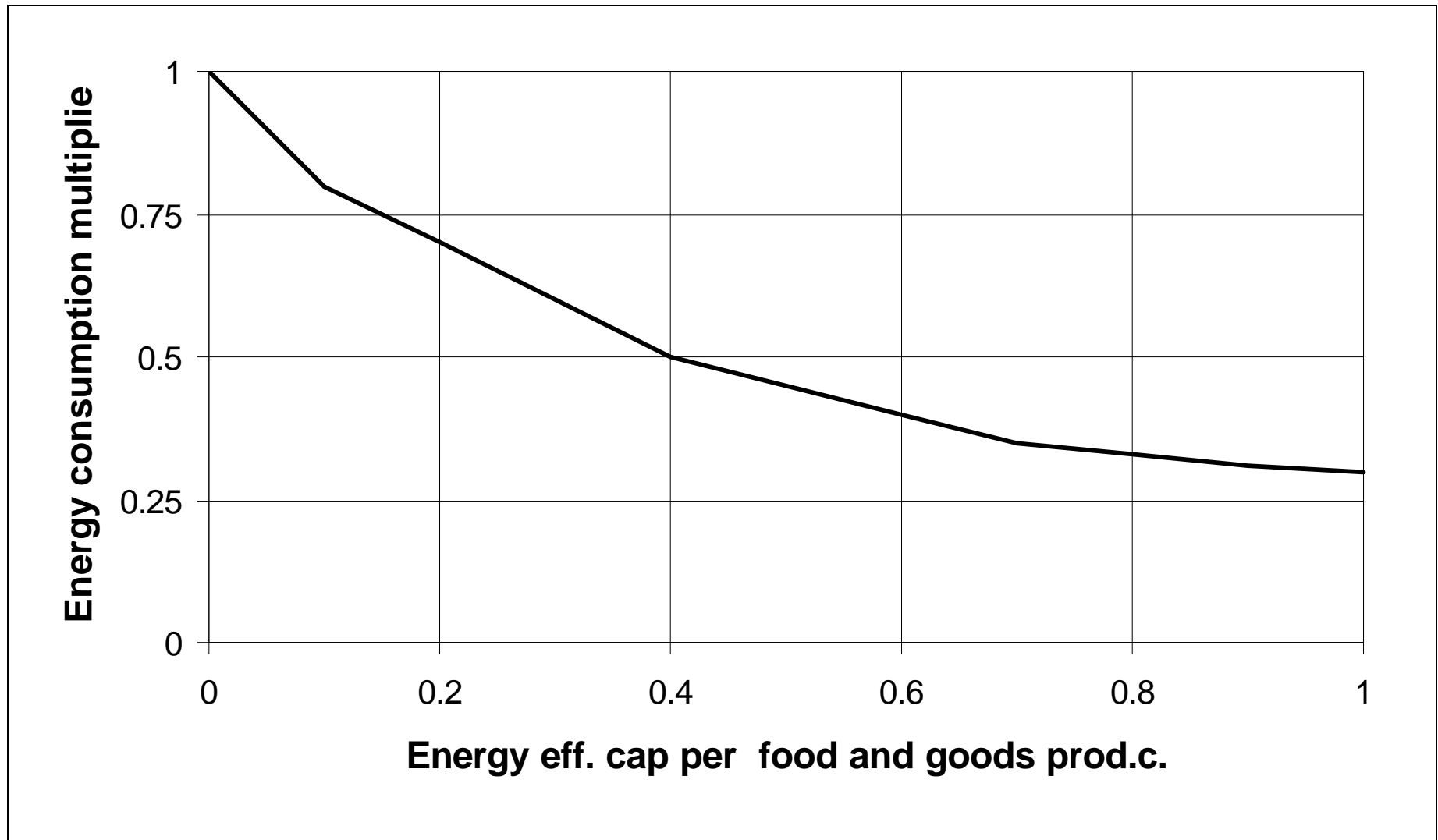
Figure 6: Energy consumption multiplier as a function of energy efficiency capital per unit of total capital in food and goods production
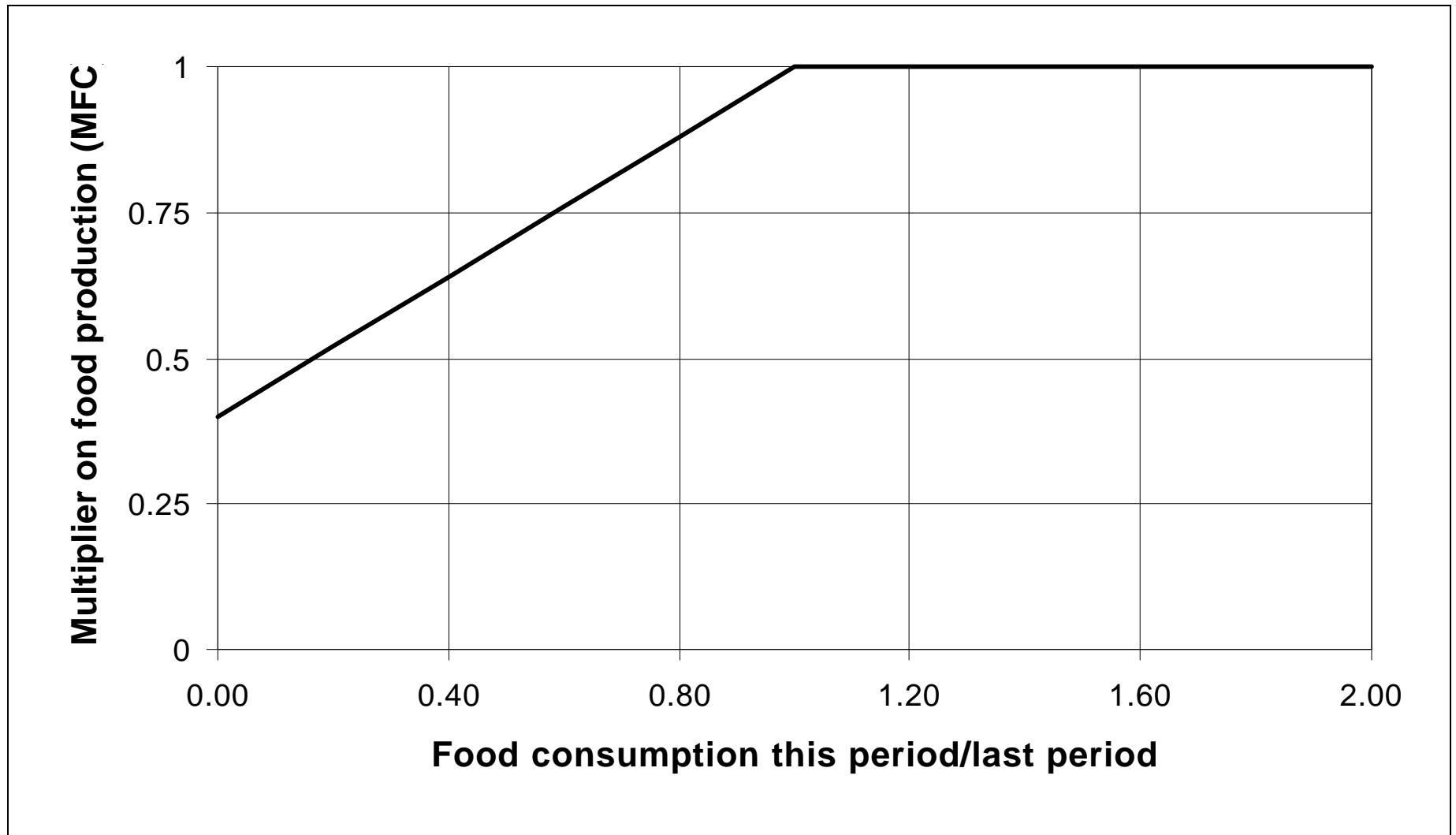
Figure 7: Multiplier on food production as a function of the ratio of food consumption this cycle to the last cycle (MFC)
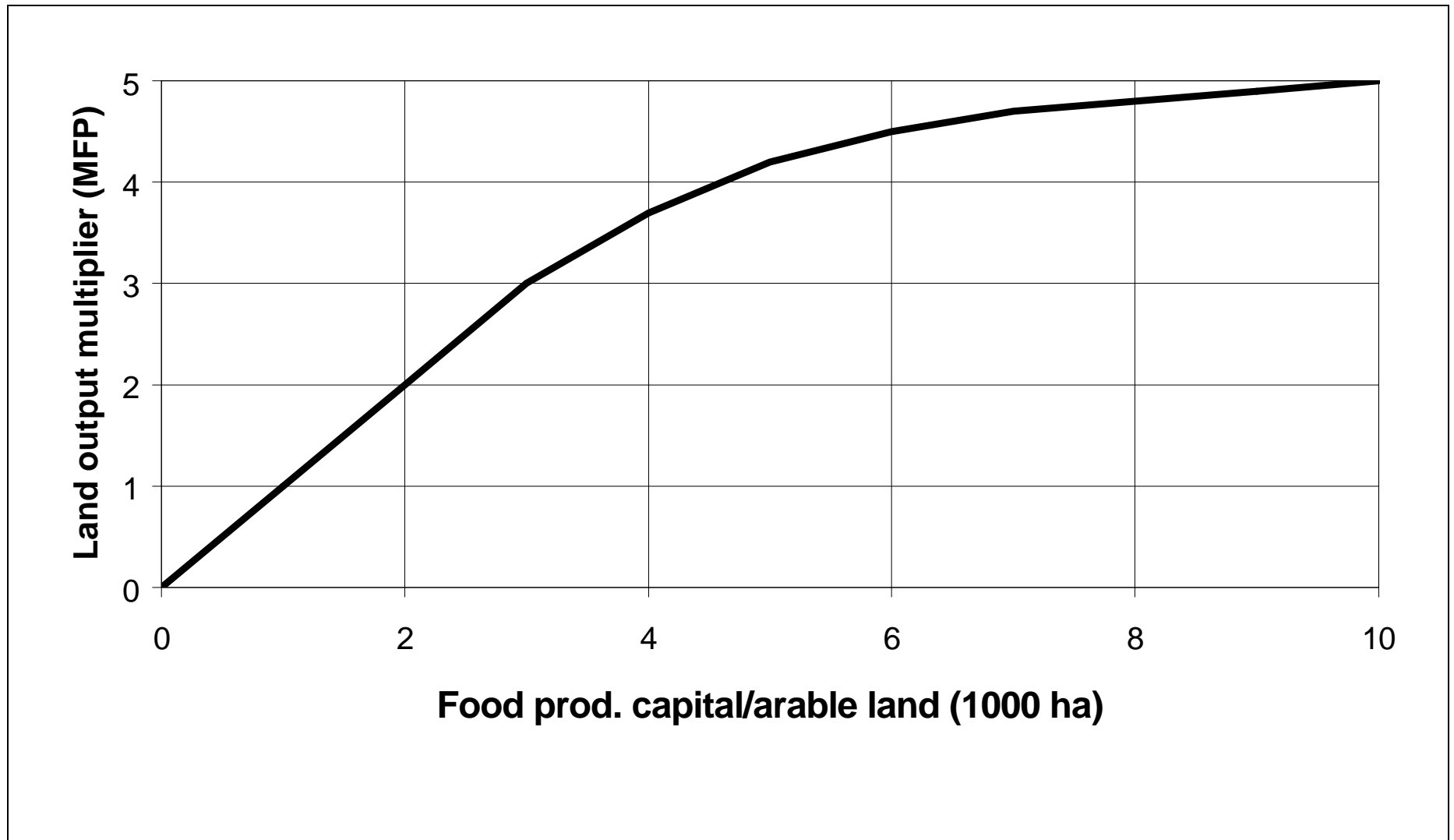
Figure 8:   Multiplier on food production as a function of the active food production capital per unit of area (MFP)
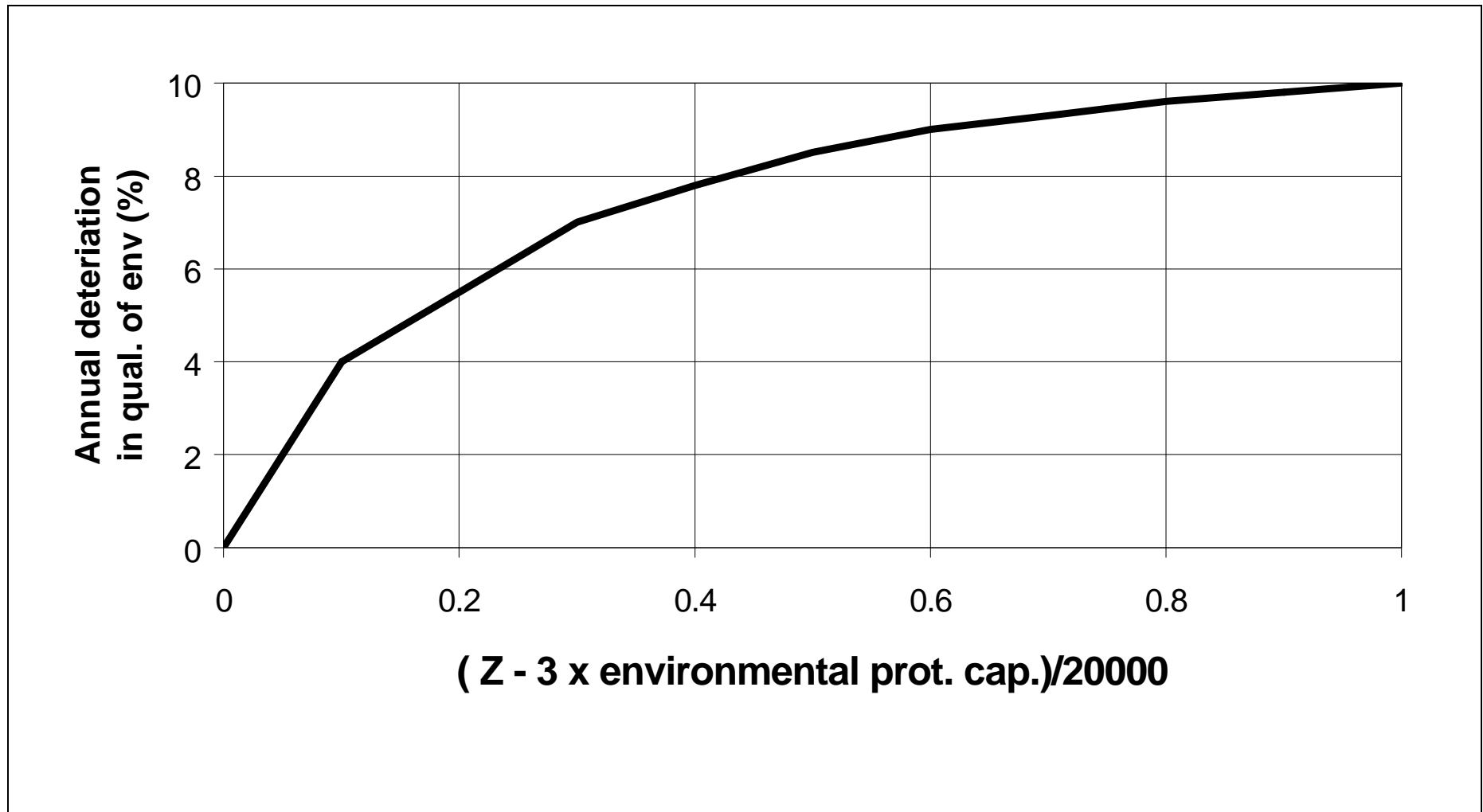
Figure 9:   Annual percentage of environmental degradation as a function of the sum of differences of active production capital (Z) and environmental protection capital, scaled to 20.000. Z = AFC + AGC + EC

Figure 10: Annual percentage of environmental regeneration capacity as a function of the quality of the environment
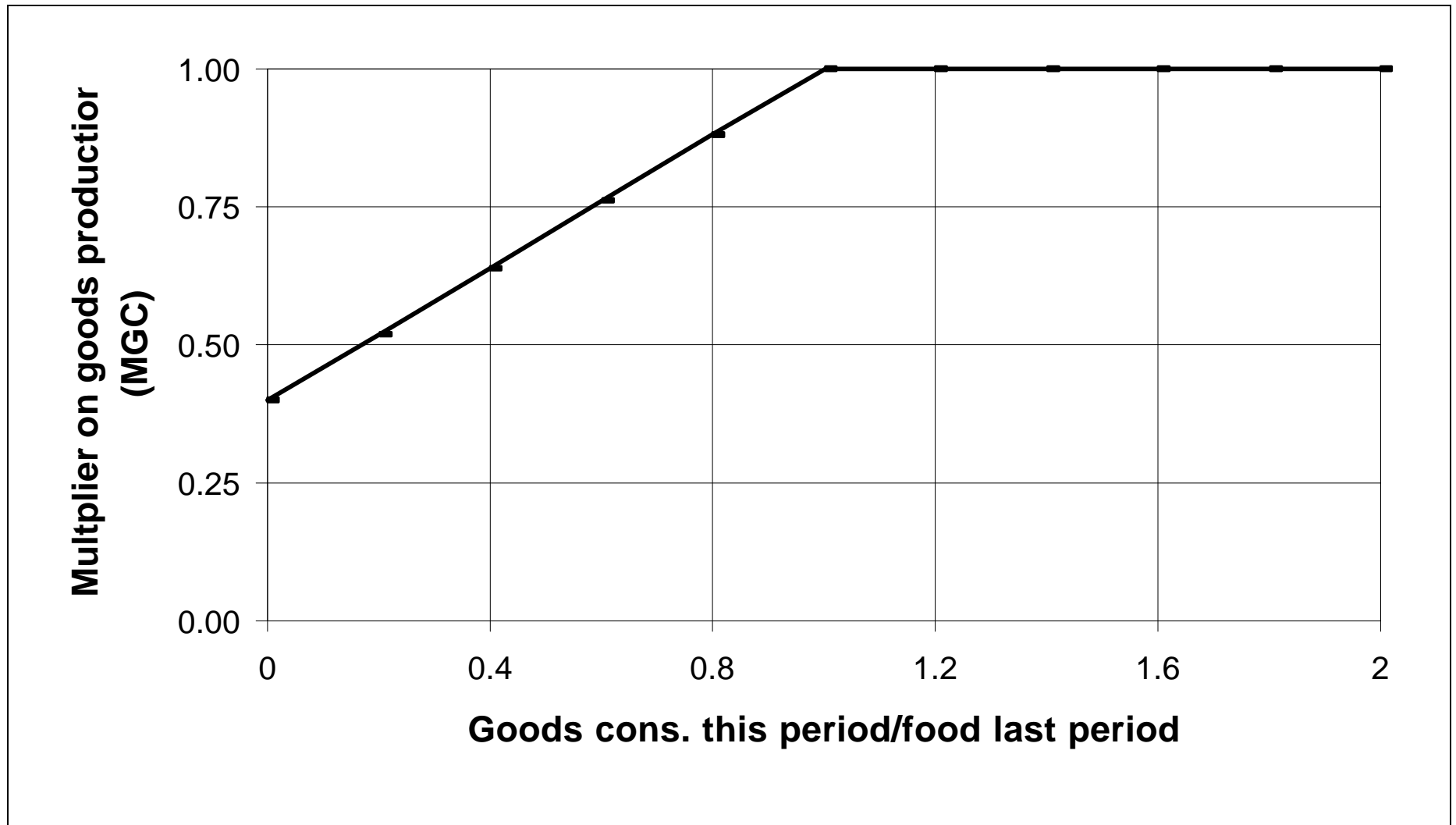
Figure 11: Multiplier on goods production as a function of the ratio of goods consumption this cycle to the consumption last cycle (MGC)

Figure 12: Multiplier on goods production as a function of the active goods production capital per labourer (MGP)
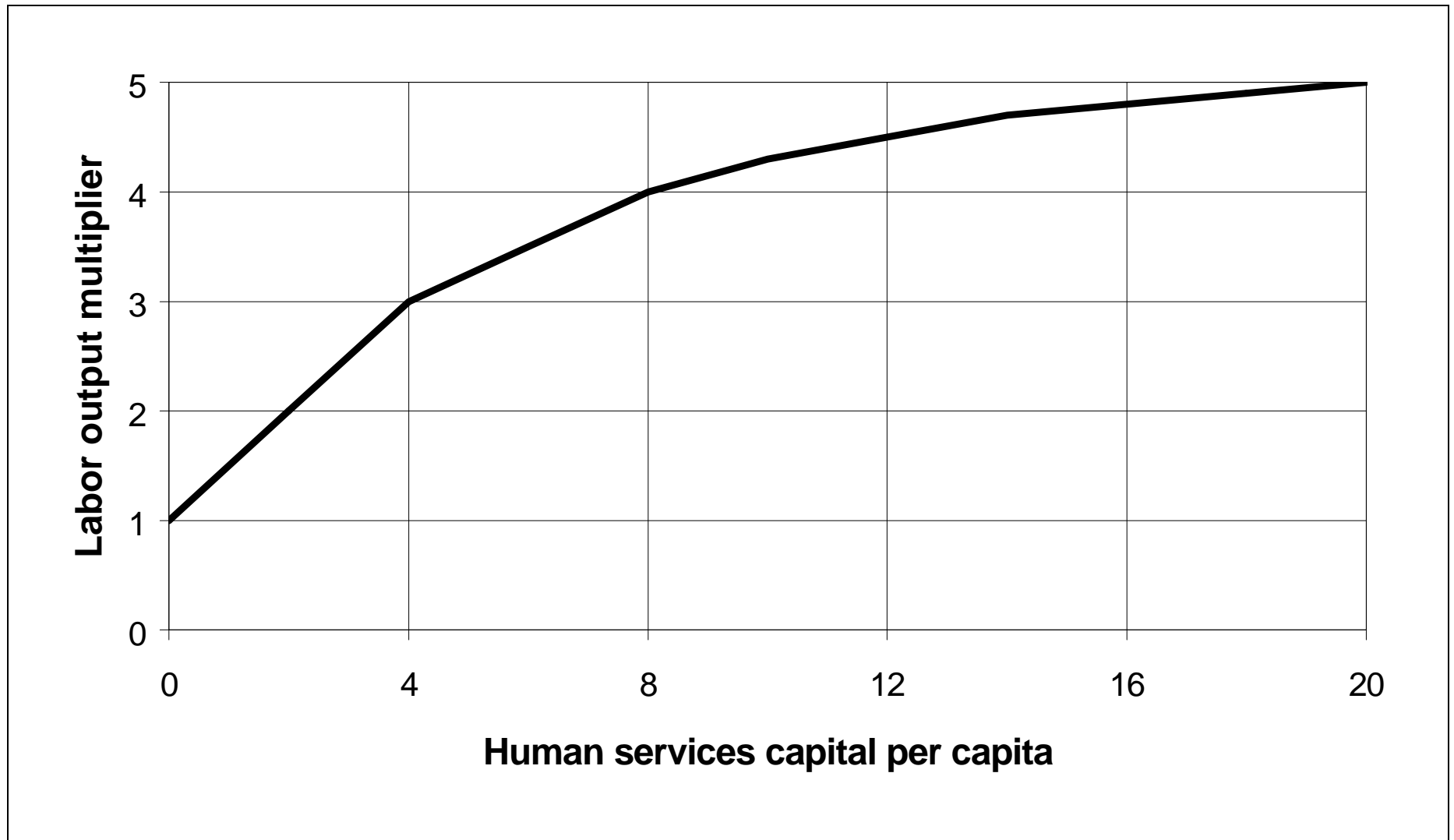
Figure 13:   Multiplier on goods production as a function of the ratio of human services capital per capita (MHS)
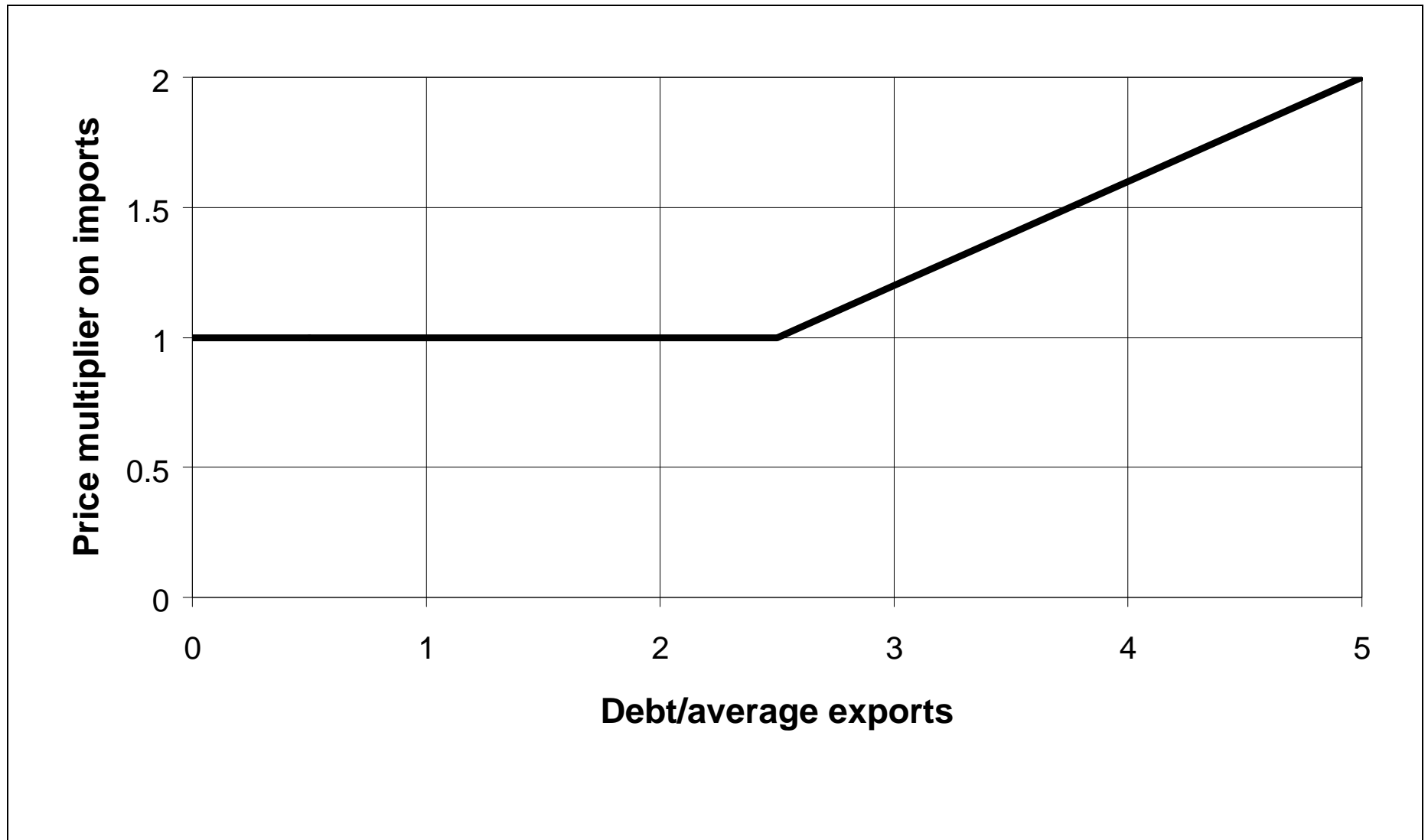
Figure 14: Multiplier on import prices as a function of the ratio of debt to the average exports
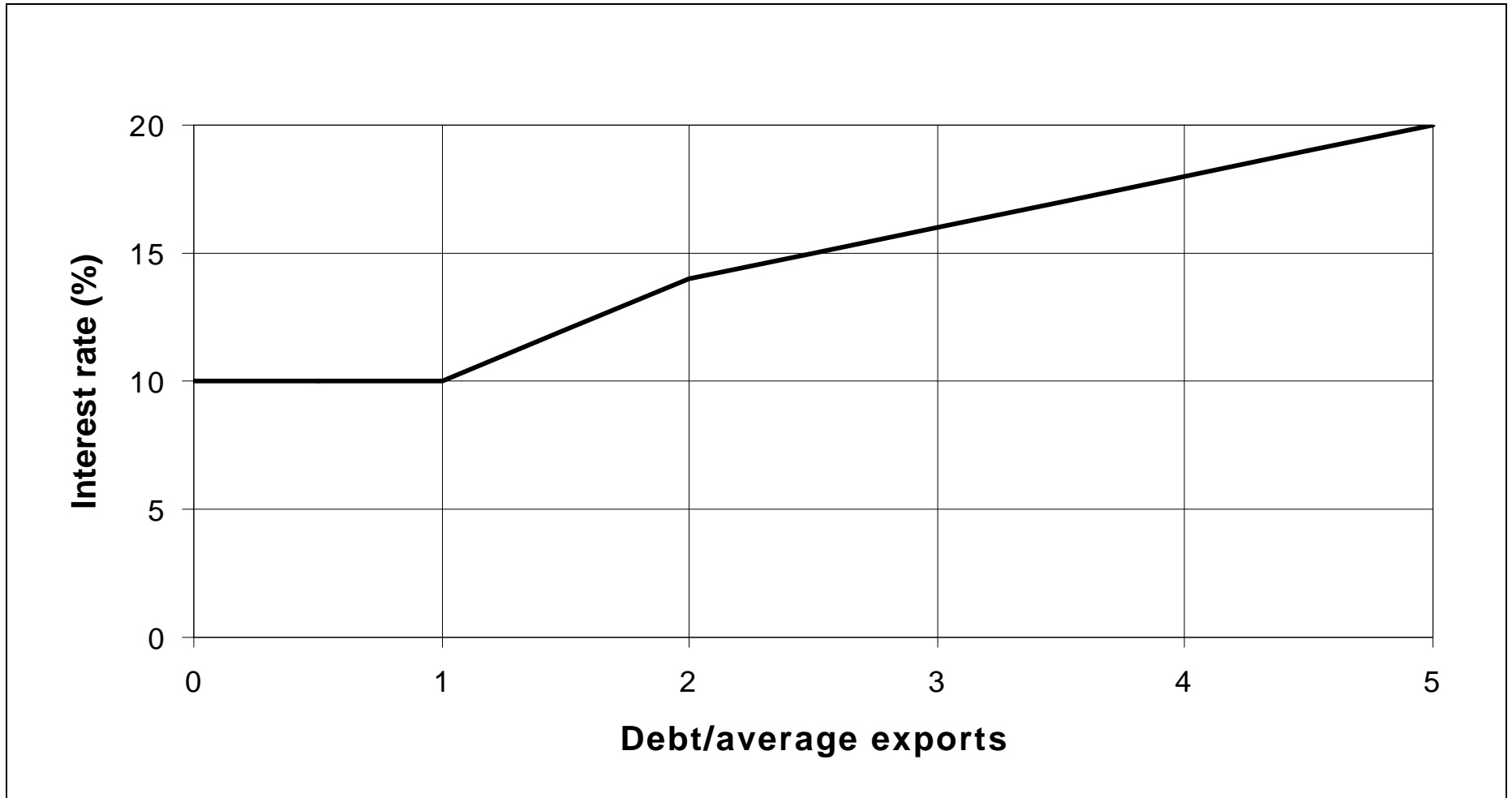
Figure 15: Interest rate as a function of the ratio of debt to the average export

APPENDIX E: BRIEFING SHEETS IN DUTCH LANGUAGE

STRATAGEM

Een management training game over de interactie
energie - milieu - bevolking - welvaart

- **1985: ontwikkeld uit het WORLD-3 model door prof. dr. Dennis Meadows**

- **1987, 1995, 2000: omgezet in PASCAL en Delphi, herzien en aangepast door het Centrum voor Energie en Milieukunde (IVEM) van de Rijksuniversiteit Groningen**

WORLD-3 vs STRATAGEM

WORLD-3:

- **Model van de wereldeconomie**

- **Complex model met veel variabelen**

- **Trend-extrapolatie:**   **- hulpbronnen**

                                      - economie

                                      - sociale dynamiek

- **Periode van 200 jaar**

STRATAGEM:

- **Model van een ontwikkelingsland**

- **Vereenvoudigd model met 16 variabelen**

- **Interactief**   **- terugkoppelingen**

                             - sociale dynamiek

- **periode van 60 jaar: 2 generaties**

kenmerken van STRATAGEM

- **geleid door een spelleider, verrassingsvrij, werkend met los van andere opererende teams, computer ondersteund, complex wisselwerkingen, interactief functioneren, simulatie spel**

- **simulatie spel *versus* spel met vaste rollen**

- **interactief van karakter *versus* wekker-achtige spelen**

(vervolg) kenmerken van STRATAGEM

- **complexe wisselwerkingen *versus* eenvoudige modellering**

- **boekhouding door de computer *versus* spelen tegen een computer (die de omgeving en/of mededingers simuleert) *of* computerondersteund leren**

- **het spel wordt gespeeld in teams bestaande uit 5-10 deelnemers die moeten besluiten over strategie en tactiek *versus* individuele oefeningen**

(vervolg) kenmerken van STRATAGEM

- **de teams functioneren onafhankelijk van elkaar *versus* een spel waarin landen onderling zijn verbonden**

- **de teams ontmoeten geen verrassingen gedurende het spel *versus* het optreden van verrassingen via toevalprocessen of afhankelijk van de geleverde prestaties**

- **de spelleider treedt op als adviseur *versus* de spelleider als deelnemer of als manager**

UITGANGSSITUATIE

- **Snelgroeiende bevolking**

- **Weinig voedsel, dus een hoog sterftecijfer**

- **Weinig goederen per hoofd van de bevolking**

- **Energietekorten**

- **Slechte milieukwaliteit**

- **Weinig sociale & milieuvoorzieningen**

- **Relatief hoge buitenlandse schuld**

DOEL STRATAGEM

**REALISEER een snelle transitie van een
ontwikkelingsland naar een samenleving
zonder netto bevolkingsaanwas, met een
hoge welvaart en een goed milieu, en**

**DOE dat zonder veel verspilling van grond-
stoffen**

**KORTOM: ontwerp in de praktijk een voorbeeld
van een duurzame ontwikkeling**

LEERDOELEN

- **systeemdynamica: actoren, rollen, verbanden, grenzen, omgeving**

- **voorraden en stromen**

- **vertragingen van verschillende duur**

- **exponentiële groei/krimp, terugkoppeling**

- **uitputting, afnemende meeropbrengsten, absolute en relatieve schaarste, afschrijving**

- **aantasting en herstel door regeneratie-processen**

(vervolg) LEERDOELEN

- **directe en indirecte gevolgen**

- **snelle en vertraagde reacties**

- **doorvoeren van kortetermijntactieken**

- **samenhang in langetermijnstrategie**

- **duurzaamheid en kwaliteit van leven**

- **groepsdynamica**

HOE WERKT STRATAGEM?

VIJF ROLLEN (MINISTERS) PER TEAM:

- **sociale zaken**

- **energievoorziening**

- **voedsel en milieu**

- **goederen en infrastructuur**

- **financiën en handel**

SIMULATIEPERIODE: 12 planperioden van 5 jaar, d.w.z. twee generaties

per cyclus moeten de negen stappen van het spelbord worden afgewerkt

(vervolg) HOE WERKT STRATAGEM?

SPEELSCHEMA STRATAGEM

PERIODE	PERIODE	PERIODE
Invoer Uitvoer	Invoer Uitvoer	Invoer Uitvoer

BESLISSINGEN   BESLISSINGEN
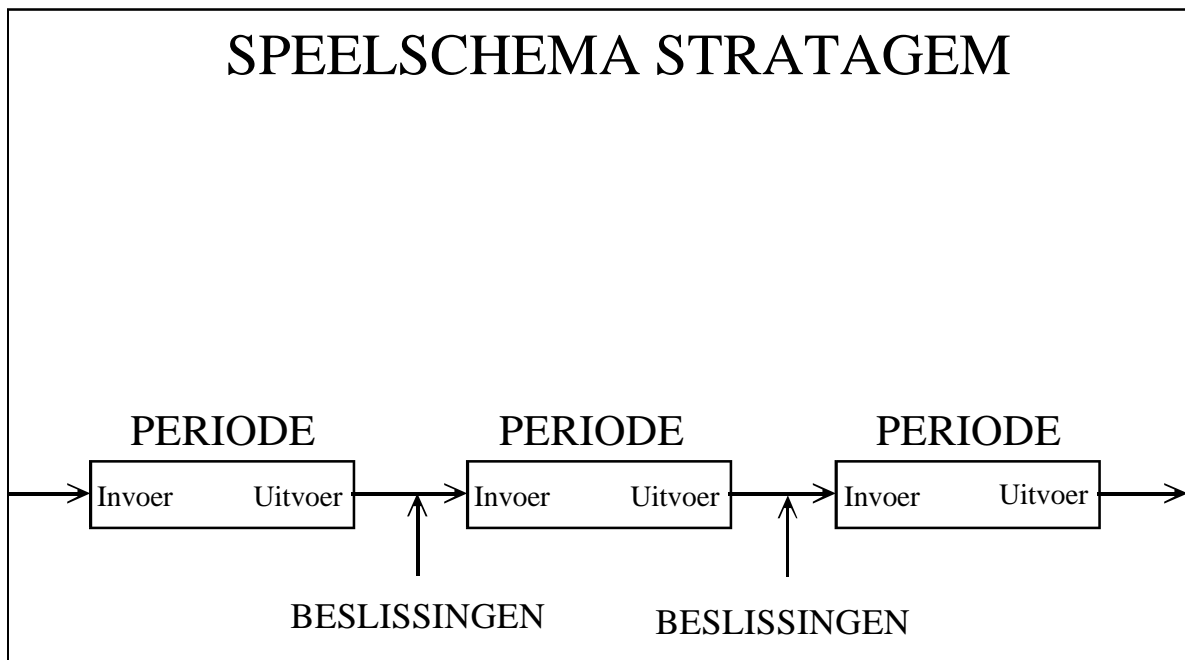
EENVOUDIGE MODELLERING

VOEDSEL:

Graansilo wordt gevuld aan het einde van de vorige periode met opbrengst van de voedsel-productie;

inhoud wordt verdeeld over bevolking en export.

GOEDEREN:

Magazijn met goederen wordt gevuld in vorige periode met opbrengst van de goederen-productie;

inhoud wordt verdeeld over bevolking, export en investeringen.

ENERGIE:

Stuwmeren met water worden gevuld in vorige periode;

opgewekte elektriciteit wordt verdeeld over huishoudens, voedsel- en goederenindustrie en export, of een deel van het water wordt bewaard.

FINANCIEN EN HANDEL

Export

Ontwikkelingshulp

Beschikbaar → **Bestellen**

Import → **Levering**

Aflossing　　**Rente**

Oude schuld ——→ **Nieuwe schuld**
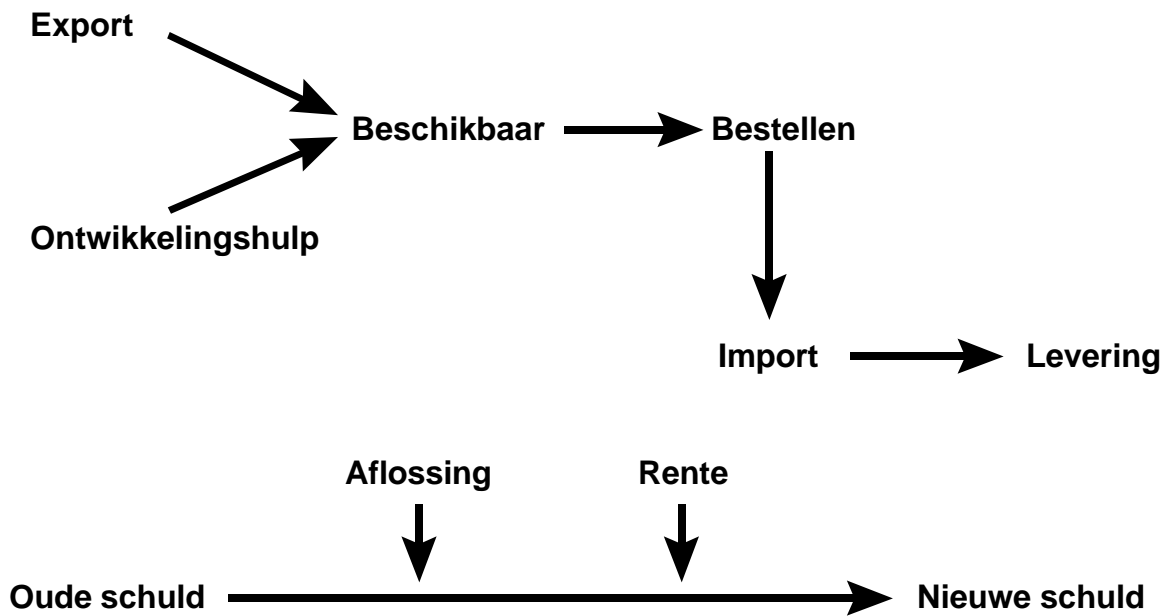
VERWACHTE PRODUCTIE

verwachte v.prod. = const. * MFC * MFP * QE

2500	6250	1	0.80	0.50
(bereik)		(0.4-1)	(0-5)	(0-1)

verw.g.prod. = const. * LF * MGC * MGP * MHS

3030	5.775	50	1	5.00	2.1
(bereik)			(0.4-1)	(0-20)	(0-5)

AFSCHRIJVING

ACTIVE CAPITAL (werkend kapitaal) = productief in deze periode

DEPRECIATED CAPITAL (af te schrijven kapitaal)= dat deel van het actieve kapitaal dat zal worden afgeschreven aan het einde van deze periode

CAPITAL UNDER CONSTRUCTION (kapitaal in aanbouw) = kapitaal dat in aanbouw blijft gedurende deze periode, en dat actief kapitaal zal worden in de volgende periode

DUS:

CAPITAL ACTIVE IN THE NEXT CYCLE (kapitaal werkzaam in de volgende periode) = kapitaal in aanbouw in deze periode + kapitaal dat reeds actief is in deze periode - kapitaal dat wordt afgeschreven aan het einde van deze periode

DEMOGRAFISCHE TRANSITIE
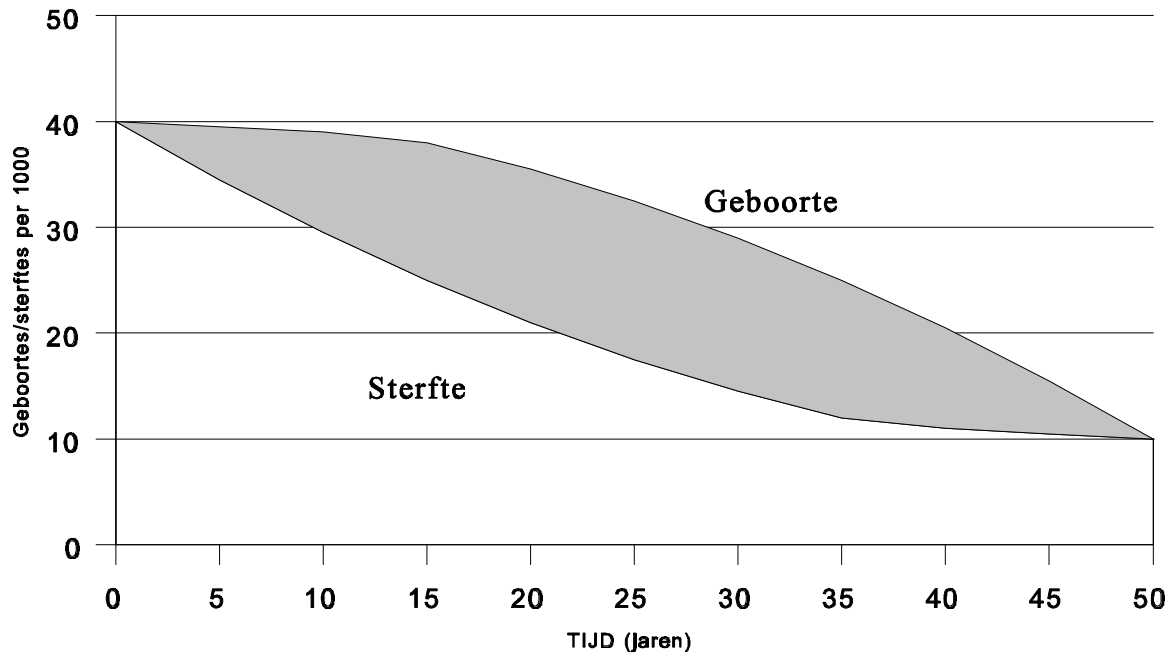
APPENDIX F DUTCH VERSION OF THE ROLE DESCRIPTIONS

Aan elk van de vijf verschillende rolbeschrijvingen dient, als ze gekopieerd worden voor de deelnemers, het stuk 'De werkelijkheid achter de aanvangssituatie bij het spelen van STRATAGEM' te worden toegevoegd.

BEVOLKING EN HUISHOUDELIJKE CONSUMPTIE

Doel

Je doel is, een stabiele populatie te bereiken met een hoge materiële en voedingsstandaard en met een goed ontwikkelde dienstensector.

Startwaarden

- De bevolking telt 200 personen.
- De voedingsstandaard is middelmatig - 2 voedseleenheden per persoon per jaar (= 10 eenheden per persoon per spelronde!). Het hoogst haalbare in dit spel is 5 voedseleenheden per jaar.
- De materiële standaard is laag - 2 goedereneenheden per persoon per jaar, terwijl het maximum hier 15 eenheden per persoon per jaar is.
- Ook de dienstensector (gezondheidszorg en onderwijs) is niet goed ontwikkeld. De standaard is nu 2,25 eenheden; dat zou kunnen stijgen tot max. 20.
- Als gevolg hiervan is het geboorte-sterftecijfer in het land erg hoog; 41 per duizend mensen per jaar. Het sterftecijfer is betrekkelijk laag; 18 of 22 per duizend per jaar (twee verschillende startwaarden mogelijk).
- Hoewel de bevolking niet heel goed gevoed is, wordt niet alles wat geproduceerd wordt, ook geconsumeerd. Het extra voedsel werd tot nu toe geëxporteerd om de energie-import te kunnen betalen. In de vorige spelronde werden 1000 voedseleenheden geëxporteerd.
- Ook goederen kunnen geëxporteerd worden. Tot nu toe heb je dat nog niet gedaan. Alle goederen die niet door de bevolking zijn gebruikt, zijn binnen het land geïnvesteerd. Je grootste probleem is om voldoende consumptiegoederen toe te wijzen, zodat de materiële standaard genoeg stijgt om het geboortecijfer terug te kunnen dringen (zonder op het zelfde moment de investeringen te verminderen, waardoor de economische groei zou stagneren).

Algemene informatie over het land

Bevolking en huishoudelijke consumptie

De bevolking in je land is niet groot; slechts 200 mensen. De voedingsstandaard is middelmatig (2 op een schaal van 0-5), zodat het sterftecijfer niet al te hoog is (18 per 1000/jaar). De materiële levensstandaard is echter laag (2 op een schaal van 0-15), zodat het geboorte-sterftecijfer hoog is (41 per 1000 mensen per jaar). De totale bevolkingsgroei is hierdoor 2,3% per jaar: de periode waarin de bevolking zich verdubbelt is dus ongeveer 30 jaar (slechts zes spelrondes!).

Je produceert genoeg om de voedingsstandaard fors te kunnen verhogen, maar op dit moment exporteer je voedsel om de import van energie te kunnen betalen.

Energie

Je hebt nog niets geïnvesteerd in energie-efficiency. Elke eenheid voedsel- of goederenkapitaal gebruikt nu drie maal zo veel energie als bij een maximale investering in energie-efficiency. In de laatste ronde was een deel van de beschikbare energie - totaal ongeveer 15000 eenheden - afkomstig uit import. Toch heb je nog niet genoeg energie om je gehele voedings- en goederenkapitaal in te zetten.

Je bronnen voor huishoudelijke energie zijn stromingsbronnen: ze worden niet uitgeput. In de eerste spelrondes zal je rendement op investering in energieproductie hoog zijn. Later wordt dit minder. Deze vermindering wordt zo ernstig dat het onmogelijk kan worden om alle energie voor binnenlands gebruik zelf te produceren.

Je kunt ook te veel energie produceren. Deze energie kan geëxporteerd worden, om zo geld te verdienen om goederen of voedsel te kunnen importeren. Het kan echter ook opgeslagen worden - in het TOTAL AVAILABLE ENERGY-vak - om in volgende spelrondes gebruikt te worden.

Het is belangrijk om in de gaten te houden dat de energiesector een cruciale rol in het spel speelt. De sector vraagt veel kapitaal, heeft invloed op het milieu, en is vaak verantwoordelijk voor energietekorten waardoor kapitaal in de goederen- en voedselsector onbenut blijft.

Er zijn vijf manieren om energietekorten terug te dringen.

1. Je kunt investeren in kapitaal voor energieproductie. De energie-opbrengst wordt hierdoor echter pas hoger na twee spelrondes.
2. Je kunt geld gebruiken om energie te importeren. Dit levert meer energie in de volgende ronde, maar kan erg duur zijn.
3. Je kunt kapitaal investeren in energie-efficiency. Dit vermindert de benodigde hoeveelheid energie al in de volgende ronde.
4. Je kunt investeringskapitaal verplaatsen van de energie-consumerende productiesector (voedsel- en goederenproductie) naar de dienstensector of naar milieubescherming. Deze sectoren gebruiken geen energie.
5. Tenslotte kun je minder energie aan de bevolking toewijzen door de productie van goederen, bestemd voor de bevolking, te verminderen. Dit is een zwakke strategie, omdat de energiebehoefte van de bevolking al laag is in de eerste paar rondes. Het is echter de enige maatregel die in de zelfde spelronde al resultaat geeft.

Voedselproductie en milieubescherming

Alhoewel je in het begin van het spel voedsel exporteert, werkt je landbouwsector veel minder productief dan zou kunnen. Je hebt het milieu ernstig laten vervuilen en je hebt weinig in de voedselproductie geïnvesteerd. Milieudegradatie vermindert tegenwoordig fors de voedselopbrengst, terwijl door maximale investeringen die opbrengst zou kunnen verzesvoudigen.

Goederenproductie en dienstensector

In de goederensector zou aanzienlijk meer geproduceerd kunnen worden. De arbeidsproductiviteit is slechts een negende van wat bereikt kan worden door maximale investeringen in productiemiddelen en sociale voorzieningen.

Handel

In de startgegevens op het uitvoerformulier staat of je wel of niet begint met een schuld van 1000 eenheden. Als je geen schuld hebt, kun je geld lenen tegen een rente van 10% per jaar.
Je verdient 1 geldeenheid aan elke geëxporteerde eenheid energie, voedsel of goederen; je betaalt 1,1 geldeenheid voor elke geïmporteerde eenheid voedsel of goederen. Het is dus geen goede strategie om bv. goederen te exporteren, en dat geld te gebruiken om goederen te importeren. Je verliest daarbij 10%, en bovendien het gebruik van het bedoelde goed tijdens één spelronde.
Voor elke eenheid geïmporteerde energie betaal je 1 geldeenheid.
Als je schuld te hoog wordt ten opzichte van de gemiddelde export, kunnen ongunstiger handels-voorwaarden voor je land worden ingesteld. Als dat gebeurt, zal de import duurder worden en zal de rente op schulden stijgen. Verder kan tijdens het spel de energieprijs tijdelijk worden verhoogd door een OPEC-actie (bepaald door de spelleider).

Beslissingen

1 Verdeel de totaal beschikbare hoeveelheid voeding tussen:
   - voeding voor de bevolking, en
   - voeding voor de export.
2 Verdeel de totaal beschikbare hoeveelheid goederen tussen:
   - goederen voor de bevolking,
   - goederen voor de export, en
   - goederen voor investeringen.
   (de getallen verwijzen naar de cijfers op het spelbord)

   Je beslissingen hebben indirect invloed op:
   - de geboorte- en sterftecijfers, dus op de bevolkingsgrootte, en dus op de hoeveelheid beschikbare arbeid,
   - de hoeveelheid benodigde energie voor de bevolking, en dus op de beschikbare energie voor de landbouw- en goederensector,
   - inkomsten uit export, en
   - de benodigde import.

Belangrijke oorzaak-gevolgrelaties

Geboortecijfer

Het normale geboortecijfer hangt af van de gemiddelde goederenconsumptie per jaar; dat is het gemiddelde van het aantal werkelijk beschikbare goederen per persoon over de laatste drie spelrondes (de startwaarde is 2 op een schaal van 0-15). Het normale geboortecijfer kan variëren van 10 tot 30 per duizend mensen per jaar. Deze functie wordt getoond in figuur 1. De huidige waarde is te vinden in het uitvoerformulier.

Afb. 1: *Standaard geboortecijfer*
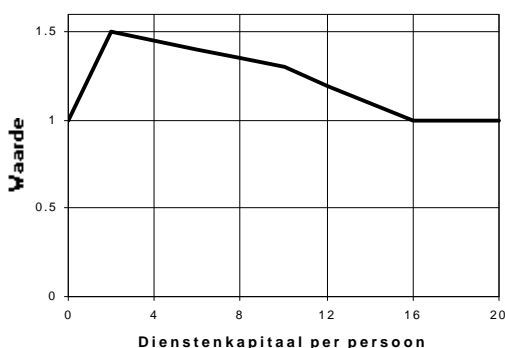
Afb. 2: *Standaard sterfte cijfer als functie van de voedselconsumptie per persoon per jaar*

Het werkelijke aantal geboortes is het product van het normale geboortecijfer en een geboortefactor. Deze factor zegt iets over het niveau van gezondheidszorg en onderwijs. De waarde ligt tussen 1 en 1,5, en hangt af van de verhouding tussen het ingezette kapitaal in de dienstensector enerzijds, en de bevolkingsgrootte anderzijds (een getal tussen 0 en 20). Zie hiervoor figuur 2. De huidige waarde is te vinden in het uitvoerformulier.

Sterftecijfer

Het normale sterftecijfer (variërend van 10 tot 60 per duizend mensen per jaar) wordt bepaald door de hoeveelheid voedsel per persoon per jaar (een getal tussen 0 en 5). Deze relatie wordt weergegeven in figuur 3. De huidige waarde is te vinden in het uitvoerformulier.

Afb. 3: *Standaardsterftecijfer als functie van de voedselconsumptie per persoon per jaar*
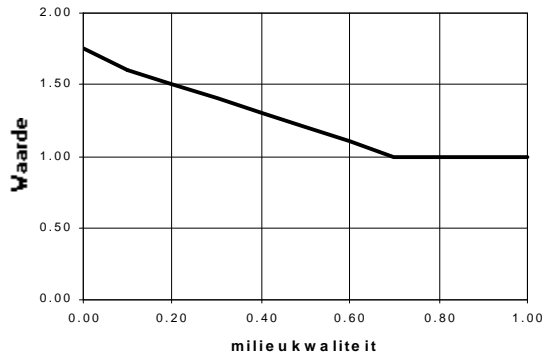
Het werkelijke aantal sterfgevallen is het product van het normale sterftecijfer en de sterftefactor, bepaald door de kwaliteit van het milieu. Deze factor is 1 als alles optima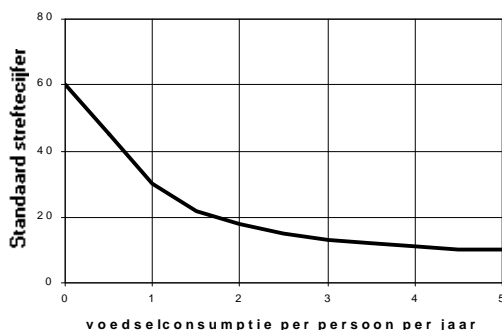al is, en 1,75 onder de slechtst denkbare ecologische omstandigheden. Zie hiervoor figuur 4. De huidige waarde is te vinden in het uitvoerformulier.

Afb. 4: *Sterftefactor als functie van de milieu-kwaliteit*

Denk erom:

- Voor elke eenheid goederen die je aan de bevolking toewijst, moet je collega in de energiesector 0,2 energie-eenheid voor de bevolking reserveren. Deze toewijzing heeft absolute voorrang boven andere toewijzingen van energie aan bijv. transport, export, of om productie in de landbouw- en industriële sector te ondersteunen.
- De toewijzing van voeding en goederen aan het begin van iedere spelronde bepaalt de hoogte van de bevolkingsgroei tijdens die ronde.
- Grote verminderingen van voedsel- en goederenconsumptie per hoofd van de bevolking tussen twee rondes, zal de productie in de desbetreffende sector doen verminderen (door stakingsdagen). De relaties worden getoond in twee figuren die te vinden zijn bij de rolbeschrijvingen voor de voedings- en goederensector (figuren 7 en 11).

Datum :   tijd   :
Land : voorbeeld
Status bij het begin van periode : 0 - 4, jaar : 0

BEVOLKING EN HUISHOUDELIJKE CONSUMPTIE

De bevolkingsgrootte is 200, als gevolg van een groeipercentage van 9.5%.
Dit percentage is gebaseerd op :
een geboortecijfer van   1.49 * 27   => 41 per 1000;
een sterftecijfer van   1.20 * 18   => 22 per 1000.
In de vorige periode ontving iedere persoon per jaar :
Voedsel: 2.00 (bereik: 0-5); Goederen: 2.00 (bereik: 0-15).
Het dienstensectorkapitaal per persoon was: 2.25 (bereik: 0-20).

Beschikbaar in deze periode:
VOEDSEL   : 3000, waarvan   ..... voor consumptie en   ..... voor export;
GOEDEREN : 3500, waarvan   ..... voor consumptie, ... voor export en
                        ..... voor investeringen
                                    (de totale afschrijving was 430).

Denk erom:
   Het laatste deel van het uitvoerformulier vat de per spelronde genomen beslissingen samen. Vul
   dit formulier in nadat jullie team alle beslissingen heeft genomen, en geef het aan de spelleider.

De werkelijkheid achter de aanvangssituatie bij het spelen van STRATAGEM

Het onderstaande bevat een typerend voorbeeld van de werkelijke situatie in een ontwikkelingsland zoals dat is vormgegeven in de startsituatie in Stratagem.

Voedsel:
Drie maal daags een kom rijst en bonen.

Goederen in een individueel huishouden:
Een eenvoudige kachel (gestookt op hout of benzine), soms gemaakt van afvalmetaal; een radio in meer welvarende gezinnen, TV's alleen bij de rijken; maar weinig goederen te koop in winkel, en de kosten van ingevoerde producten zijn zo hoog dat deze buiten bereik van de gemiddelde burger blijven; de meeste mensen lopen, nemen het openbaar vervoer of fietsen; erg weinig privé auto's op de weg.

Diensten:
Weinig scholen, die bovendien slecht zijn uitgerust; jongens worden aangemoedigd om de school te bezoeken, en meisjes worden aangezet om thuis in het huishouden te helpen; er is één ziekenhuis per 250.000 mensen; de meeste mensen bezoeken nooit een tandarts (tanden worden getrokken in plaats van gevuld).

Energiebronnen en beschikbaarheid:
Waterkracht levert elektriciteit in stedelijke gebieden voor bedrijven en overheidsdiensten; er zijn vaak storingen. Men importeert wat olie als motorbrandstof.

Toestand van de voedselproductie:
De productiviteit daalt als gevolg van uitputting van de bodem (roofbouw en geen rotatie van gewassen).

Toestand van het milieu:
Bodemerosie en veelvuldig optreden van modderstromen; geen financiële middelen voor herbebossing of terugwinning van (land)bouwgrond; ernstige problemen met slib, industrieel afval en luchtverontreiniging in woon- en werkgebieden.

Soort industrie:
Basisgoederen industrie in de grote steden, die grote aantallen laagbetaalde werknemers aantrekken (afkomstig van het platteland).

Toestand van 's lands financiën:
Internationale vraag naar voedsel export levert enige financiële stabiliteit, maar de inkomsten uit export moeten worden aangewend voor de aankoop van energie en basisgoederen.

ENERGIEPRODUKTIE EN ENERGIE-EFFICIENCY

Doel

Je belangrijkste doel is, ervoor te zorgen dat er genoeg energie is voor de consumptiegoederen en voor de voedsel- en goederenindustrie. Dit kan je bereiken door te vragen om import van energie, door kapitaal in te zetten voor energieproductie, of door de vraag naar energie terug te brengen door kapitaal in te zetten in energie-efficiency. Een secundair doel kan zijn om energie te exporteren en zodoende middelen te creëren voor de import van voedsel of goederen.
Verspil bij dit alles zo weinig mogelijk grondstoffen.

Startwaarden

Je land heeft tot nu toe niets geïnvesteerd in energie-efficiency. Het energiegebruik per eenheid kapitaal voor voedsel of goederen is dus hoog, meer dan drie maal zo veel als na de maximale investering in energie-efficiency.
De binnenlandse energievoorziening is niet voldoende om aan de energiebehoefte te voldoen. In de laatste spelronde werd energie geïmporteerd; dat deed een belangrijke aanslag op de opbrengsten uit export. Desondanks heb je in de nieuwe ronde nog steeds niet voldoende energie tot je beschikking om al het beschikbare voedings- en goederenkapitaal te exploiteren.

Algemene informatie over het land

Bevolking en huishoudelijke consumptie

De bevolking in je land is niet groot; slechts 200 mensen. De voedingsstandaard is middelmatig (2 op een schaal van 0-5), zodat het sterftecijfer niet al te hoog is (18 per 1000/jaar). De materiële levensstandaard is echter laag (2 op een schaal van 0-15), zodat het geboorte-sterftecijfer hoog is (41 per 1000 mensen per jaar). De totale bevolkingsgroei is hierdoor 2,3% per jaar: de periode waarin de bevolking zich verdubbelt is dus ongeveer 30 jaar (slechts zes spelrondes!).

Je produceert genoeg om de voedingsstandaard fors te kunnen verhogen, maar op dit moment exporteer je voedsel om de import van energie te kunnen betalen.

Energie

Je hebt nog niets geïnvesteerd in energie-efficiency. Elke eenheid voedsel- of goederenkapitaal gebruikt nu drie maal zo veel energie als bij een maximale investering in energie-efficiency. In de laatste ronde was een deel van de beschikbare energie - totaal ongeveer 15000 eenheden - afkomstig uit import. Toch heb je nog niet genoeg energie om je gehele voedings- en goederenkapitaal in te zetten.

Je bronnen voor huishoudelijke energie zijn stromingsbronnen: ze worden niet uitgeput. In de eerste spelrondes zal je rendement op investering in energieproductie hoog zijn. Later wordt dit minder. Deze vermindering wordt zo ernstig dat het onmogelijk kan worden om alle energie voor binnenlands gebruik zelf te produceren.

Je kunt ook te veel energie produceren. Deze energie kan geëxporteerd worden, om zo geld te verdienen om goederen of voedsel te kunnen importeren. Het kan echter ook opgeslagen worden - in het TOTAL AVAILABLE ENERGY-vak - om in volgende spelrondes gebruikt te worden.

Het is belangrijk om in de gaten te houden dat de energiesector een cruciale rol in het spel speelt. De sector vraagt veel kapitaal, heeft invloed op het milieu, en is vaak verantwoordelijk voor energietekorten waardoor kapitaal in de goederen- en voedselsector onbenut blijft.

Er zijn vijf manieren om energietekorten terug te dringen.

1. Je kunt investeren in kapitaal voor energieproductie. De energie-opbrengst wordt hierdoor echter pas hoger na twee spelrondes.
2. Je kunt geld gebruiken om energie te importeren. Dit levert meer energie in de volgende ronde, maar kan erg duur zijn.
3. Je kunt kapitaal investeren in energie-efficiency. Dit vermindert de benodigde hoeveelheid energie al in de volgende ronde.
4. Je kunt investeringskapitaal verplaatsen van de energie-consumerende productiesector (voedsel- en goederenproductie) naar de dienstensector of naar milieubescherming. Deze sectoren gebruiken geen energie.
5. Tenslotte kun je minder energie aan de bevolking toewijzen door de productie van goederen, bestemd voor de bevolking, te verminderen. Dit is een zwakke strategie, omdat de energiebehoefte van de bevolking al laag is in de eerste paar rondes. Het is echter de enige maatregel die in de zelfde spelronde al resultaat geeft.

Voedselproductie en milieubescherming

Alhoewel je in het begin van het spel voedsel exporteert, werkt je landbouwsector veel minder productief dan zou kunnen. Je hebt het milieu ernstig laten vervuilen en je hebt weinig in de voedselproductie geïnvesteerd. Milieudegradatie vermindert tegenwoordig fors de voedsel-opbrengst, terwijl door maximale investeringen die opbrengst zou kunnen verzesvoudigen.

Goederenproductie en dienstensector

In de goederensector zou aanzienlijk hoger geproduceerd kunnen worden. De arbeids-productiviteit is slechts een negende van wat bereikt kan worden door maximale investeringen in productiemiddelen en sociale voorzieningen.

Handel

In de startgegevens op het uitvoerformulier staat of je wel of niet begint met een schuld van 1000 eenheden. Als je geen schuld hebt, kun je geld lenen tegen een rente van 10% per jaar.

Je verdient 1 geldeenheid aan elke geëxporteerde eenheid energie, voedsel of goederen; je betaalt 1,1 geldeenheid voor elke geïmporteerde eenheid voedsel of goederen. Het is dus geen goede strategie om bv. goederen te exporteren, en dat geld te gebruiken om goederen te importeren. Je verliest daarbij 10%, en bovendien het gebruik van het bedoelde goed tijdens één spelronde.

Voor elke eenheid geïmporteerde energie betaal je 1 geldeenheid.

Als je schuld te hoog wordt ten opzichte van de gemiddelde export, kunnen ongunstiger handels-voorwaarden voor je land worden ingesteld. Als dat gebeurt, zal de import duurder worden en zal de rente op schulden stijgen. Verder kan tijdens het spel de energieprijs tijdelijk worden verhoogd door een OPEC-actie (bepaald door de spelleider).

Beslissingen

3   Verdeel de totale hoeveelheid beschikbare energie tussen:
  - energie voor de bevolking (= 1/5 van "Goederen voor de bevolking"),
  - energie voor de export,
  - energiereservering, voor de volgende ronde (carry over), en
  - energie beschikbaar voor productie.

4   Verdeel de totale hoeveelheid beschikbare energie voor productie tussen:
  - energie voor voedselproductie, en
  - energie voor goederenproductie.

5   Verdeel een deel van de goederen beschikbaar voor investeringen tussen:
  - ontwikkeling van energieproductie , en
  - ontwikkeling van energie-efficiency.
 (de getallen verwijzen naar de cijfers op het spelbord)

Je beslissingen hebben indirect invloed op:
  - de benodigde hoeveelheid te importeren energie,
  - de beschikbare goederen voor investering in andere sectoren,
  - de mate van gebruik van de beschikbare capaciteit in industriële sectoren en in de landbouwsector,
  - de beschikbare fondsen voor import en rente-aflossing, en
  - de kwaliteit van het milieu.

Belangrijke oorzaak-gevolgrelaties

Energieproductie

De energieproductie is alleen afhankelijk van de hoeveelheid kapitaal, ingezet in de energiesector. De energiesector is analoog aan waterkracht gemodelleerd; energie is dus een hernieuwbare energiebron. Er treedt geen uitputting op, maar wel een verminderde meeropbrengst van investeringen. Dit wil zeggen dat als je je kapitaal voor energieproductie op een constant niveau houdt, dit ieder jaar dezelfde hoeveelheid energie zal opleveren (er tenminste voor zorgend dat de investeringen in iedere spelronde de afschrijving neutraliseren). Echter, een verhoging van de ingezette hoeveelheid kapitaal levert een steeds kleinere verhoging van de hoeveelheid energie op (in je uitvoerformulier wordt dit zichtbaar gemaakt in een kleiner wordende energie-opbrengst per eenheid ingezet kapitaal). De relatie tussen energiekapitaal en energieproductie wordt getoond in figuur 5. Deze laat twee curves zien. Welke van toepassing is, wordt vermeld op het eerste uitvoerformulier.
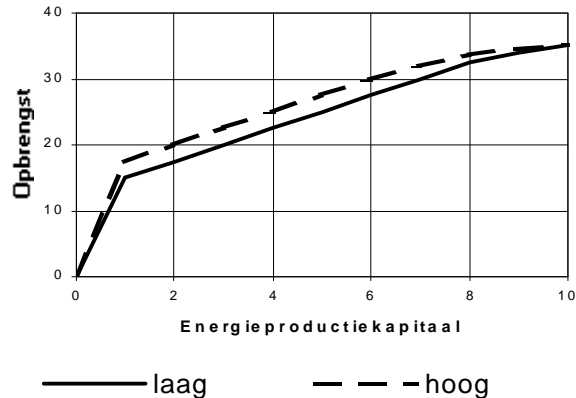
Afb. 5: Energieproductie per periode (in eenheden van 1000) als functie van productiekapitaal (in eenheden van 1000)

Denk erom:

- In elke spelronde krijgt de bevolking 1 energie-eenheid toegewezen voor iedere 5 goedereneenheden die ze in die ronde ontvangen. Dit is al in het programma vastgelegd; Energie voor de Bevolking (Energy for Population) is dus geen onafhankelijke invoerbeslissing.
- De levensduur van energieproductiekapitaal en van energie-efficiencykapitaal is 25 jaar. Dit betekent dat aan het einde van iedere spelronde, nadat de productie voor die spelronde is uitgerekend, een-vijfde wordt afgeschreven.
- Als je een energie-overschot hebt kun je dat exporteren tegen een prijs van één geldeenheid voor één energie-eenheid. Een andere mogelijkheid is, het op te slaan in het TOTAL ENERGY AVAILABLE-vak, om het te bewaren voor een volgende ronde (carry over). De totaal beschikbare energie aan het begin van elke ronde is dus de som van de productie van de laatste ronde plus de import plus de energievoorraad.
- Geld, bestemd voor de import van energie in één spelronde zorgt niet voor het terugdringen van een energietekort in die zelfde ronde. Met dit geld geïmporteerde energie komt aan het begin van de volgende spelronde (dus de volgende vijf-jarencyclus) beschikbaar, en is dan onderdeel van de totaal beschikbare energie.
- Je toewijzing van energie aan voedsel- en goederenproductie bepaalt de Capaciteits-gebruiksfactor (CU) van de respectievelijke kapitaalvoorraden. Gebruik van Capaciteit is gedefinieerd als:

- $$CU = \frac{\text{toegewezen energie}}{\text{benodigde energie voor volledig capaciteitsgebruik}}$$

Aan deze variabele wordt gerefereerd als resp. CUF (inv. in voedsel) en CUG (inv. in

goederen). De waarde kan variëren van 0 tot 1,1. Het heeft geen zin om beide sectoren van meer dan 110% van de benodigde energie te voorzien; het meerdere wordt verspild. Merk op dat je door 10% meer energie toe te wijzen dan nodig voor gebruik van het volledige productiekapitaal, je je effectieve kapitaalvoorraad met 10% verhoogt.

- Investeringen in energie-efficiency kunnen alleen worden gedaan met **nieuw** productiekapitaal; dit beperkt je dus in de mate waarin je in energie-efficiency kan investeren. In elke spelronde is dus de maximaal mogelijke investering in energie-efficiency de som van twee investeringen (geïnvesteerd kapitaal in voedsel- en in goederenproductie) tijdens die zelfde ronde. Dus:

-
> **Investering in energie-efficiency** $\leq$ **Investering in voedselproductie**
> **+ Investering in goederenproductie**

Energie-efficiency

Elke eenheid voedsel- of goederen-productiekapitaal vraagt een hoeveelheid energie die het product is van de energieverbruksfactor en een standaard hoeveelheid energie, nodig voor de productie van een eenheid voedsel- of goederenproductiekapitaal. De waarden voor die standaard hoeveelheid energie per spelronde van vijf jaar zijn: 12,5 energie-eenheden voor één eenheid voedselproductiekapitaal, en 20 energie-eenheden voor één eenheid goederenproductiekapitaal. Investeringen in energie-efficiencykapitaal zullen de energieverbruksfactor verlagen (bereik: 0,3 - 1). Elke eenheid ingezet energie-efficiencykapitaal levert maximale energiebesparing op voor één eenheid productiekapitaal. Deze relatie wordt getoond in Figuur 6.
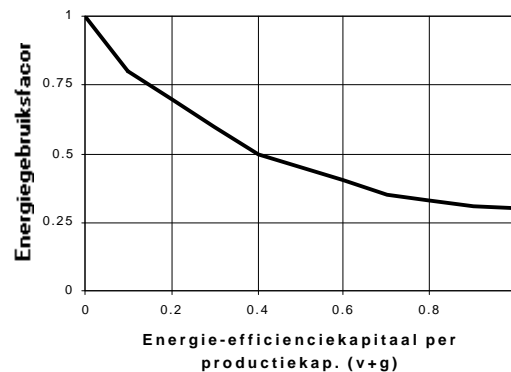
Afb. 6: *Energiegebruiksfactor als functie van opgesteld energie-efficiency kapitaal per eenheid kapitaal in de voedsel- en goederenproductie*

Datum :   tijd   :
Land   : voorbeeld
Status bij het begin van periode : 0 - 4, jaar : 0

ENERGIEPRODUKTIE EN ENERGIE-EFFICIENCY

In de vorige periode werden 12000 energie-eenheden geproduceerd.
De import was 1500; de carry-over bedroeg 1000 eenheden.
Er zijn dus totaal 14500 energie-eenheden beschikbaar.
Deze zullen als volgt worden ingezet:

energie voor de bevolking	(.....)	(400 was in de vorige periode nodig)
voor voedselproductie	....	(10000 is nodig voor 100% cap. gebruik)
voor goederenproductie	....	(6000 is nodig voor 100% cap. gebruik)
export	....	(in de vorige periode was dit 0)
carry-over		
(naar volgende periode)	....	(in de vorige periode was dit 1000)

De gemiddelde energieverbruiksfactor is in deze periode 1.00 (bereik: 0.3-1),
dus voor één periode heb je nodig :
12.5 energie-eenheden voor elke te gebruiken eenheid voedselproductiekapitaal
20.0 energie-eenheden voor elke te gebruiken eenheid goederenproductiekapitaal

In deze periode zullen 12000 energie-eenheden worden geproduceerd door
800 kapitaaleenheden (een gemiddelde van 15.00 energie-eenheden per eenheid
beschikbaar productiekapitaal). Van deze totale hoeveelheid kapitaal zullen
aan het einde van de periode 160 worden afgeschreven, wat het totaal
op 640 brengt, tenzij je opnieuw investeert.

Het energie-efficiencykapitaal is 0. Hiervan zullen aan het einde van
deze periode 0 worden afgeschreven, wat het totaal op 0 brengt,
tenzij je opnieuw investeert.

Je investeringen in kapitaalgoederen voor de volgende periode zijn:
.... eenheden voor energieproductie,
.... eenheden voor energie-efficiency.

Denk erom:
> Het laatste deel van het uitvoerformulier vat de per spelronde genomen beslissingen samen. Vul
> dit formulier in nadat jullie team alle beslissingen heeft genomen, en geef het aan de spelleider.

De werkelijkheid achter de aanvangssituatie bij het spelen van STRATAGEM

Het onderstaande bevat een typerend voorbeeld van de werkelijke situatie in een ontwikkelingsland zoals dat is vormgegeven in de startsituatie in Stratagem.

Voedsel:
Drie maal daags een kom rijst en bonen.

Goederen in een individueel huishouden:
Een eenvoudige kachel (gestookt op hout of benzine), soms gemaakt van afvalmetaal; een radio in meer welvarende gezinnen, TV's alleen bij de rijken; maar weinig goederen te koop in winkel, en de kosten van ingevoerde producten zijn zo hoog dat deze buiten bereik van de gemiddelde burger blijven; de meeste mensen lopen, nemen het openbaar vervoer of fietsen; erg weinig privé auto's op de weg.

Diensten:
Weinig scholen, die bovendien slecht zijn uitgerust; jongens worden aangemoedigd om de school te bezoeken, en meisjes worden aangezet om thuis in het huishouden te helpen; er is één ziekenhuis per 250.000 mensen; de meeste mensen bezoeken nooit een tandarts (tanden worden getrokken in plaats van gevuld).

Energiebronnen en beschikbaarheid:
Waterkracht levert elektriciteit in stedelijke gebieden voor bedrijven en overheidsdiensten; er zijn vaak storingen. Men importeert wat olie als motorbrandstof.

Toestand van de voedselproductie:
De productiviteit daalt als gevolg van uitputting van de bodem (roofbouw en geen rotatie van gewassen).

Toestand van het milieu:
Bodemerosie en veelvuldig optreden van modderstromen; geen financiële middelen voor herbebossing of terugwinning van (land)bouwgrond; ernstige problemen met slib, industrieel afval en luchtverontreiniging in woon- en werkgebieden.

Soort industrie:
Basisgoederen industrie in de grote steden, die grote aantallen laagbetaalde werknemers aantrekken (afkomstig van het platteland).

Toestand van 's lands financiën:
Internationale vraag naar voedsel export levert enige financiële stabiliteit, maar de inkomsten uit export moeten worden aangewend voor de aankoop van energie en basisgoederen.

VOEDSELPRODUKTIE EN MILIEUBESCHERMING

Doel

Je doel is om genoeg voedsel te produceren om de bevolking te voeden en om eventueel te exporteren. Het streven moet zijn dat daarbij de kwaliteit van het milieu op een hoog niveau komt (max. = 0,95).
Verspil bij dit alles zo weinig mogelijk grondstoffen.

Startwaarden

- Je hebt tot nu toe nog niet geïnvesteerd in milieubescherming, zodat de kwaliteit van het milieu drastisch verslechterd is. De huidige waarde is te vinden op het uitvoerformulier. Op deze manier verlies je een belangrijk deel van de capaciteit van je voedselproductiekapitaal. Met andere woorden, de voedselproductie is belangrijk lager dan het zou zijn bij een hoge milieukwaliteit.
- Maar, per saldo ben je een voedselexporteur. Het niveau van de voedselconsumptie is middelmatig, en de bevolking groeit snel. Aangezien de energiesector nog niet heeft geïnvesteerd in energie-efficiency, is de totale energiebehoefte van je sector relatief hoog.

Algemene informatie over het land

Bevolking en huishoudelijke consumptie

De bevolking in je land is niet groot; slechts 200 mensen. De voedingsstandaard is middelmatig (2 op een schaal van 0-5), zodat het sterftecijfer niet al te hoog is (18 per 1000/jaar). De materiële levensstandaard is echter laag (2 op een schaal van 0-15), zodat het geboorte-sterftecijfer hoog is (41 per 1000 mensen per jaar). De totale bevolkingsgroei is hierdoor 2,3% per jaar: de periode waarin de bevolking zich verdubbelt is dus ongeveer 30 jaar (slechts zes spelrondes!).

Je produceert genoeg om de voedingsstandaard fors te kunnen verhogen, maar op dit moment exporteer je voedsel om de import van energie te kunnen betalen.

Energie

Je hebt nog niets geïnvesteerd in energie-efficiency. Elke eenheid voedsel- of goederenkapitaal gebruikt nu drie maal zo veel energie als bij een maximale investering in energie-efficiency. In de laatste ronde was een deel van de beschikbare energie - totaal ongeveer 15000 eenheden - afkomstig uit import. Toch heb je nog niet genoeg energie om je gehele voedings- en goederenkapitaal in te zetten.

Je bronnen voor huishoudelijke energie zijn stromingsbronnen: ze worden niet uitgeput. In de eerste spelrondes zal je rendement op investering in energieproductie hoog zijn. Later wordt dit minder. Deze vermindering wordt zo ernstig dat het onmogelijk kan worden om alle energie voor binnenlands gebruik zelf te produceren.

Je kunt ook te veel energie produceren. Deze energie kan geëxporteerd worden, om zo geld te verdienen om goederen of voedsel te kunnen importeren. Het kan echter ook opgeslagen worden - in het TOTAL AVAILABLE ENERGY-vak - om in volgende spelrondes gebruikt te worden.

Het is belangrijk om in de gaten te houden dat de energiesector een cruciale rol in het spel speelt. De sector vraagt veel kapitaal, heeft invloed op het milieu, en is vaak verantwoordelijk voor energietekorten waardoor kapitaal in de goederen- en voedselsector onbenut blijft.

Er zijn vijf manieren om energietekorten terug te dringen.

1. Je kunt investeren in kapitaal voor energieproductie. De energie-opbrengst wordt hierdoor echter pas hoger na twee spelrondes.
2. Je kunt geld gebruiken om energie te importeren. Dit levert meer energie in de volgende ronde, maar kan erg duur zijn.
3. Je kunt kapitaal investeren in energie-efficiency. Dit vermindert de benodigde hoeveelheid energie al in de volgende ronde.
4. Je kunt investeringskapitaal verplaatsen van de energie-consumerende productiesector (voedsel- en goederenproductie) naar de dienstensector of naar milieubescherming. Deze sectoren gebruiken geen energie.
5. Tenslotte kun je minder energie aan de bevolking toewijzen door de productie van goederen, bestemd voor de bevolking, te verminderen. Dit is een zwakke strategie, omdat de energiebehoefte van de bevolking al laag is in de eerste paar rondes. Het is echter de enige maatregel die in de zelfde spelronde al resultaat geeft.

Voedselproductie en milieubescherming

Alhoewel je in het begin van het spel voedsel exporteert, werkt je landbouwsector veel minder productief dan zou kunnen. Je hebt het milieu ernstig laten vervuilen en je hebt weinig in de voedselproductie geïnvesteerd. Milieudegradatie vermindert tegenwoordig fors de voedsel-opbrengst, terwijl door maximale investeringen die opbrengst zou kunnen verzesvoudigen.

Goederenproductie en dienstensector

In de goederensector zou aanzienlijk hoger geproduceerd kunnen worden. De arbeids-productiviteit is slechts een negende van wat bereikt kan worden door maximale investeringen in productiemiddelen en sociale voorzieningen.

Handel

In de startgegevens op het uitvoerformulier staat of je wel of niet begint met een schuld van 1000 eenheden. Als je geen schuld hebt, kun je geld lenen tegen een rente van 10% per jaar.

Je verdient 1 geldeenheid aan elke geëxporteerde eenheid energie, voedsel of goederen; je betaalt 1,1 geldeenheid voor elke geïmporteerde eenheid voedsel of goederen. Het is dus geen goede strategie om bv. goederen te exporteren, en dat geld te gebruiken om goederen te importeren. Je verliest daarbij 10%, en bovendien het gebruik van het bedoelde goed tijdens één spelronde.

Voor elke eenheid geïmporteerde energie betaal je 1 geldeenheid.

Als je schuld te hoog wordt ten opzichte van de gemiddelde export, kunnen ongunstiger handels-voorwaarden voor je land worden ingesteld. Als dat gebeurt, zal de import duurder worden en zal de rente op schulden stijgen. Verder kan tijdens het spel de energieprijs tijdelijk worden verhoogd door een OPEC-actie (bepaald door de spelleider).

Beslissingen

5 Verdeel een deel van de totale hoeveelheid goederen beschikbaar voor investeringen, over:
- kapitaal voor ontwikkeling van voedselproductie, en
- kapitaal voor ontwikkeling van milieubescherming.
(de getallen verwijzen naar de cijfers op het spelbord)

Je beslissingen hebben indirect invloed op:
- de hoeveelheid goederen om elders te investeren,
- de inkomsten uit export,
- het sterftecijfer van de bevolking, en
- de totale energiebehoefte van de sector.

Belangrijke oorzaak-gevolgrelaties
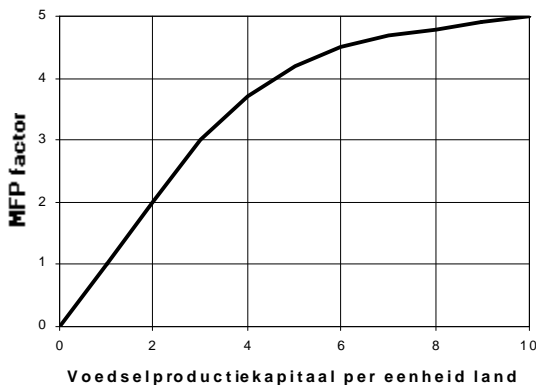
Voedselproductie

De voedselproductie is het product van de hoeveelheid bouwland (AL) (een constante van 1000 hectare) en de productiviteit van het land per eenheid bouwland. Deze productiviteit (ALP) is een functie van diverse parameters:

ALP = ALPN x MFC x MFP x QE, waarbij

ALPN = normale productiviteit van het land per gebiedseenheid (constant op 1,25);

MFC = een factor die afgeleid wordt uit veranderingen in de voedselconsumptie per hoofd van de bevolking van de vorige spelronde naar deze ronde (bereik: 0,4-1,0; zie figuur 7);
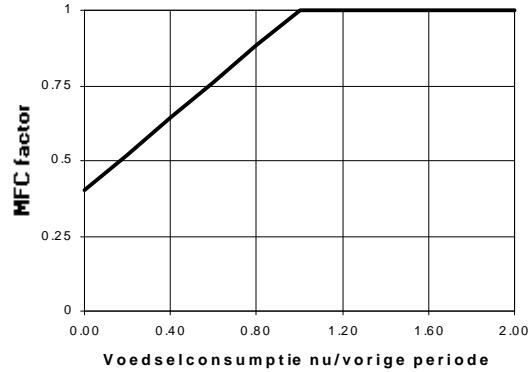
Afb. 7: De MFC-factor voor voedselproductie als functie van de verhouding tussen de voedselconsumptie in deze periode en die in de vorige periode

Afb. 8: De MFP-factor voor voedselproductie als functie van de hoeveelheid actief voedselproductie-kapitaal per eenheid van bouwland

MFP = de factor landopbrengst uit voedselkapitaal, die afhangt van de verhouding tussen actief productiekapitaal en landbouwgebied. Zie figuur 8. Actief productiekapitaal is het product van het huidige productiekapitaal en de capaciteits-gebruiksfactor voor voedselkapitaal (CUF) tijdens deze spelronde. Als er een energietekort is, wordt het actieve voedselproductiekapitaal kleiner, en dus ook de productie. De capaciteits-gebruiksfactor CUF geeft de verhouding weer tussen energie, toegewezen aan goederen-productie en energie, nodig voor optimaal gebruik van de kapitaalvoorraad. De waarde ligt tussen 0 en 1,1.

QE = kwaliteit van het milieu (bereik: 0-1). De milieukwaliteit kan zowel verbeteren als verslechteren; zie hieronder.

Denk erom:

- De benodigde hoeveelheid energie om de maximale voedselproductie te bereiken is het product van voedselproductiekapitaal, standaard energiegebruik (in dit model een constante van 12,5), en de energieverbruiksfactor (waarvan het bereik 0,3-1 is).
- De levensduur van voedselproductiekapitaal is 25 jaar. Een-vijfde van dit kapitaal wordt dus aan het einde van elke ronde afgeschreven.
- In het uitvoerformulier staat de volgende formule voor de verwachte voedselproductie:

VERWACHTE VOEDSELPRODUKTIE = Constante x MFC x MFP x QE
waarbij de Constante gelijk is aan AL x ALPN x 5 =6250 (een spelronde duurt vijf jaar). De verwachte productie wordt berekend met hulp van een voorlopige waarde voor MFC (=1), aannemende dat er ook genoeg energie is om het productiekapitaal volledig te gebruiken. In de berekeningen na je eigen beslissingen wordt uiteraard gebruik gemaakt van de actuele waarde voor MFC en CUF.

Milieubescherming

Het milieu wordt aangetast door het gebruik van energieproductiekapitaal, goederenproductiekapitaal en voedselproductiekapitaal. De negatieve invloeden van deze kapitaalvoorraden kunnen worden verminderd door investeringen in milieu-beschermingskapitaal. Elke eenheid milieubeschermingskapitaal neutraliseert de invloed van drie eenheden productiekapitaal.
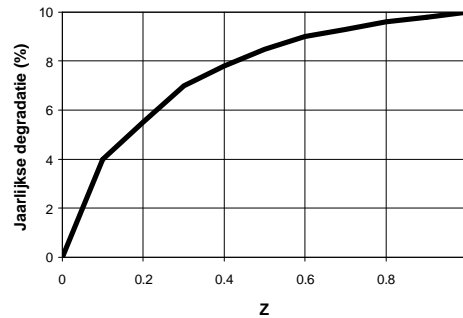
Afb. 9: Jaarlijks percentage milieudegratie als functie van Z (zie tekst).

Figuur 9 toont de relatie tussen degeneratie en productiekapitaal. Het jaarlijkse percentage milieudegradatie is hier een functie van Z, het verschil tussen enerzijds de som van de actieve hoeveelheden kapitaal in de productiesectoren en anderzijds 3x de hoeveelheid milieubeschermingskapitaal, geschaald op 20.000. In formule:
Figuur 9 toont de relatie tussen degeneratie en productiekapitaal. Het jaarlijkse percentage milieudegradatie is hier een functie van Z, het verschil tussen enerzijds de som van de actieve hoeveelheden kapitaal in de productiesectoren en anderzijds 3x de hoeveelheid milieubeschermingskapitaal, geschaald op 20.000. In formule:
$Z = ((AFC + AGC + EC) - 3*EnvPC)/20.000$,
waarin AFC= actief voedselproductiekapitaal; AGC= actief goederenproductiekapitaal; EC= energieproductiekapitaal en EnvPC= milieubeschermingskapitaal.
Merk op dat voedselproductiekapitaal en goederenproductiekapitaal worden vermenigvuldigd met hun respectievelijke capaciteitsgebruiksfactoren (CUF en CUG) bij de bepaling van hun invloed op het milieu. Dit geeft aan dat als door energietekorten niet het volledige productiekapitaal kan worden ingezet in een ronde, dit niet gebruikte kapitaal geen invloed heeft op het milieu in die ronde.

Afb. 10: *Het jaarlijkse percentage van milieuherstel als functie van de milieukwaliteit.*
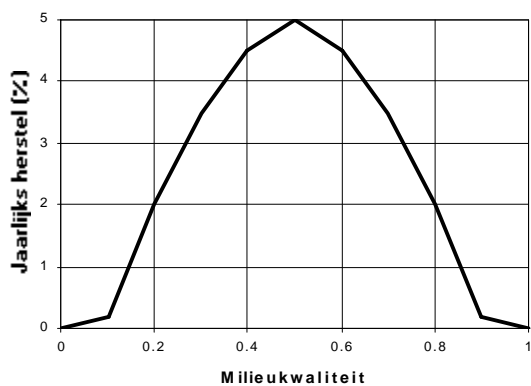
Het milieu kan ook regenereren. Het jaarlijkse regeneratiepercentage hangt af van de huidige kwaliteit van het milieu (waarde tussen 0 en 1). De relatie wordt afgebeeld in figuur 10. Merk op dat als de kwaliteit precies 0 of 1 is, er geen regeneratie optreedt.

Denk erom:
- De levensduur van milieubeschermingskapitaal is 30 jaar. Een-zesde van het kapitaal wordt afgeschreven aan het einde van elke ronde, nadat de productie voor die ronde is berekend.
- In de praktijk ligt de waarde van de milieukwaliteit tussen 0,05 en 0,95, door de teruglopende regeneratiekracht en kleine afrondingen in de berekening van elkaar opheffende effecten van verslechtering en regeneratie.

Datum :   tijd   :
Land : voorbeeld
Status bij het begin van periode : 0 - 4, jaar : 0

VOEDSELPRODUKTIE EN MILIEUBESCHERMING

In de vorige periode werden 3000 eenheden voedsel geproduceerd.
De import was 0; er zijn dus totaal 3000 eenheden voedsel beschikbaar.
In de vorige periode was de capaciteitsgebruiksfactor (CUF) 1.00,
en de multiplier voor voedselconsumptie (MFC) was 1.00.

De kapitaalgoederenvoorraad voor voedselproductie is 800;
daarvan worden aan het einde van deze periode 160 afgeschreven,
wat het totaal op 640 brengt, tenzij je opnieuw investeert.

De kapitaalgoederenvoorraad voor milieubescherming is 0;
daarvan worden aan het einde van deze periode 0 afgeschreven,
wat het totaal op 0 brengt, tenzij je opnieuw investeert.

Verwachte voedselproductie   = Constante * MFC *   MFP   *   QE
              2500   6250.00   1   0.80   0.50
(bereik:)   (0.4-1)(0-5)   (0-1)

Je investeringen in kapitaalgoederen voor de volgende periode zijn:
.... eenheden voor voedselproductie,
.... eenheden voor milieubescherming.

Denk erom:
Het laatste deel van het uitvoerformulier vat de per spelronde genomen beslissingen samen. Vul dit formulier in nadat jullie team alle beslissingen heeft genomen, en geef het aan de spelleider.

De werkelijkheid achter de aanvangssituatie bij het spelen van STRATAGEM

Het onderstaande bevat een typerend voorbeeld van de werkelijke situatie in een ontwikkelingsland zoals dat is vormgegeven in de startsituatie in Stratagem.

Voedsel:

Drie maal daags een kom rijst en bonen.

Goederen in een individueel huishouden:

Een eenvoudige kachel (gestookt op hout of benzine), soms gemaakt van afvalmetaal; een radio in meer welvarende gezinnen, TV's alleen bij de rijken; maar weinig goederen te koop in winkel, en de kosten van ingevoerde producten zijn zo hoog dat deze buiten bereik van de gemiddelde burger blijven; de meeste mensen lopen, nemen het openbaar vervoer of fietsen; erg weinig privé auto's op de weg.

Diensten:

Weinig scholen, die bovendien slecht zijn uitgerust; jongens worden aangemoedigd om de school te bezoeken, en meisjes worden aangezet om thuis in het huishouden te helpen; er is één ziekenhuis per 250.000 mensen; de meeste mensen bezoeken nooit een tandarts (tanden worden getrokken in plaats van gevuld).

Energiebronnen en beschikbaarheid:

Waterkracht levert elektriciteit in stedelijke gebieden voor bedrijven en overheidsdiensten; er zijn vaak storingen. Men importeert wat olie als motorbrandstof.

Toestand van de voedselproductie:

De productiviteit daalt als gevolg van uitputting van de bodem (roofbouw en geen rotatie van ge- wassen).

Toestand van het milieu:

Bodemerosie en veelvuldig optreden van modderstromen; geen financiële middelen voor herbebossing of terugwinning van (land)bouwgrond; ernstige problemen met slib, industrieel afval en luchtverontreiniging in woon- en werkgebieden.

Soort industrie:

Basisgoederen industrie in de grote steden, die grote aantallen laagbetaalde werknemers aantrekken (afkomstig van het platteland).

Toestand van 's lands financiën:

Internationale vraag naar voedsel export levert enige financiële stabiliteit, maar de inkomsten uit export moeten worden aangewend voor de aankoop van energie en basisgoederen.

GOEDERENPRODUCTIE EN DIENSTENSECTOR

Doel

Je belangrijkste doel is om voldoende goederen te produceren om te voldoen aan de consumptieve behoefte van de bevolking, aan de investeringsbehoefte en aan de behoefte aan export. Maar je moet ook de gezondheids- en onderwijsstandaard proberen te verhogen door te investeren in kapitaal voor de dienstensector. Dat zal namelijk leiden tot een hogere arbeids-productiviteit en een lager geboortecijfer.
Verspil bij dit alles zo weinig mogelijk grondstoffen.

Startwaarden

- De arbeidsproductiviteit is laag, ongeveer een-negende van wat bereikt kan worden bij maximale investering van kapitaal in de goederenproductie en in de dienstensector.
- De arbeidskrachten in je land hebben geen bijzonder hoge levensstandaard; de hoeveelheid goederen die aan de bevolking werd toegewezen tijdens de vorige spelronde was laag. Die hoeveelheid bedroeg slechts twee eenheden per persoon per jaar (= 10 eenheden per persoon per ronde), terwijl vijftien eenheden het maximum is.
- Het niveau van de dienstensector (gezondheidszorg en onderwijs) is eveneens laag. De huidige verhouding tussen het kapitaal in de dienstensector en de bevolkingsomvang is slechts 2,25 terwijl het maximum twintig is.

Algemene informatie over het land

Bevolking en huishoudelijke consumptie

De bevolking in je land is niet groot; slechts 200 mensen. De voedingsstandaard is middelmatig (2 op een schaal van 0-5), zodat het sterftecijfer niet al te hoog is (18 per 1000/jaar). De materiële levensstandaard is echter laag (2 op een schaal van 0-15), zodat het geboorte-sterftecijfer hoog is (41 per 1000 mensen per jaar). De totale bevolkingsgroei is hierdoor 2,3% per jaar: de periode waarin de bevolking zich verdubbelt is dus ongeveer 30 jaar (slechts zes spelrondes!).

Je produceert genoeg om de voedingsstandaard fors te kunnen verhogen, maar op dit moment exporteer je voedsel om de import van energie te kunnen betalen.

Energie

Je hebt nog niets geïnvesteerd in energie-efficiency. Elke eenheid voedsel- of goederenkapitaal gebruikt nu drie maal zo veel energie als bij een maximale investering in energie-efficiency. In de laatste ronde was een deel van de beschikbare energie - totaal ongeveer 15000 eenheden - afkomstig uit import. Toch heb je nog niet genoeg energie om je gehele voedings- en goederenkapitaal in te zetten.

Je bronnen voor huishoudelijke energie zijn stromingsbronnen: ze worden niet uitgeput. In de eerste spelrondes zal je rendement op investering in energieproductie hoog zijn. Later wordt dit minder. Deze vermindering wordt zo ernstig dat het onmogelijk kan worden om alle energie voor binnenlands gebruik zelf te produceren.

Je kunt ook te veel energie produceren. Deze energie kan geëxporteerd worden, om zo geld te verdienen om goederen of voedsel te kunnen importeren. Het kan echter ook opgeslagen worden - in het TOTAL AVAILABLE ENERGY-vak - om in volgende spelrondes gebruikt te worden.

Het is belangrijk om in de gaten te houden dat de energiesector een cruciale rol in het spel speelt. De sector vraagt veel kapitaal, heeft invloed op het milieu, en is vaak verantwoordelijk voor energietekorten waardoor kapitaal in de goederen- en voedselsector onbenut blijft.

Er zijn vijf manieren om energietekorten terug te dringen.

1. Je kunt investeren in kapitaal voor energieproductie. De energie-opbrengst wordt hierdoor echter pas hoger na twee spelrondes.
2. Je kunt geld gebruiken om energie te importeren. Dit levert meer energie in de volgende ronde, maar kan erg duur zijn.
3. Je kunt kapitaal investeren in energie-efficiency. Dit vermindert de benodigde hoeveelheid energie al in de volgende ronde.
4. Je kunt investeringskapitaal verplaatsen van de energie-consumerende productiesector (voedsel- en goederenproductie) naar de dienstensector of naar milieubescherming. Deze sectoren gebruiken geen energie.
5. Tenslotte kun je minder energie aan de bevolking toewijzen door de productie van goederen, bestemd voor de bevolking, te verminderen. Dit is een zwakke strategie, omdat de energiebehoefte van de bevolking al laag is in de eerste paar rondes. Het is echter de enige maatregel die in de zelfde spelronde al resultaat geeft.

Voedselproductie en milieubescherming

Alhoewel je in het begin van het spel voedsel exporteert, werkt je landbouwsector veel minder productief dan zou kunnen. Je hebt het milieu ernstig laten vervuilen en je hebt weinig in de voedselproductie geïnvesteerd. Milieudegradatie vermindert tegenwoordig fors de voedsel-opbrengst, terwijl door maximale investeringen die opbrengst zou kunnen verzesvoudigen.

Goederenproductie en dienstensector

In de goederensector zou aanzienlijk hoger geproduceerd kunnen worden. De arbeids- productiviteit is slechts een negende van wat bereikt kan worden door maximale investeringen in productiemiddelen en sociale voorzieningen.

Handel

In de startgegevens op het uitvoerformulier staat of je wel of niet begint met een schuld van 1000 eenheden. Als je geen schuld hebt, kun je geld lenen tegen een rente van 10% per jaar.

Je verdient 1 geldeenheid aan elke geëxporteerde eenheid energie, voedsel of goederen; je betaalt 1,1 geldeenheid voor elke geïmporteerde eenheid voedsel of goederen. Het is dus geen goede strategie om bv. goederen te exporteren, en dat geld te gebruiken om goederen te importeren. Je verliest daarbij 10%, en bovendien het gebruik van het bedoelde goed tijdens één spelronde.

Voor elke eenheid geïmporteerde energie betaal je 1 geldeenheid.

Als je schuld te hoog wordt ten opzichte van de gemiddelde export, kunnen ongunstiger handels- voorwaarden voor je land worden ingesteld. Als dat gebeurt, zal de import duurder worden en zal de rente op schulden stijgen. Verder kan tijdens het spel de energieprijs tijdelijk worden verhoogd door een OPEC-actie (bepaald door de spelleider).

Beslissingen

5   Verdeel een deel van de totale goederen beschikbaar voor investeringen, over:
- ontwikkeling van de goederenproductie, en
- ontwikkeling van de dienstensector.
(de getallen verwijzen naar de cijfers op het spelbord)

Je beslissingen hebben indirect invloed op:
- de hoeveelheid goederen om elders te investeren,
- de kwaliteit van het milieu,
- de arbeidsproductiviteit, en
- het geboortecijfer.

Belangrijke oorzaak-gevolgrelaties
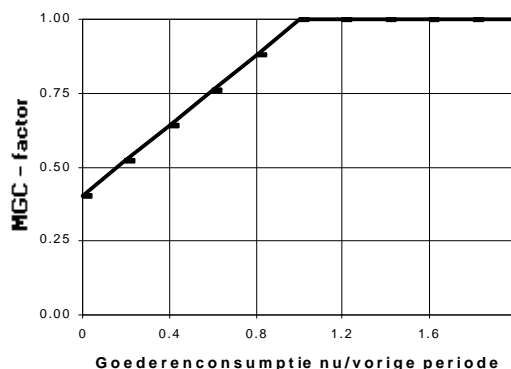
Goederenproductie en Dienstensector

De goederenproductie is het product van het aantal werkenden (LF; altijd 25% van de bevolking) en de arbeidsproductiviteit per hoofd van de bevolking (LP; uitgedrukt in goederen per arbeider). De arbeidsproductiviteit is een functie van verschillende variabelen:

LP = LPN x MGC x MGP x MHS, waarbij

LPN = de normale arbeidsproductiviteit per jaar (in deze versie van het model een constante van 1,155);
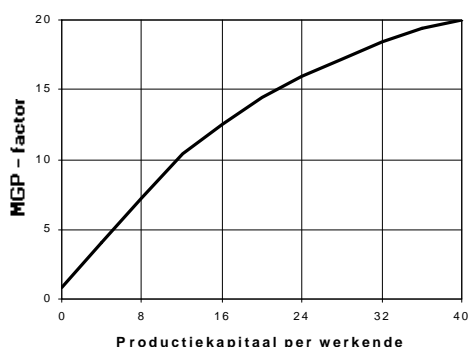
MGC = een factor die afgeleid wordt uit veranderingen in de goederenconsumptie per hoofd van de bevolking van de vorige spelronde naar deze ronde (bereik: tussen 0,4 en 1; zie figuur 11);

Afb. 11: De MGC-factor voor goederenproductie als functie van de verhouding tussen de goederen-consumptie in deze periode en die in de vorige periode

MGP = een factor m.b.t. goederenproductiekapitaal, die afgeleid wordt uit de verhouding tussen actief goederenproductiekapitaal en arbeidskracht. Deze functie is te zien in figuur 12. Actief goederenproductiekapitaal is het produkt van het huidige productiekapitaal en de capaciteits-gebruiksfactor voor goederenkapitaal (CUG) tijdens deze spelronde. Als er een energietekort is, wordt het actieve goederenproductiekapitaal kleiner, en dus ook de productie. De capaciteits-gebruiksfactor CUG geeft de verhouding weer tussen energie, toegewezen aan goederen-productie en energie, nodig voor optimaal gebruik van de kapitaalvoorraad. De waarde ligt tussen 0 en 1,1.
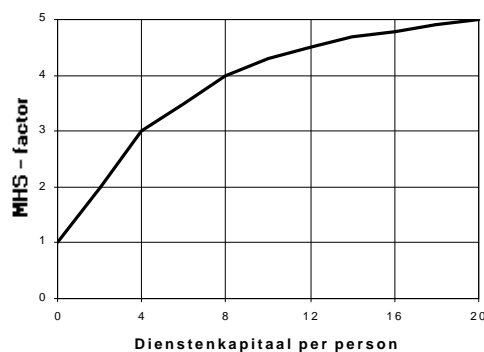
MHS = de factor m.b.t. dienstenkapitaal, die bepaald wordt door het kapitaal dat is geïnvesteerd in de dienstensectorkapitaal per hoofd van de bevolking. De functie wordt getoond in figuur 13.

Afb. 12: De MGP-factor als functie van de hoeveelheid actief productiekapitaal per werkende

Afb. 13: De MHS-factor als functie van de verhouding tussen dienstenkapitaal en bevolkingsaantal

Denk erom:

- De energie, nodig voor de goederenproductie, is het product van het volledige productiekapitaal, het standaard energiegebruik per ronde (in deze versie van het model een constante van 20), en de energieverbruiksfactor (bereik: 0,3-1).

- De gemiddelde levensduur van goederenproductiekapitaal is 25 jaar, en de gemiddelde levensduur van het dienstenkapitaal is 45 jaar. Dus een-vijde van het goederenproductiekapitaal en een-negende van het dienstenkapitaal worden aan het einde van iedere ronde afgeschreven.

- In het uitvoerformulier staat de volgende formule voor de "verwachte goederenproductie":
VERWACHTE GOEDERENPRODUKTIE = Constante x LF x MGC x MGP x MHS
waarbij de Constante gelijk is aan LPN x 5 = 5,775 (een spelronde duurt vijf jaar). De verwachte productie is berekend met hulp van een voorlopige waarde voor MGC (=1), aannemende dat er ook genoeg energie is om het productiekapitaal volledig te gebruiken. In de berekeningen na je eigen beslissingen wordt uiteraard gebruik gemaakt van de actuele waarden voor MGC en CUG.

- Als de schuld stijgt tot boven de helft van het BNP (is gelijk aan de som van de totale goederen- en voedselproductie) wordt aan het begin van de volgende spelronde door het IMF 10% aan je goederenproductie onttrokken, en gebruikt voor aflossingen. Indien dit plaatsvindt, volgt een melding op het uitvoerformulier.

Datum :   tijd   :
Land   : voorbeeld
Status bij het begin van periode : 0 - 4, jaar : 0

GOEDERENPRODUCTIE EN DIENSTENSECTOR

In de vorige periode werden 3000 eenheden goederen geproduceerd.
De import was 500; er zijn dus totaal 3500 eenheden goederen beschikbaar.
In de vorige periode was de capaciteitsgebruiksfactor (CUG) 1.00,
en de multiplier voor goederenconsumptie (MGC) was 1.00.

De kapitaalgoederenvoorraad voor goederenproductie is 300;
daarvan worden aan het einde van deze periode 60 afgeschreven,
wat het totaal op 240 brengt, tenzij je opnieuw investeert.

De kapitaalgoederenvoorraad in de dienstensector is 450;
daarvan worden aan het einde van deze periode 50 afgeschreven,
wat het totaal op 400 brengt, tenzij je opnieuw investeert.

Verwachte goederenproductie	= Constante	*	LF	*	MGC	*	MGP	*	MHS
3450	5.775		50		1		5.60		2.1
(bereik:)			(0.4-1)		(0-20)		(0-5)		

Je investeringen in kapitaalgoederen voor de volgende periode zijn:
.... eenheden voor goederenproductie,
.... eenheden in de dienstensector.

Denk erom:

    Het laatste deel van het uitvoerformulier vat de per spelronde genomen beslissingen samen. Vul
    dit formulier in nadat jullie team alle beslissingen heeft genomen, en geef het aan de spelleider.

De werkelijkheid achter de aanvangssituatie bij het spelen van STRATAGEM

Het onderstaande bevat een typerend voorbeeld van de werkelijke situatie in een ontwikkelingsland zoals dat is vormgegeven in de startsituatie in Stratagem.

Voedsel:
Drie maal daags een kom rijst en bonen.

Goederen in een individueel huishouden:
Een eenvoudige kachel (gestookt op hout of benzine), soms gemaakt van afvalmetaal; een radio in meer welvarende gezinnen, TV's alleen bij de rijken; maar weinig goederen te koop in winkel, en de kosten van ingevoerde producten zijn zo hoog dat deze buiten bereik van de gemiddelde burger blijven; de meeste mensen lopen, nemen het openbaar vervoer of fietsen; erg weinig privé auto's op de weg.

Diensten:
Weinig scholen, die bovendien slecht zijn uitgerust; jongens worden aangemoedigd om de school te bezoeken, en meisjes worden aangezet om thuis in het huishouden te helpen; er is één ziekenhuis per 250.000 mensen; de meeste mensen bezoeken nooit een tandarts (tanden worden getrokken in plaats van gevuld).

Energiebronnen en beschikbaarheid:
Waterkracht levert elektriciteit in stedelijke gebieden voor bedrijven en overheidsdiensten; er zijn vaak storingen. Men importeert wat olie als motorbrandstof.

Toestand van de voedselproductie:
De productiviteit daalt als gevolg van uitputting van de bodem (roofbouw en geen rotatie van ge-wassen).

Toestand van het milieu:
Bodemerosie en veelvuldig optreden van modderstromen; geen financiële middelen voor herbebossing of terugwinning van (land)bouwgrond; ernstige problemen met slib, industrieel afval en luchtverontreiniging in woon- en werkgebieden.

Soort industrie:
Basisgoederen industrie in de grote steden, die grote aantallen laagbetaalde werknemers aantrekken (afkomstig van het platteland).

Toestand van 's lands financiën:
Internationale vraag naar voedsel export levert enige financiële stabiliteit, maar de inkomsten uit export moeten worden aangewend voor de aankoop van energie en basisgoederen.

INTERNATIONALE FINANCIËN, EXPORT, IMPORT EN SCHULDEN

Doel

Je werkgebied is de buitenlandse handel. Je zet exportgoederen om in hun financiële equivalent, je beheert de buitenlandse schulden en je wijst geld toe voor de import. Je doel is om de handel van het land te beheren, zodat er genoeg goederen, energie en voedsel zijn om een bevredigend niveau van consumptie en investering te bereiken, terwijl te hoge rentebetalingen voorkomen moeten worden, evenals verslechtering van de handelsvoorwaarden. In de financiële wereld zijn het Bruto Nationaal Product (hier: BNP) en het BNP per hoofd van de bevolking belangrijke parameters van het economisch welzijn van een land. Groei van deze parameters duidt op economische groei, en zal je prestige in de internationale financiële wereld doen stijgen.

Startwaarden

- Je land begint met een lichte overproductie van voedsel, waardoor een gedeelte geëxporteerd kan worden, en je kunt een schuld hebben (afhankelijk van de beginwaarden) aan internationale banken.
- Je rentepercentage is 10%, veel minder dan te verdienen is op investeringen in productiekapitaal.
- Het Bruto Nationaal Product (BNP) van je land is gelijk aan de som van de opbrengst van de goederenproductie- en de voedselproductiesector. De startwaarde is geïndexeerd op 100. De actuele waarde, en de groei of afname, wordt op het uitvoerformulier vermeld. Daarnaast wordt een waarde van het BNP per hoofd van de bevolking gegeven, om de invloed van bevolkingsgroei te laten zien.

Algemene informatie over het land

Bevolking en huishoudelijke consumptie

De bevolking in je land is niet groot; slechts 200 mensen. De voedingsstandaard is middelmatig (2 op een schaal van 0-5), zodat het sterftecijfer niet al te hoog is (18 per 1000/jaar). De materiële levensstandaard is echter laag (2 op een schaal van 0-15), zodat het geboorte-sterftecijfer hoog is (41 per 1000 mensen per jaar). De totale bevolkingsgroei is hierdoor 2,3% per jaar: de periode waarin de bevolking zich verdubbelt is dus ongeveer 30 jaar (slechts zes spelrondes!).

Je produceert genoeg om de voedingsstandaard fors te kunnen verhogen, maar op dit moment exporteer je voedsel om de import van energie te kunnen betalen.

Energie

Je hebt nog niets geïnvesteerd in energie-efficiency. Elke eenheid voedsel- of goederenkapitaal gebruikt nu drie maal zo veel energie als bij een maximale investering in energie-efficiency. In de laatste ronde was een deel van de beschikbare energie - totaal ongeveer 15000 eenheden - afkomstig uit import. Toch heb je nog niet genoeg energie om je gehele voedings- en goederenkapitaal in te zetten.

Je bronnen voor huishoudelijke energie zijn stromingsbronnen: ze worden niet uitgeput. In de eerste spelrondes zal je rendement op investering in energieproductie hoog zijn. Later wordt dit minder. Deze vermindering wordt zo ernstig dat het onmogelijk kan worden om alle energie voor binnenlands gebruik zelf te produceren.

Je kunt ook te veel energie produceren. Deze energie kan geëxporteerd worden, om zo geld te verdienen om goederen of voedsel te kunnen importeren. Het kan echter ook opgeslagen worden - in het TOTAL AVAILABLE ENERGY-vak - om in volgende spelrondes gebruikt te worden.

Het is belangrijk om in de gaten te houden dat de energiesector een cruciale rol in het spel speelt. De sector vraagt veel kapitaal, heeft invloed op het milieu, en is vaak verantwoordelijk voor energietekorten waardoor kapitaal in de goederen- en voedselsector onbenut blijft.

Er zijn vijf manieren om energietekorten terug te dringen.

1. Je kunt investeren in kapitaal voor energieproductie. De energie-opbrengst wordt hierdoor echter pas hoger na twee spelrondes.
2. Je kunt geld gebruiken om energie te importeren. Dit levert meer energie in de volgende ronde, maar kan erg duur zijn.
3. Je kunt kapitaal investeren in energie-efficiency. Dit vermindert de benodigde hoeveelheid energie al in de volgende ronde.
4. Je kunt investeringskapitaal verplaatsen van de energie-consumerende productiesector (voedsel- en goederenproductie) naar de dienstensector of naar milieubescherming. Deze sectoren gebruiken geen energie.
5. Tenslotte kun je minder energie aan de bevolking toewijzen door de productie van goederen, bestemd voor de bevolking, te verminderen. Dit is een zwakke strategie, omdat de energiebehoefte van de bevolking al laag is in de eerste paar rondes. Het is echter de enige maatregel die in de zelfde spelronde al resultaat geeft.

Voedselproductie en milieubescherming

Alhoewel je in het begin van het spel voedsel exporteert, werkt je landbouwsector veel minder productief dan zou kunnen. Je hebt het milieu ernstig laten vervuilen en je hebt weinig in de voedselproductie geïnvesteerd. Milieudegradatie vermindert tegenwoordig fors de voedsel-opbrengst, terwijl door maximale investeringen die opbrengst zou kunnen verzesvoudigen.

Goederenproductie en dienstensector

In de goederensector zou aanzienlijk hoger geproduceerd kunnen worden. De arbeids-productiviteit is slechts een negende van wat bereikt kan worden door maximale investeringen in productiemiddelen en sociale voorzieningen.

Handel

In de startgegevens op het uitvoerformulier staat of je wel of niet begint met een schuld van 1000 eenheden. Als je geen schuld hebt, kun je geld lenen tegen een rente van 10% per jaar.
Je verdient 1 geldeenheid aan elke geëxporteerde eenheid energie, voedsel of goederen; je betaalt 1,1 geldeenheid voor elke geïmporteerde eenheid voedsel of goederen. Het is dus geen goede strategie om bv. goederen te exporteren, en dat geld te gebruiken om goederen te importeren. Je verliest daarbij 10%, en bovendien het gebruik van het bedoelde goed tijdens één spelronde.
Voor elke eenheid geïmporteerde energie betaal je 1 geldeenheid.
Als je schuld te hoog wordt ten opzichte van de gemiddelde export, kunnen ongunstiger handels-voorwaarden voor je land worden ingesteld. Als dat gebeurt, zal de import duurder worden en zal de rente op schulden stijgen. Verder kan tijdens het spel de energieprijs tijdelijk worden verhoogd door een OPEC-actie (bepaald door de spelleider).

Beslissingen

6   Verzamel ontwikkelingshulp (als dat er is) en vertaal Energie voor Export, Voedsel voor Export, en Goederen voor Export naar Geld beschikbaar voor Export.
7   Leen geld als je meer wilt importeren (mogelijk als het Maximaal Te Lenen bedrag groter is dan 0).
8   Los een deel van je schuld af als je je renteverplichtingen terug wilt brengen en de prijs voor importeren wilt verlagen.
9   Wijs Geld Beschikbaar voor Import toe aan één of meer van de drie sectoren: energie, voeding en goederen.
(de getallen verwijzen naar de cijfers op het spelbord)

Je beslissingen hebben indirect invloed op:
- de beschikbare hoeveelheid energie, voeding en goederen in de volgende ronde,
- de hoogte van de rente, dus de renteverplichtingen over de staatsschuld,
- de prijs van ingekochte energie, voeding en goederen, en
- een mogelijke IMF-interventie.

Belangrijke oorzaak-gevolgrelaties

Ontwikkelingshulp

Ontwikkelingshulp is een beslissing van buitenaf, te nemen door de spelleider. De hulp wordt dus niet standaard gegeven.

IMF-interventie

Als je schuld stijgt tot boven de helft van je BNP (is gelijk aan de som van de totale goederen- en voedselproductie), wordt aan het begin van de volgende spelronde, als gevolg van een IMF-interventie, 10% van je totale goederenproductie gebruikt voor aflossingen. Indien dit plaatsvindt, volgt een melding op het uitvoerformulier.
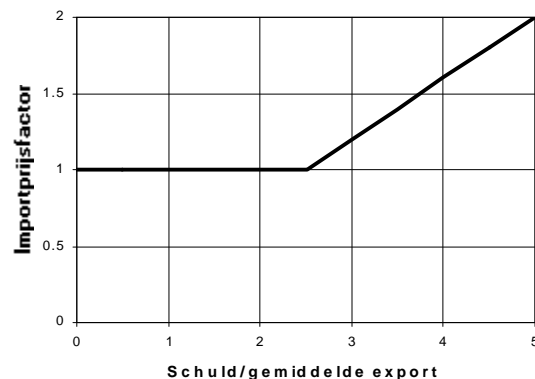
Export

De exportprijs van voedsel, energie en goederen is constant op 1,0. Van de totale export over drie spelrondes wordt een gemiddelde waarde bepaald; deze speelt een rol bij de bepaling van je maximale schuld en de hoogte van de rente.

Import

Geïmporteerde zaken zijn niet direct beschikbaar in de ronde waarin geld daarvoor is toegewezen. Ze verschijnen in de voorraden beschikbaar voedsel, goederen en energie aan het begin van de volgende spelronde.

Op het spelbord wordt de mogelijkheid geboden om geld te investeren in de import van technologie. Deze mogelijkheid zit niet standaard in deze versie van het spel.

De handelsvoorwaarden zullen verslechteren als je schuld hoger wordt dan je gemiddelde export. De importprijs voor voedsel en goederen is normaal 1,1. De normale energie-importprijs is 1,0. Deze prijzen worden vermenigvuldigd met de importprijs-factor die van 1 kan oplopen naar 2, als de verhouding schuld-gemiddelde export naar 5 loopt. In figuur 14 wordt deze importprijs-factor getoond. De spelleider kan een OPEC OLIE-EMBARGO instellen, waardoor de olieprijzen tijdelijk (voor twee rondes) zullen stijgen.


Afb. 14: *Importprijsfacor als functie van de verhouding tussen schuld en gemiddelde export*

Schulden

De hoogte van de rente die je over je schulden moet betalen, hangt af van de verhouding tussen schuld en gemiddelde export. De rente loopt van 10% per jaar (dat is 50% per spelronde) tot 20% per jaar, als je schuld stijgt tot vijf maal de gemiddelde export. De functie is afgebeeld in figuur 15.

Het is niet toegestaan, je schuld te vergroten door nieuwe leningen, indien die schuld groter is dan de gemiddelde export van je land. Natuurlijk kan je schuld wel groter worden dan die gemiddelde export, nl. als je export terug loopt of als de rentelasten zich opstapelen.

Als je erg veel geld hebt, kan je meer schuld "terugbetalen" dan je hebt. In dat geval ontvang je inkomsten uit rente op deze lening, tegen de heersende rentestand.
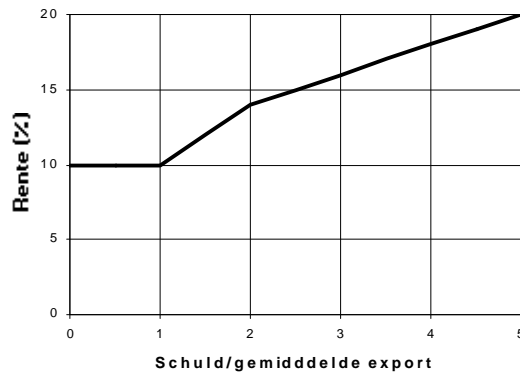
*Afb. 15: Rentepercentage als functie van de verhouding tussen schuld en gemiddelde **export***

Datum :   tijd   :
Land : voorbeeld
Status bij het begin van periode : 0 - 4, jaar : 0

INTERNATIONALE FINANCIEN, EXPORT, IMPORT EN SCHULDEN

Aan het begin van deze periode is de schuld 1000, en de jaarrente is 10 %.
In de vorige periode betaalde je aan rente 300.
Het maximaal te lenen bedrag in deze periode is 0.
De groei van het BNP was 0. Je BNP index is nu dus 100.
De index voor het BNP per hoofd van de bevolking was 100

De balans:
inkomsten uit energie-export: (.....)
inkomsten uit goederenexport: (.....)
inkomsten uit voedselexport: (.....)
inkomsten uit ontwikkelingshulp: .... (bepaald door de spelleider)
nieuwe leningen: ....
                                       ------- +
TOTAAL: (.....)
aflossingen: ....
                                       ------- -
BESCHIKBAAR VOOR IMPORT   (.....), als volgt te verdelen:

    voor energie   ..... (de importprijs is 1.00)
    voor voedsel   ..... (de importprijs is 1.10)
    voor goederen   ..... (de importprijs is 1.10)

Denk erom:
Het laatste deel van het uitvoerformulier vat de per spelronde genomen beslissingen samen. Vul
dit formulier in nadat jullie team alle beslissingen heeft genomen, en geef het aan de spelleider.

De werkelijkheid achter de aanvangssituatie bij het spelen van STRATAGEM

Het onderstaande bevat een typerend voorbeeld van de werkelijke situatie in een ontwikkelingsland zoals dat is vormgegeven in de startsituatie in Stratagem.

Voedsel:
Drie maal daags een kom rijst en bonen.

Goederen in een individueel huishouden:
Een eenvoudige kachel (gestookt op hout of benzine), soms gemaakt van afvalmetaal; een radio in meer welvarende gezinnen, TV's alleen bij de rijken; maar weinig goederen te koop in winkel, en de kosten van ingevoerde producten zijn zo hoog dat deze buiten bereik van de gemiddelde burger blijven; de meeste mensen lopen, nemen het openbaar vervoer of fietsen; erg weinig privé auto's op de weg.

Diensten:
Weinig scholen, die bovendien slecht zijn uitgerust; jongens worden aangemoedigd om de school te bezoeken, en meisjes worden aangezet om thuis in het huishouden te helpen; er is één ziekenhuis per 250.000 mensen; de meeste mensen bezoeken nooit een tandarts (tanden worden getrokken in plaats van gevuld).

Energiebronnen en beschikbaarheid:
Waterkracht levert elektriciteit in stedelijke gebieden voor bedrijven en overheidsdiensten; er zijn vaak storingen. Men importeert wat olie als motorbrandstof.

Toestand van de voedselproductie:
De productiviteit daalt als gevolg van uitputting van de bodem (roofbouw en geen rotatie van gewassen).

Toestand van het milieu:
Bodemerosie en veelvuldig optreden van modderstromen; geen financiële middelen voor herbebossing of terugwinning van (land)bouwgrond; ernstige problemen met slib, industrieel afval en luchtverontreiniging in woon- en werkgebieden.

Soort industrie:
Basisgoederen industrie in de grote steden, die grote aantallen laagbetaalde werknemers aantrekken (afkomstig van het platteland).

Toestand van 's lands financiën:
Internationale vraag naar voedsel export levert enige financiële stabiliteit, maar de inkomsten uit export moeten worden aangewend voor de aankoop van energie en basisgoederen.

APPENDIX G INITIAL STOCKS AND VALUES

This appendix contains the sets of initial values developed thus far for the simulation game STRATAGEM. It also contains the result graphs for the SIMPLE, TOUGH and VERYHARD versions of the game.
The STARTING VALUES reflect the state of the country in the starting position of the game. The CONTANTS contain some game parameters; they don't change during the game. The TABLE VALUES contain information for the graphs used in the STRATAGEM user manual.

SIMPLE
This version is simpler than the standard version: no foreign debt; maximum loan is 1000; the energy supply follows the HIGH curve.

STANDARD
This version is the standard one: a foreign debt of 1000 and no loan in the first cycle; relative good quality of the environment; the energy production follows the LOW curve.

TOUGH
This version is more difficult than the STANDARD version: the environmental quality is lowered from 0.69 to 0.60, which has consequences for the death rate.

VERYHARD
This version is the most complicated developed thus far: the LOW energy graph is used, the start value of the environmental quality is lowered from 0.69 to 0.50, and the start value of food production is lowered to 3000 units.
NB: these changes influence the death rate multiplier!

HIGHEQ
This version reflects the end point of a high equilibrium development path that resulted in a stable population at high levels of welfare, realized through efficient use of resources, although a better performance is still feasible. The LOW energy curve is used here.

SIMPLE

```
Starting values of STRATAGEM, version 3.0
200     41      18                          population, birthrate, deathrate
1.49    1.0     27.33   18                  birthmult, deathmult, normbr, normdr
3300    3500    15000                       totalfood, totalgoods, totalenergy
3300    2                                   foodproduction, foodpercapita
3000    2       2000                        goodsproduction, goodspercapita, goodsforpopulation
14500   14500                               energyprod, totenprod
0       0                                   energycarry, energyexport
1       1                                   foodcapacityutilisation, goodscapacityutilisation
1       1                                   cmf cmg (consumption multiplier f and g prod)
2.25    2.25    1000    0.69                oldhumservpc,  humservpc, totexpincome, qualenv
0.1     0       0       1000                interestrate, debt, imf-repayment, maxloan
300     0                                   interestcharges, lastforeignaid
2       2       2                           goodsconsumption last 3 years
1000    1000    1000                        export last 3 years
1       1.1     1.1                         importprices energy, food, goods
500     0       500                         import energy, food, goods
800     0       800     0       300   450   capitalstocks
25      25      25      30      25    45    lifetimes (years)
160     0       160     0       60    50    depreciation (per period)
1       1       1       1       1           technology investments


Constants of STRATAGEM, version 3.0
100                 oilcrisisyear
20000               sustainable capital
3                   env prot capital
1000                agricultural area;
0.25                employed fraction;
2       1       1.1     newoilprice;  exportprice  normimpprice ;
4.0     2.5     0.2     specengprodcap ; specenfprodcap ; hhenergymult ;
1.25    1.155   0.1     landprodnorm ; laborprodnorm ; norminterest ;
1       10000           eneffmultnorm ; totenergyresources ;
10000   10              maxuseencap ; maxfprodcapperland ;


Tablevalues of STRATAGEM, version 3.0
30.0 28.0 26.0 24.0 22.0 19.0 16.0 13.0 11.0 10.0 10.0  birthrate from gcons
1.00 1.50 1.45 1.40 1.35 1.30 1.20 1.10 1.00 1.00 1.00  birthmult from humserv
60.0 45.0 30.0 22.0 18.0 15.0 13.0 12.0 11.0 10.0 10.0  deathrate from fcons
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult goods
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult food
1.00 0.80 0.70 0.58 0.50 0.42 0.40 0.35 0.33 0.31 0.30  en cons mult eneffcap
0.00 0.35 0.40 0.45 0.50 0.55 0.60 0.64 0.67 0.69 0.70  en outp mult encap
0.00 0.20 2.00 3.50 4.50 5.00 4.50 3.50 2.00 0.20 0.00  regeneration from qe
1.75 1.60 1.50 1.40 1.30 1.20 1.10 1.00 1.00 1.00 1.00  death mult from qe
0.00 4.00 5.50 7.00 7.80 8.30 9.00 9.30 9.50 9.70 10.0  deterioration from qe
0    1    2    3    3.7  4.2  4.5  4.7  4.8  4.9  5      landproductivity
1    2    3    3.5  4    4.3  4.5  4.7  4.8  4.9  5      labor outp mult humserv
0.8  4    7.2  10.4 12.5 14.4 16   17.2 18.5 19.4 20     labor outp mult g.cap
10   10   10   12   14   15   16   17   18   19   20     interestrate
1    1    1    1    1    1    1.2  1.4  1.6  1.8  2      price mult imports
```

STANDARD

```
Starting values of STRATAGEM, version 3.0
200     41      18                              population, birthrate, deathrate
1.49    1.0     27.33    18                     birthmult, deathmult, normbr, normdr
3300    3500    14500                           total food, tot. goods, total energy
3300    2                                       foodproduction, foodpercapita
3000    2       2000                            goodsproduction, goodspercapita, goodsforpopulation
12000   12000                                   energyprod, totenprod
1000    0                                       energycarry, energyexport
1       1                                       foodcapacityutilisation, goodscapacityutilisation
1       1                                       cmf cmg (consumption multiplier f and g prod)
2.25    2.25    1000     0.69                   oldhumservpc,  humservpc, totexpincome, qualenv
0.1     1000    0    0                          interestrate, debt, imf-repayment, maxloan
300     0                                       interestcharges, lastforeignaid
2       2       2                               goodsconsumption last 3 years
1000    1000    1000                            export last 3 years
1       1.1     1.1                             importprices energy, food, goods
1500    0       500                             import energy, food, goods
800     0       800     0       300     450     capitalstocks
25      25      25      30      25      45      lifetimes (years)
160     0       160     0       60      50      depreciation (per period)
1       1       1       1       1               technology investments


Constants of STRATAGEM, version 3.0
100                     oilcrisisyear
20000                   sustainable capital
3                       env prot capital
1000                    agricultural area;
0.25                    employed fraction;
2       1       1.1     newoilprice;  exportprice  normimpprice ;
4.0     2.5     0.2     specengprodcap ; specenfprodcap ; hhenergymult ;
1.25    1.155   0.1     landprodnorm ; laborprodnorm ; norminterest ;
1       10000           eneffmultnorm ; totenergyresources ;
10000   10              maxuseencap ; maxfprodcapperland ;


Tablevalues of STRATAGEM, version 3.0
30.0 28.0 26.0 24.0 22.0 19.0 16.0 13.0 11.0 10.0 10.0  birthrate from gcons
1.00 1.50 1.45 1.40 1.35 1.30 1.20 1.10 1.00 1.00 1.00  birthmult from humserv
60.0 45.0 30.0 22.0 18.0 15.0 13.0 12.0 11.0 10.0 10.0  deathrate from fcons
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult goods
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult food
1.00 0.80 0.70 0.58 0.50 0.42 0.40 0.35 0.33 0.31 0.30  en cons mult eneffcap
0.00 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65 0.68 0.70  en outp mult encap
0.00 0.20 2.00 3.50 4.50 5.00 4.50 3.50 2.00 0.20 0.00  regeneration from qe
1.75 1.60 1.50 1.40 1.30 1.20 1.10 1.00 1.00 1.00 1.00  death mult from qe
0.00 4.00 5.50 7.00 7.80 8.30 9.00 9.30 9.50 9.70 10.0  deterioration from qe
0    1    2    3    3.7  4.2  4.5  4.7  4.8  4.9  5       landproductivity
1    2    3    3.5  4    4.3  4.5  4.7  4.8  4.9  5       labor outp mult humserv
0.8  4    7.2  10.4 12.5 14.4 16   17.2 18.5 19.4 20      labor outp mult g.cap
10   10   10   12   14   15   16   17   18   19   20      interestrate
1    1    1    1    1    1    1.2  1.4  1.6  1.8  2       price mult imports
```

TOUGH

```
Starting values of STRATAGEM, version 3.0
200     41      20                          population, birthrate, deathrate
1.49    1.1     27.33   18                  birthmult, deathmult, normbr, normdr
3300    3500    14500                       total food, tot. goods, total energy
3300    2                                   foodproduction, foodpercapita
3000    2       2000                        goodsproduction, goodspercapita, goodsforpopulation
12000   12000                               energyprod, totenprod
1000    0                                   energycarry, energyexport
1       1                                   foodcapacityutilisation, goodscapacityutilisation
1       1                                   cmf cmg (consumption multiplier f and g prod)
2.25    2.25    1000    0.60                oldhumservpc,  humservpc, totexpincome, qualenv
0.1     1000    0   0                       interestrate, debt, imf-repayment, maxloan
300     0                                   interestcharges, lastforeignaid
2       2       2                           goodsconsumption last 3 years
1000    1000    1000                        export last 3 years
1       1.1     1.1                         importprices energy, food, goods
1500    0       500                         import energy, food, goods
800     0       800     0       300     450 capitalstocks
25      25      25      30      25      45  lifetimes (years)
160     0       160     0       60      50  depreciation (per period)
1       1       1       1       1           technology investments


Constants of STRATAGEM, version 3.0
100                     oilcrisisyear
20000                   sustainable capital
3                       env prot capital
1000                    agricultural area;
0.25                    employed fraction;
2       1       1.1     newoilprice;  exportprice  normimpprice ;
4.0     2.5     0.2     specengprodcap ; specenfprodcap ; hhenergymult ;
1.25    1.155   0.1     landprodnorm ; laborprodnorm ; norminterest ;
1       10000           eneffmultnorm ; totenergyresources ;
10000   10              maxuseencap ; maxfprodcapperland ;


Tablevalues of STRATAGEM, version 3.0
30.0 28.0 26.0 24.0 22.0 19.0 16.0 13.0 11.0 10.0 10.0  birthrate from gcons
1.00 1.50 1.45 1.40 1.35 1.30 1.20 1.10 1.00 1.00 1.00  birthmult from humserv
60.0 45.0 30.0 22.0 18.0 15.0 13.0 12.0 11.0 10.0 10.0  deathrate from fcons
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult goods
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult food
1.00 0.80 0.70 0.58 0.50 0.42 0.40 0.35 0.33 0.31 0.30  en cons mult eneffcap
0.00 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65 0.68 0.70  en outp mult encap
0.00 0.20 2.00 3.50 4.50 5.00 4.50 3.50 2.00 0.20 0.00  regeneration from qe
1.75 1.60 1.50 1.40 1.30 1.20 1.10 1.00 1.00 1.00 1.00  death mult from qe
0.00 4.00 5.50 7.00 7.80 8.30 9.00 9.30 9.50 9.70 10.0  deterioration from qe
0    1    2    3    3.7  4.2  4.5  4.7  4.8  4.9  5      landproductivity
1    2    3    3.5  4    4.3  4.5  4.7  4.8  4.9  5      labor outp mult humserv
0.8  4    7.2  10.4 12.5 14.4 16   17.2 18.5 19.4 20     labor outp mult g.cap
10   10   10   12   14   15   16   17   18   19   20     interestrate
1    1    1    1    1    1    1.2  1.4  1.6  1.8  2      price mult imports
```
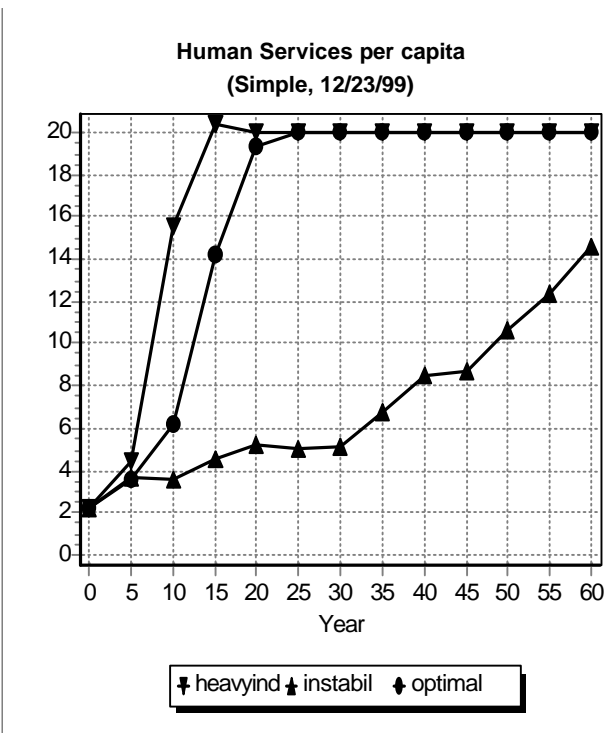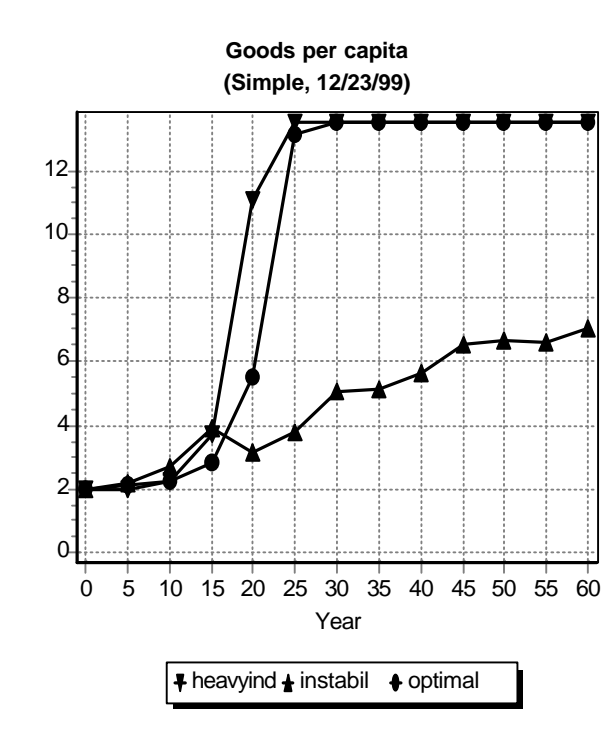
VERYHARD

```
Starting values of STRATAGEM, version 3.0
200     41       22                          population, birthrate, deathrate
1.49    1.2      27.33    18                 birthmult, deathmult, normbr, normdr
3000    3500     14500                        total food, tot. goods, total energy
3000    2                                    foodproduction, foodpercapita
3000    2        2000                         goodsproduction, goodspercapita, goodsforpopulation
12000   12000                                energyprod, totenprod
1000    0                                    energycarry, energyexport
1       1                                    foodcapacityutilisation, goodscapacityutilisation
1       1                                    cmf cmg (consumption multiplier f and g prod)
2.25    2.25     1000     0.50               oldhumservpc,  humservpc, totexpincome, qualenv
0.1     1000  0     0                        interestrate, debt, imf-repayment, maxloan
300     0                                    interestcharges, lastforeignaid
2       2        2                            goodsconsumption last 3 years
1000    1000     1000                         export last 3 years
1       1.1      1.1                          importprices energy, food, goods
1500    0        500                          import energy, food, goods
800     0        800      0       300    450  capitalstocks
25      25       25       30      25     45   lifetimes (years)
160     0        160      0       60     50   depreciation (per period)
1       1        1        1       1          technology investments

Constants of STRATAGEM, version 3.0
2000                     oilcrisisyear
20000                    sustainable capital
3                        env prot capital
1000                     agricultural area;
0.25                     employed fraction;
2       1        1.1     newoilprice;  exportprice  normimpprice ;
4.0     2.5      0.2     specengprodcap ; specenfprodcap ; hhenergymult ;
1.25    1.155    0.1     landprodnorm ; laborprodnorm ; norminterest ;
1       10000            eneffmultnorm ; totenergyresources ;
10000   10               maxuseencap ; maxfprodcapperland ;

Tablevalues of STRATAGEM, version 3.0
30.0 28.0 26.0 24.0 22.0 19.0 16.0 13.0 11.0 10.0 10.0  birthrate from gcons
1.00 1.50 1.45 1.40 1.35 1.30 1.20 1.10 1.00 1.00 1.00  birthmult from humserv
60.0 45.0 30.0 22.0 18.0 15.0 13.0 12.0 11.0 10.0 10.0  deathrate from fcons
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult goods
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult food
1.00 0.80 0.70 0.58 0.50 0.42 0.40 0.35 0.33 0.31 0.30  en cons mult eneffcap
0.00 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65 0.68 0.70  en outp mult encap
0.00 0.20 2.00 3.50 4.50 5.00 4.50 3.50 2.00 0.20 0.00  regeneration from qe
1.75 1.60 1.50 1.40 1.30 1.20 1.10 1.00 1.00 1.00 1.00  death mult from qe
0.00 4.00 5.50 7.00 7.80 8.30 9.00 9.30 9.50 9.70 10.0  deterioration from qe
0    1    2    3    3.7  4.2  4.5  4.7  4.8  4.9  5      landproductivity
1    2    3    3.5  4    4.3  4.5  4.7  4.8  4.9  5      labor outp mult humserv
0.8  4    7.2  10.4 12.5 14.4 16   17.2 18.5 19.4 20     labor outp mult g.cap
10   10   10   12   14   15   16   17   18   19   20     interestrate
1    1    1    1    1    1    1.2  1.4  1.6  1.8  2      price mult imports
```
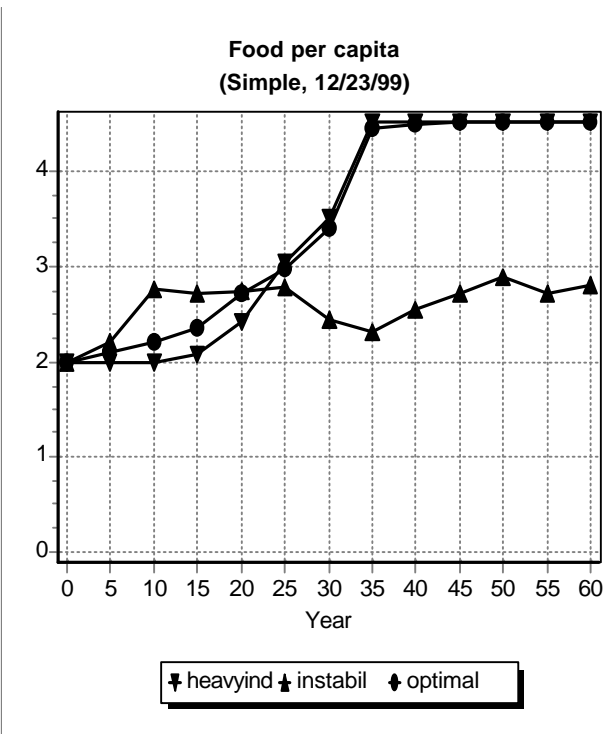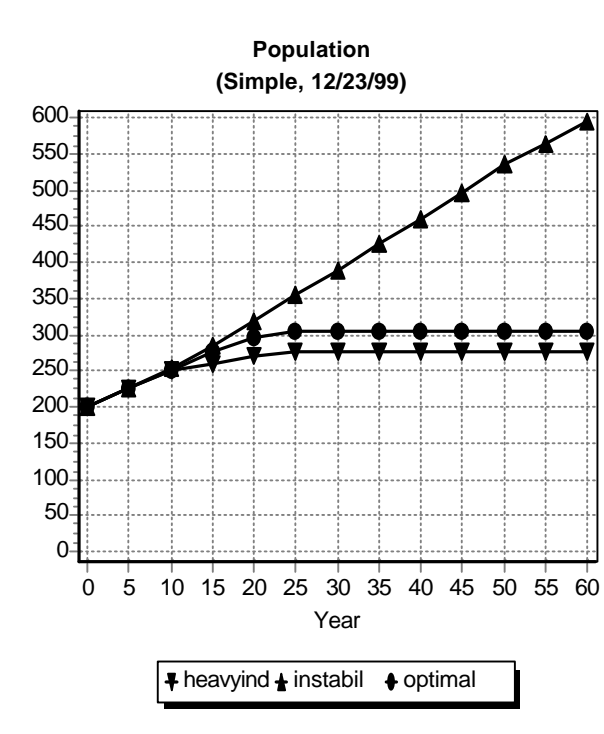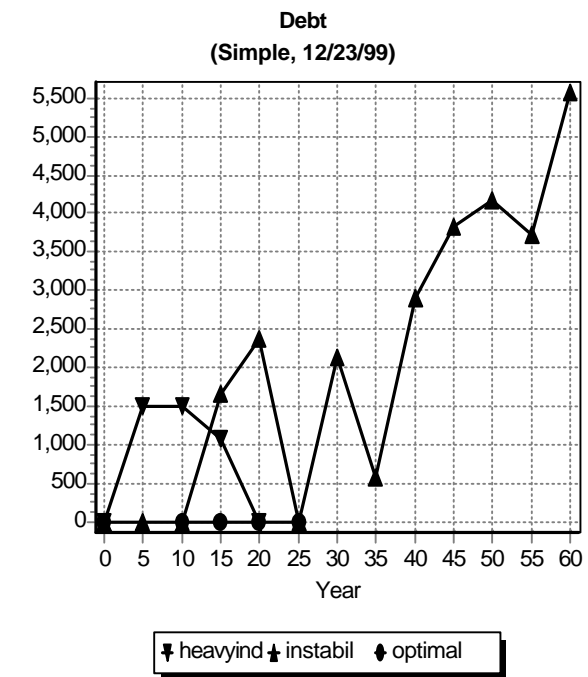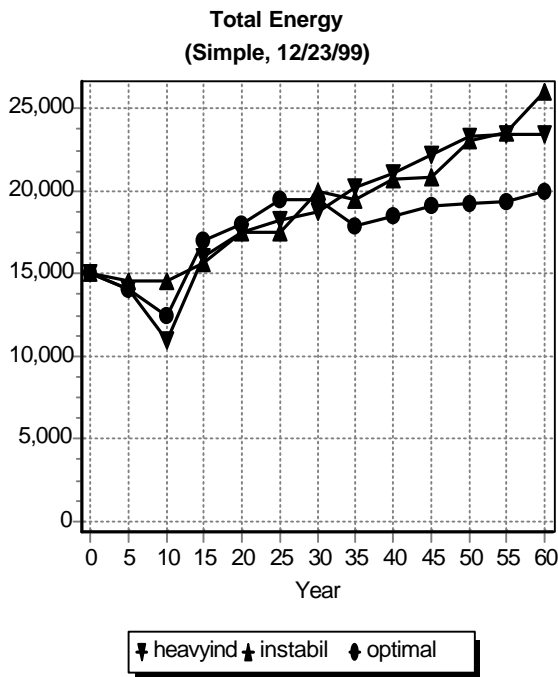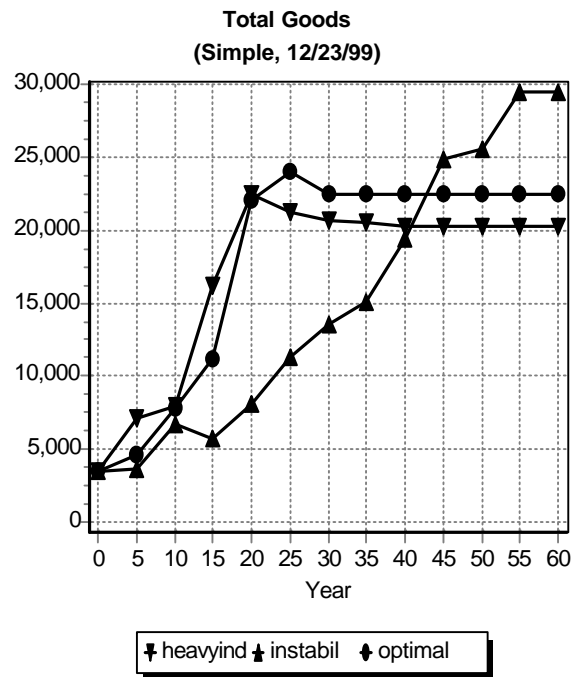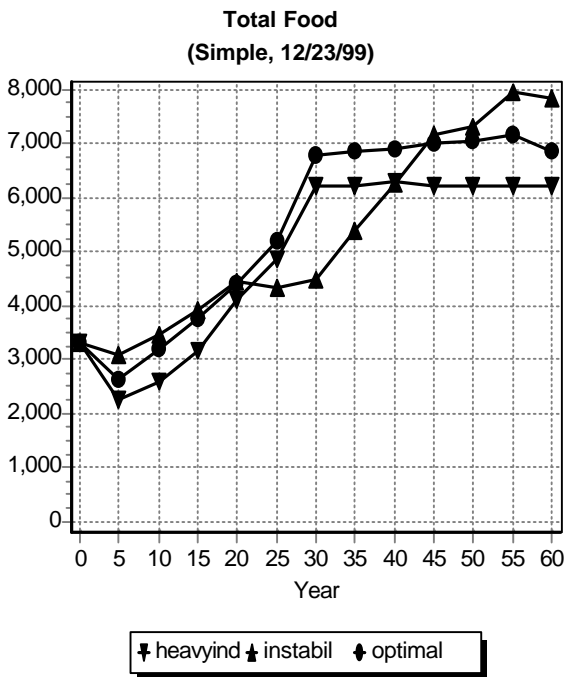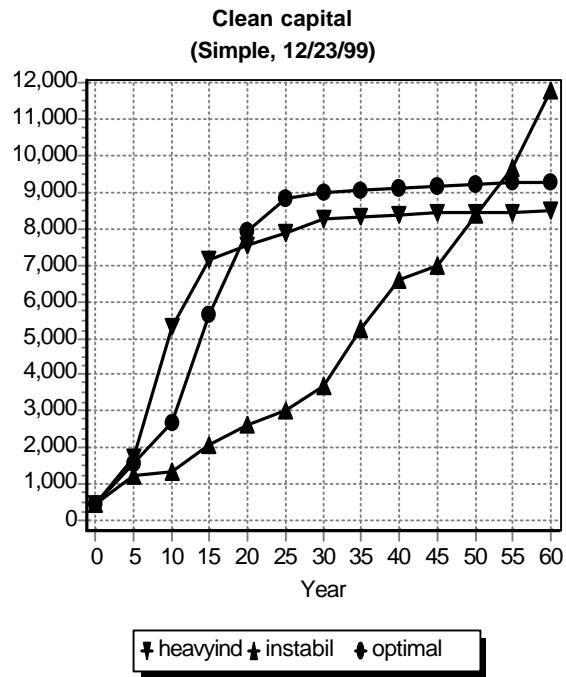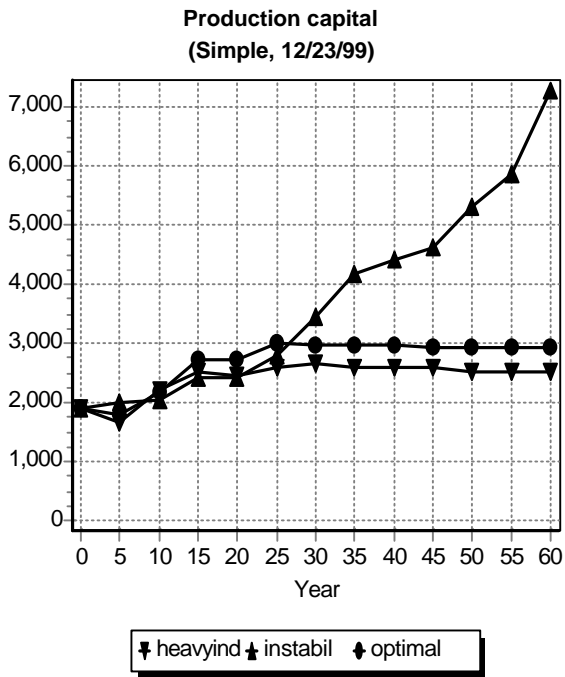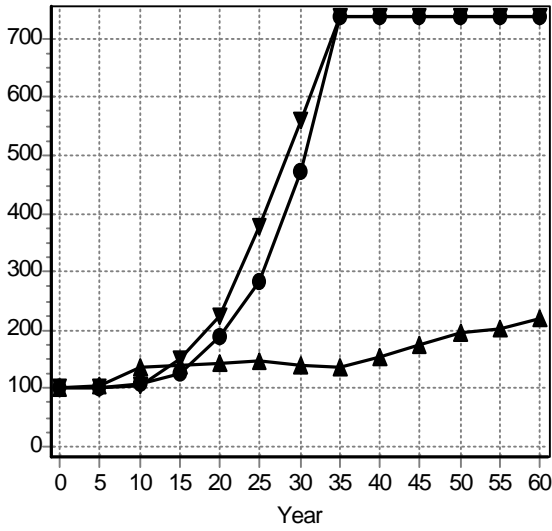
HIGHEQ

```
Starting values of STRATAGEM, version 3.0
400      10       10                             population, birthrate, deathrate
1.0      1.0      10       10                    birthmult, deathmult, normbr, normdr
9000     38530    35400                           totalfood, totalgoods, totalenergy
8000     4.5                                      foodproduction, foodpercapita
36530    13.5     27000                            goodsproduction, goodspercapita, goodsforpopulation
25000    35400                                     energyprod, totenprod
0        0                                         energycarry, energyexport
1        1                                         foodcapacityutilisation, goodscapacityutilisation
1        1                                         cmf cmg (consumption multiplier f and g prod)
16.0     16.0     2000     0.8                      oldhumservpc,  humservpc, totexpincome, qualenv
0.1      5000     0        5000                     interestrate, debt, imf-repayment, maxloan
1000     0                                         interestcharges, lastforeignaid
13.5     13.5     13.5                              goodsconsumption last 3 years
10000    10000    10000                             export last 3 years
1        1.1      1.1                               importprices energy, food, goods
10400    1000     2000                              import energy, food, goods
5000     1450     1600     1980     2000     6400   capitalstocks
25       25       25       30       25       45     lifetimes (years)
1000     290      320      330      400      710    depreciation (per period)
1        1        1        1        1                technology investments


Constants of STRATAGEM, version 3.0
1                        oilcrisisyear
20000                    sustainable capital
3                        env prot capital
1000                     agricultural area;
0.25                     employed fraction;
2        1        1.1     newoilprice;  exportprice  normimpprice ;
4.0      2.5      0.2     specengprodcap ; specenfprodcap ; hhenergymult ;
1.25     1.155    0.1     landprodnorm ; laborprodnorm ; norminterest ;
1        10000            eneffmultnorm ; totenergyresources ;
10000    10               maxuseencap ; maxfprodcapperland ;


Tablevalues of STRATAGEM, version 3.0
30.0 28.0 26.0 24.0 22.0 19.0 16.0 13.0 11.0 10.0 10.0  birthrate from gcons
1.00 1.50 1.45 1.40 1.35 1.30 1.20 1.10 1.00 1.00 1.00  birthmult from humserv
60.0 45.0 30.0 22.0 18.0 15.0 13.0 12.0 11.0 10.0 10.0  deathrate from fcons
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult goods
0.40 0.52 0.64 0.76 0.88 1.00 1.00 1.00 1.00 1.00 1.00  cons mult food
1.00 0.80 0.70 0.58 0.50 0.42 0.40 0.35 0.33 0.31 0.30  en cons mult eneffcap
0.00 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65 0.68 0.70  en outp mult encap
0.00 0.20 2.00 3.50 4.50 5.00 4.50 3.50 2.00 0.20 0.00  regeneration from qe
1.75 1.60 1.50 1.40 1.30 1.20 1.10 1.00 1.00 1.00 1.00  death mult from qe
0.00 4.00 5.50 7.00 7.80 8.30 9.00 9.30 9.50 9.70 10.0  deterioration from qe
0    1    2    3    3.7  4.2  4.5  4.7  4.8  4.9  5      landproductivity
1    2    3    3.5  4    4.3  4.5  4.7  4.8  4.9  5      labor outp mult humserv
1    4    6    10.4 12.5 14.4 16   17.2 18.5 19.4 20     labor outp mult g.cap
10   10   10   12   14   15   16   17   18   19   20     interestrate
1    1    1    1    1    1    1.2  1.4  1.6  1.8  2       price mult imports
```

Resulting graph's for the example with the 'SIMPLE' initial data.

Population
(Simple, 12/23/99)

Food per capita
(Simple, 12/23/99)

Goods per capita
(Simple, 12/23/99)

Human Services per capita
(Simple, 12/23/99)

Total Food
(Simple, 12/23/99)

Total Goods
(Simple, 12/23/99)

Total Energy
(Simple, 12/23/99)

Debt
(Simple, 12/23/99)

Production capital
(Simple, 12/23/99)

Clean capital
(Simple, 12/23/99)

**Population Index
(Simple, 12/23/99)**

**Quality index
(Simple, 12/23/99)**
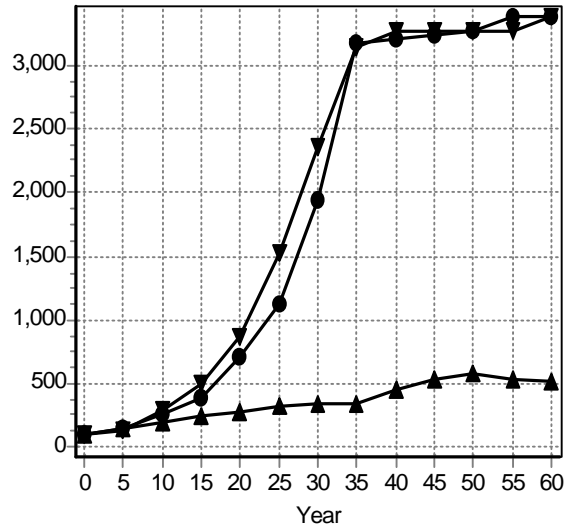
**GDP index
(Simple, 12/23/99)**
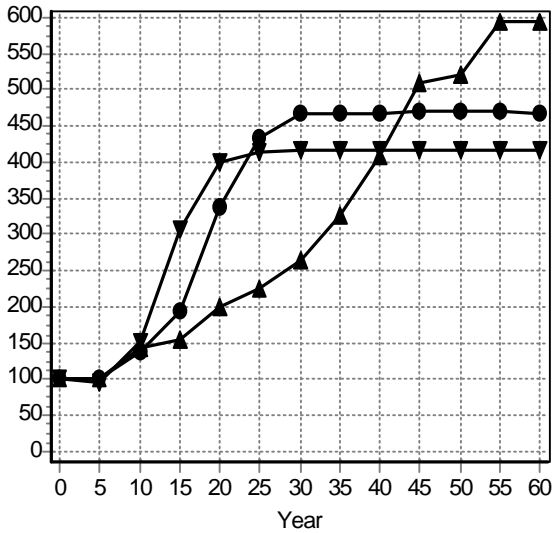
**GDP per capita index
(Simple, 12/23/99)**

Resulting graph's for the example with the 'TOUGH' initial data.

**Population
(Tough, 12/23/99)**

**Food per capita
(Tough, 12/23/99)**

**Goods per capita
(Tough, 12/23/99)**

**Human Services per capita
(Tough, 12/23/99)**
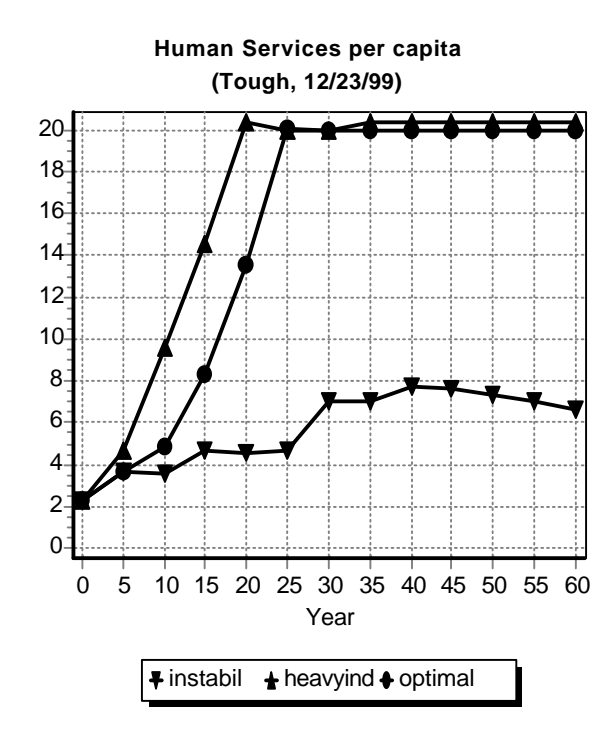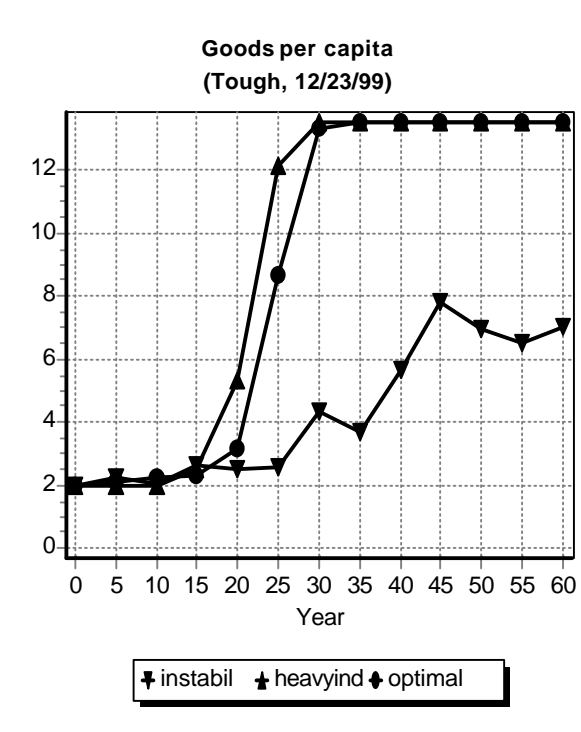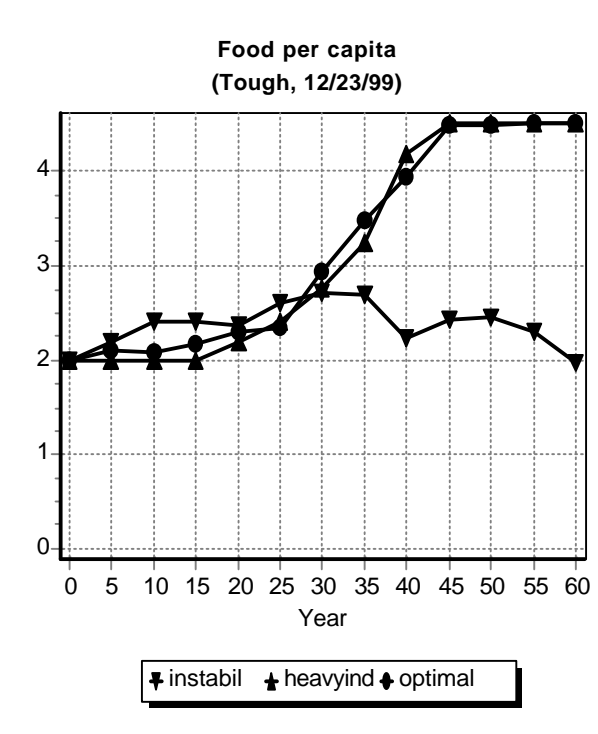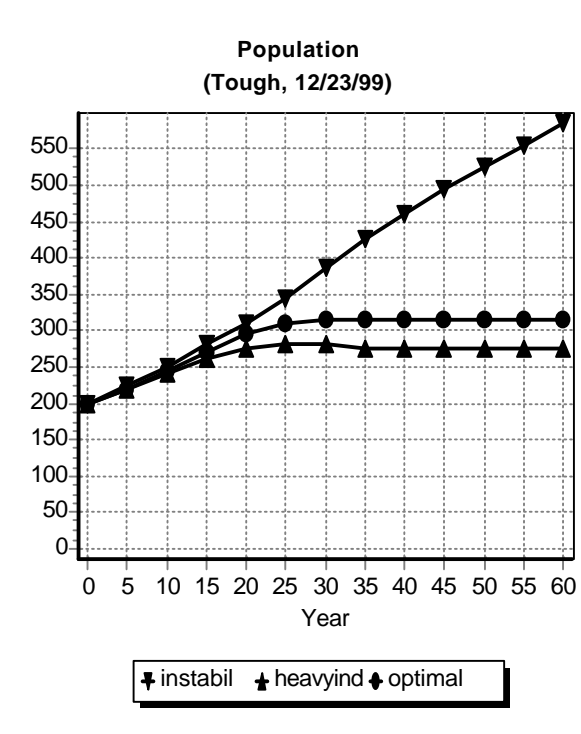
Total Food
(Tough, 12/23/99)

Year
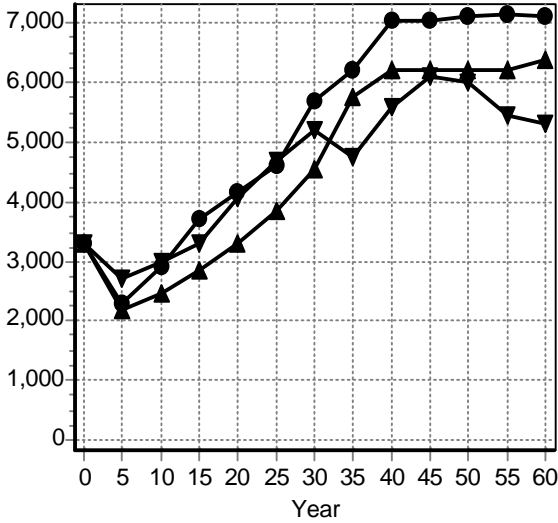
▼ instabil ▲ heavyind ● optimal

Total Goods
(Tough, 12/23/99)

Year
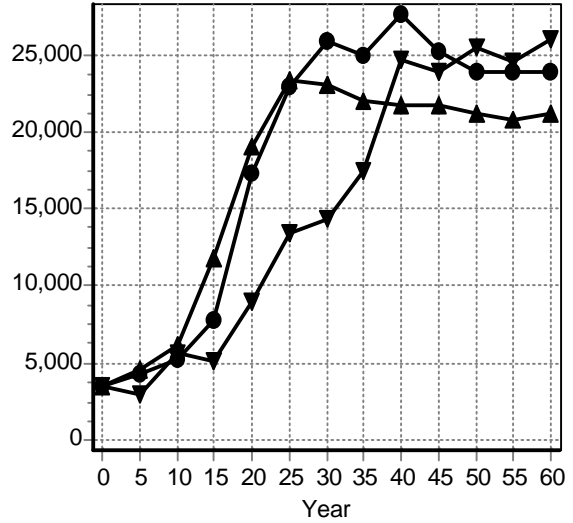
▼ instabil ▲ heavyind ● optimal

Total Energy
(Tough, 12/23/99)

Year
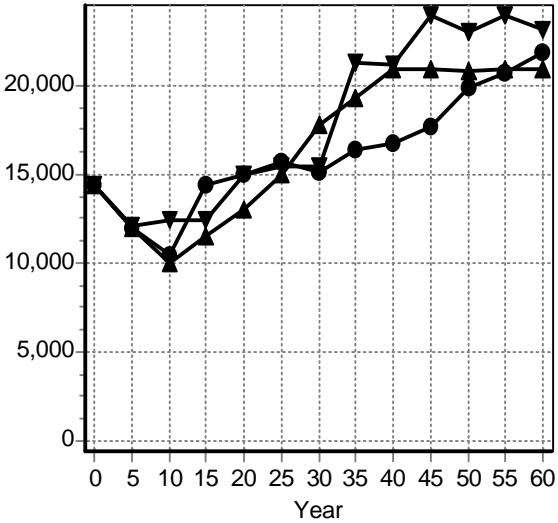
▼ instabil ▲ heavyind ● optimal

Debt
(Tough, 12/23/99)

Year
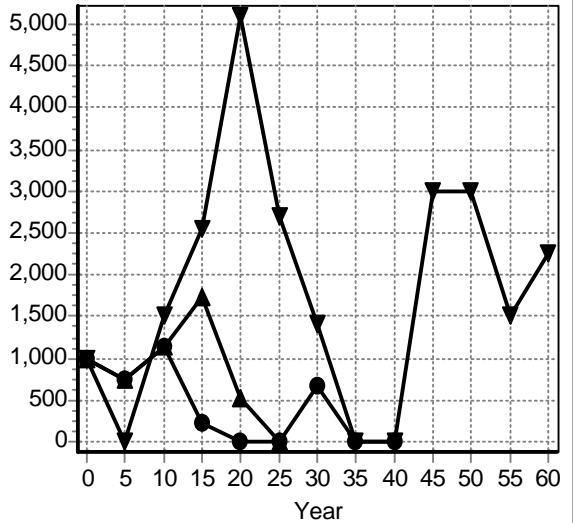
▼ instabil ▲ heavyind ● optimal

**Energy efficiency
(Tough, 12/23/99)**

instabil   heavyind   optimal
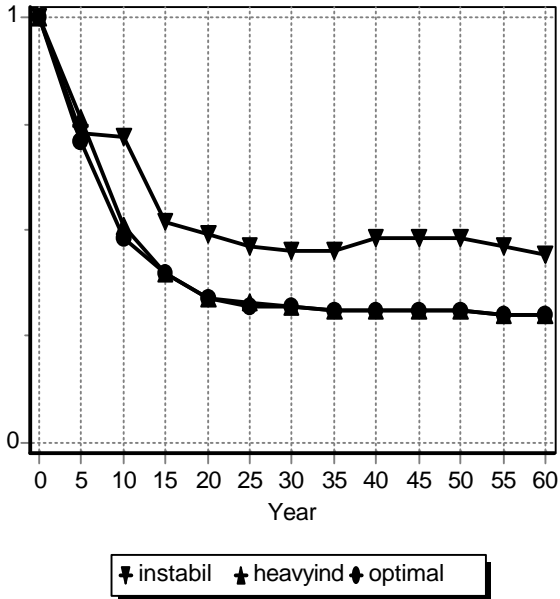
**Quality of Environment
(Tough, 12/23/99)**

instabil   heavyind   optimal
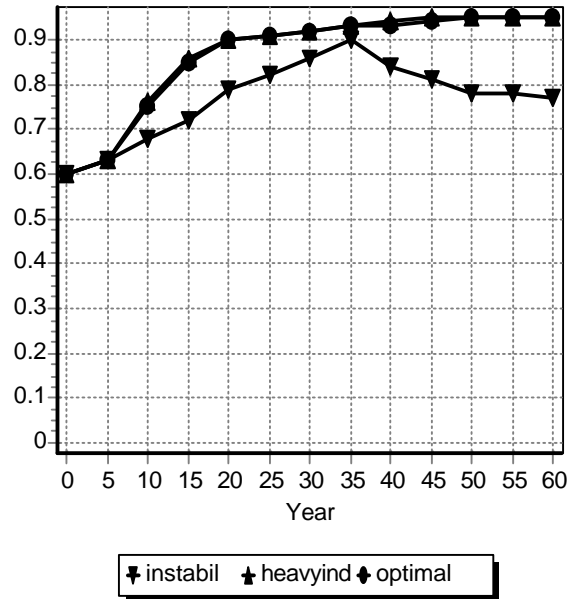
**Production capital
(Tough, 12/23/99)**

instabil   heavyind   optimal
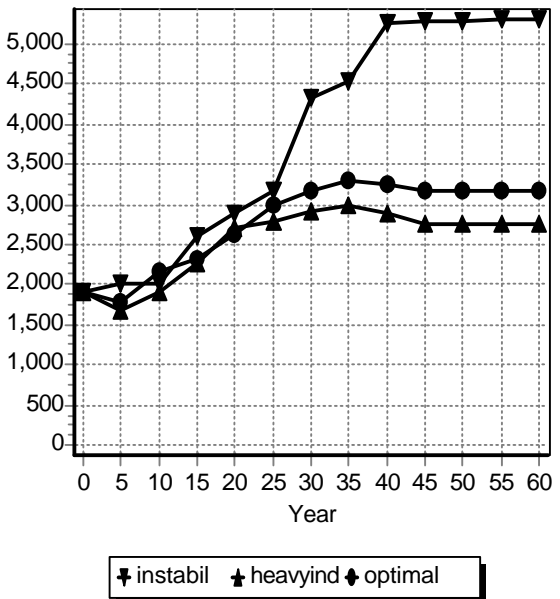
**Clean capital
(Tough, 12/23/99)**

instabil   heavyind   optimal
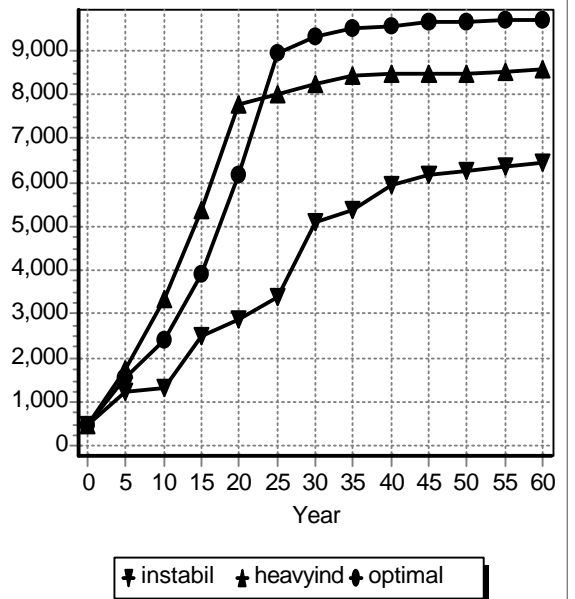
Population Index
(Tough, 12/23/99)

Quality index
(Tough, 12/23/99)
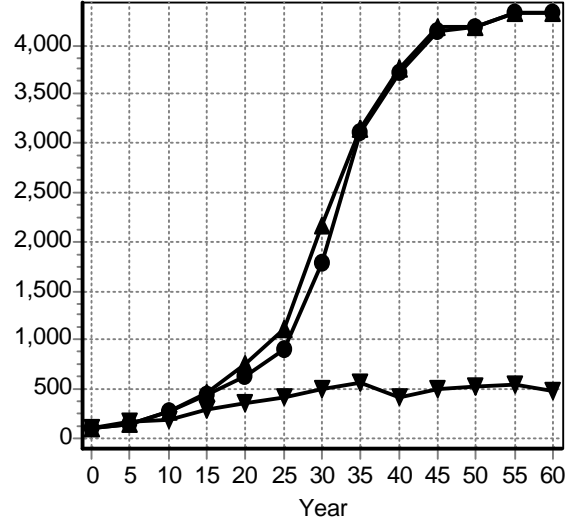
GDP index
(Tough, 12/23/99)
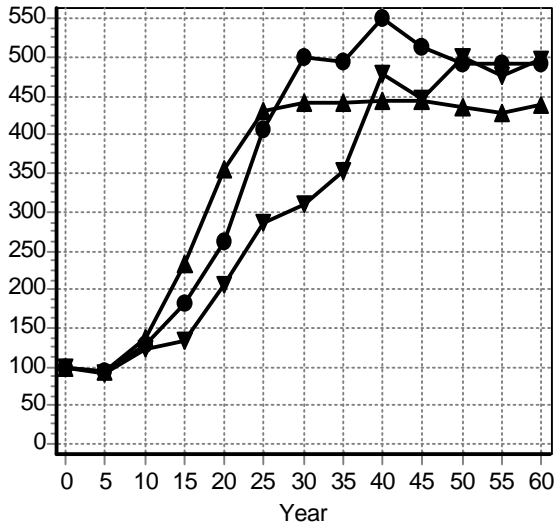
GDP per capita index
(Tough, 12/23/99)

Resulting graph's for the example with the 'VERYHARD' initial data.

Population
(Veryhard, 12/23/99)

Food per capita
(Veryhard, 12/23/99)
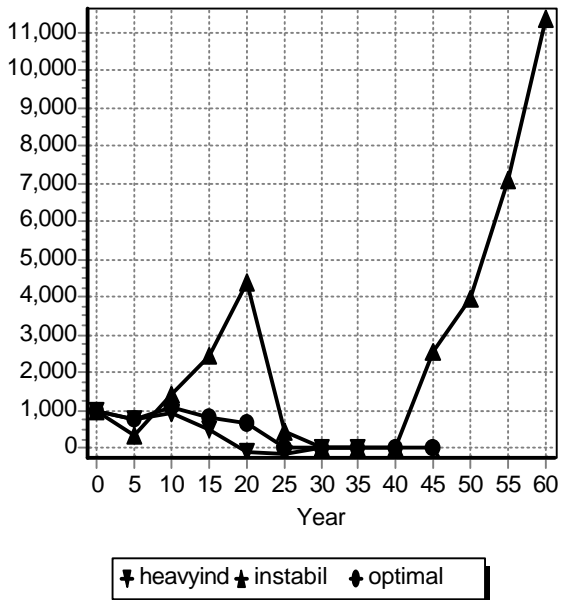

Goods per capita
(Veryhard, 12/23/99)

Human Services per capita
(Veryhard, 12/23/99)

Total Food
(Veryhard, 12/23/99)
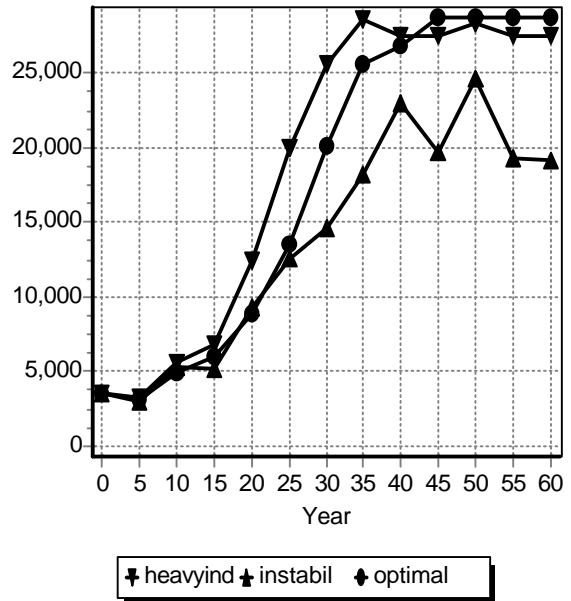
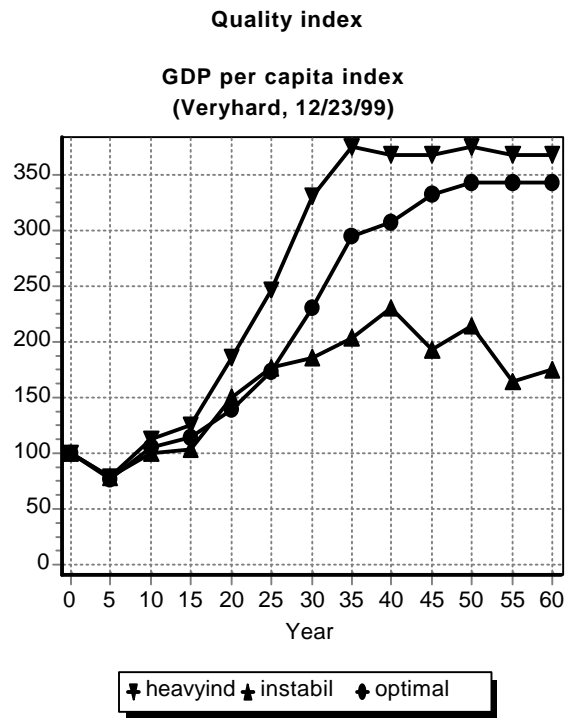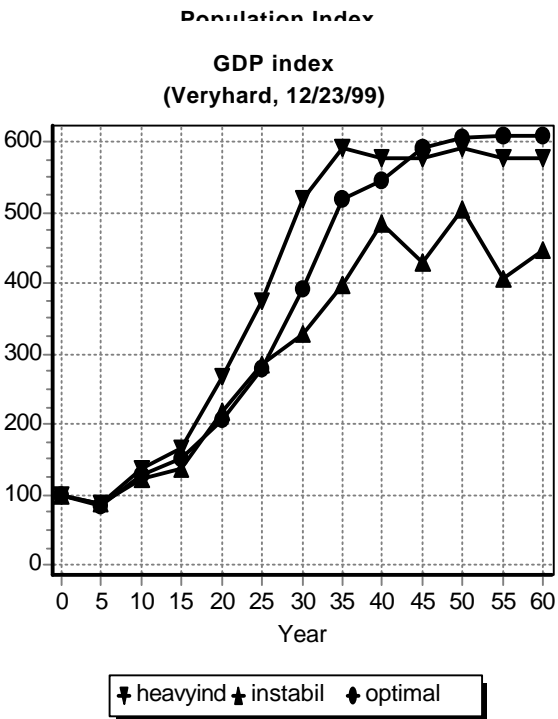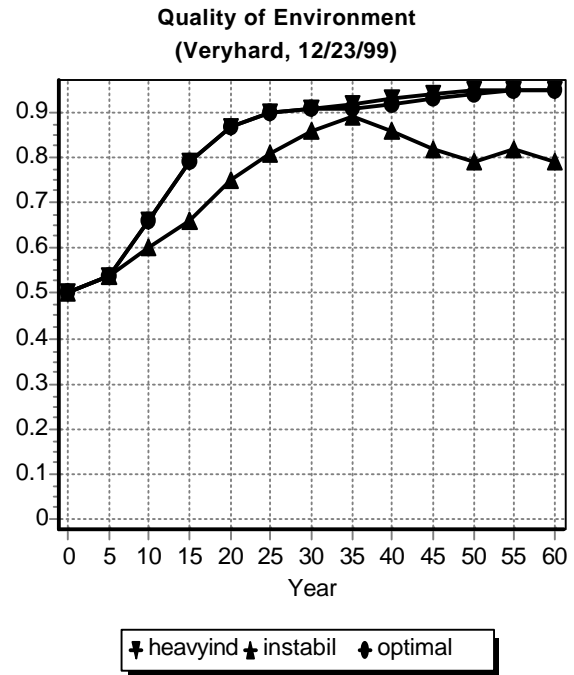heavyind   instabil   optimal

Total Goods
(Veryhard, 12/23/99)

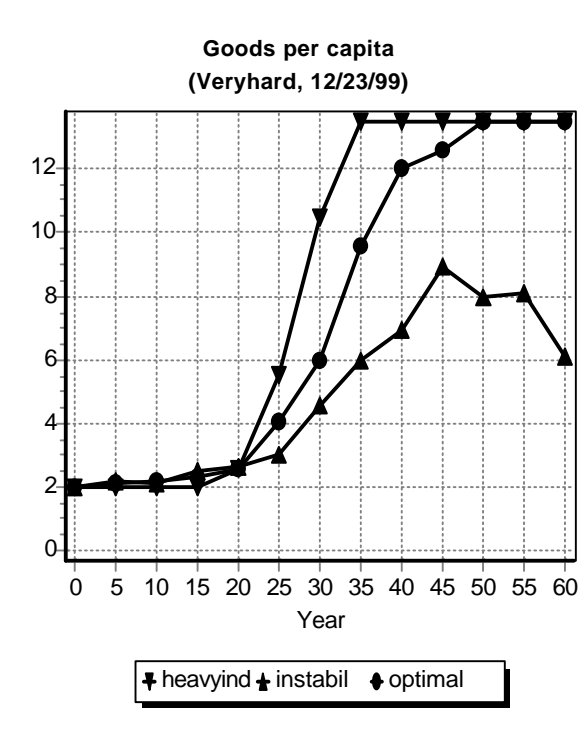heavyind   instabil   optimal

Total Energy
(Veryhard, 12/23/99)

heavyind   instabil   optimal

Debt
(Veryhard, 12/23/99)

heavyind   instabil   optimal

**Energy efficiency
(Veryhard, 12/23/99)**

heavyind   instabil   optimal

**Quality of Environment
(Veryhard, 12/23/99)**

heavyind   instabil   optimal

Population Index

**GDP index
(Veryhard, 12/23/99)**

heavyind   instabil   optimal

Quality index

**GDP per capita index
(Veryhard, 12/23/99)**

heavyind   instabil   optimal

Resulting graph's for the example with the 'HIGHEQ' initial data.
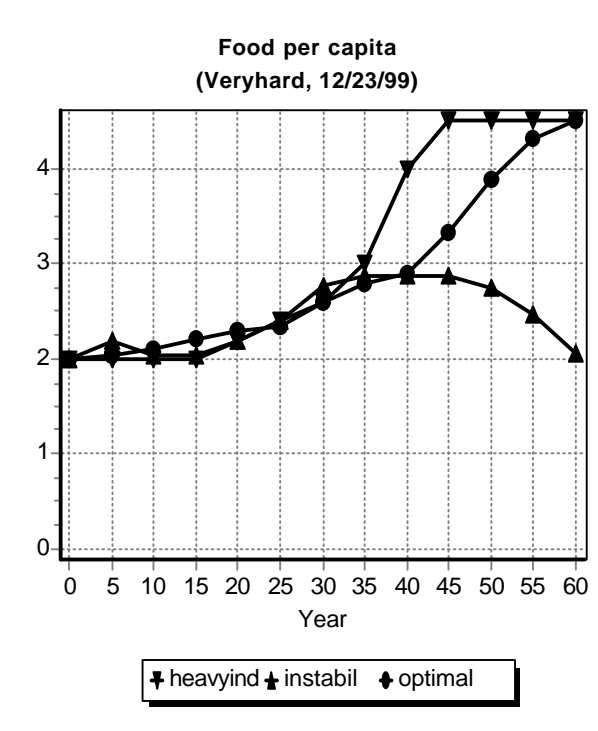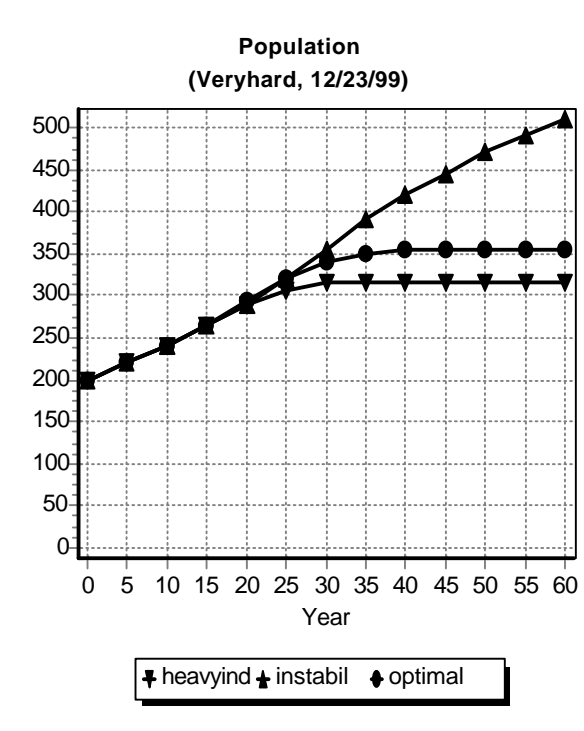
Population
(Veryhard, 12/23/99)

▼ heavyind ▲ instabil ● optimal

Food per capita
(Veryhard, 12/23/99)

▼ heavyind ▲ instabil ● optimal

Goods per capita
(Veryhard, 12/23/99)

▼ heavyind ▲ instabil ● optimal

Human Services per capita
(Veryhard, 12/23/99)

▼ heavyind ▲ instabil ● optimal

Total Food
(Veryhard, 12/23/99)

Year

▼ heavyind ▲ instabil ● optimal

Total Goods
(Veryhard, 12/23/99)
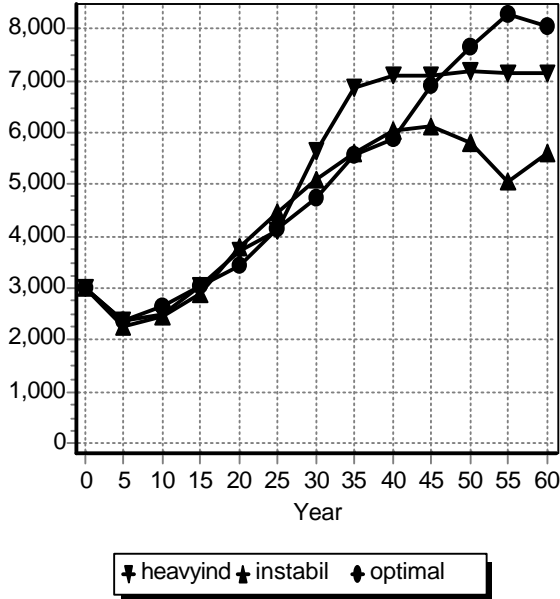

Year

▼ heavyind ▲ instabil ● optimal

Total Energy
(Veryhard, 12/23/99)

Year

▼ heavyind ▲ instabil ● optimal

Debt
(Veryhard, 12/23/99)

Year

▼ heavyind ▲ instabil ● optimal
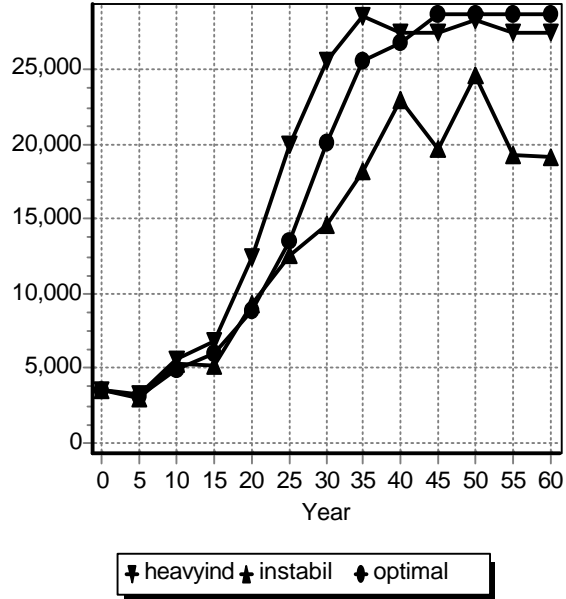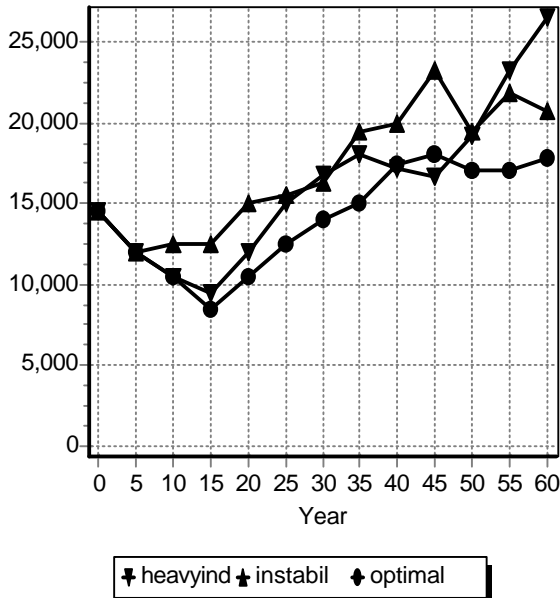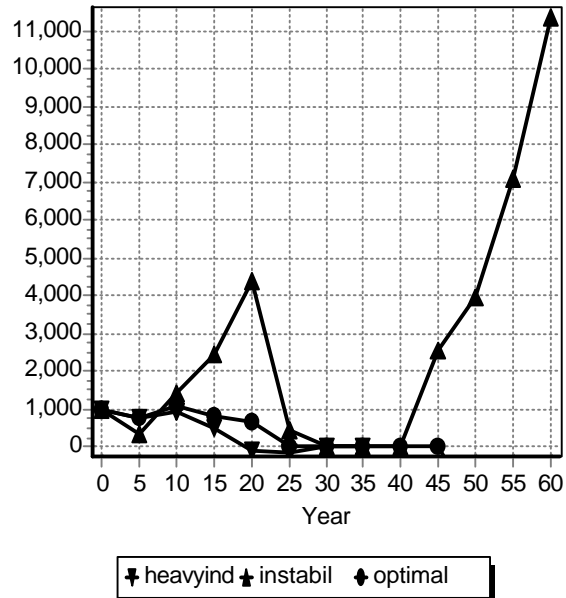
**Energy efficiency
(Veryhard, 12/23/99)**
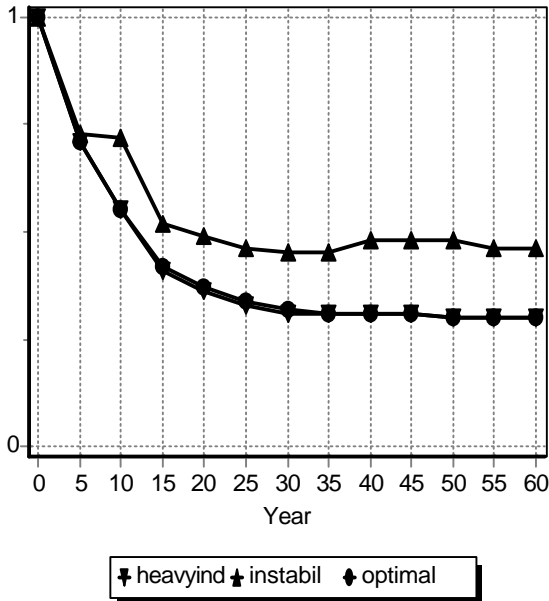
**Quality of Environment
(Veryhard, 12/23/99)**

**Production capital
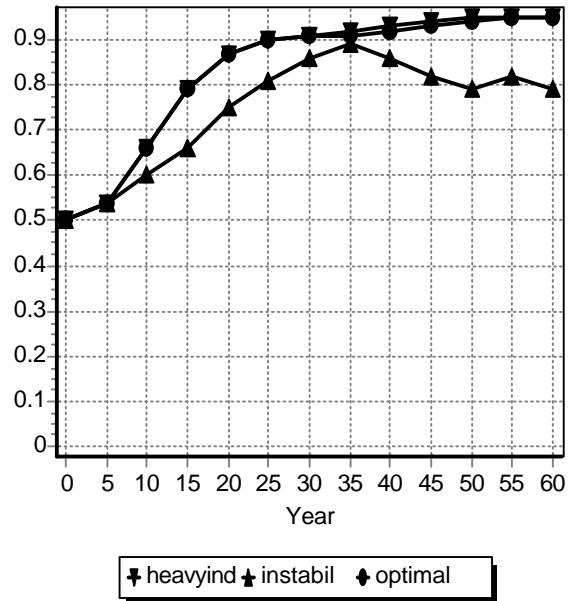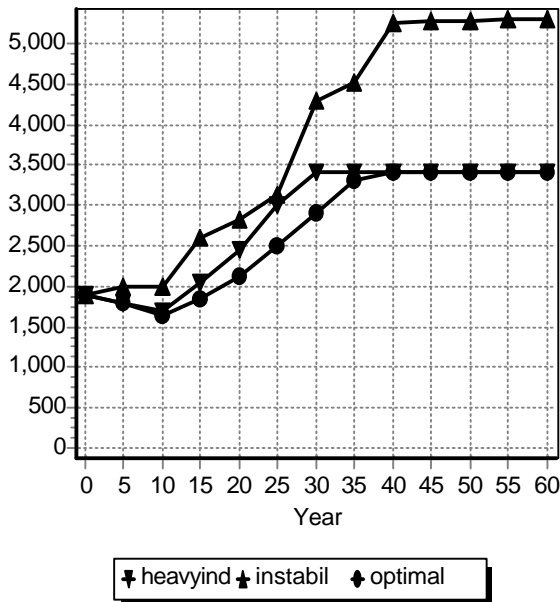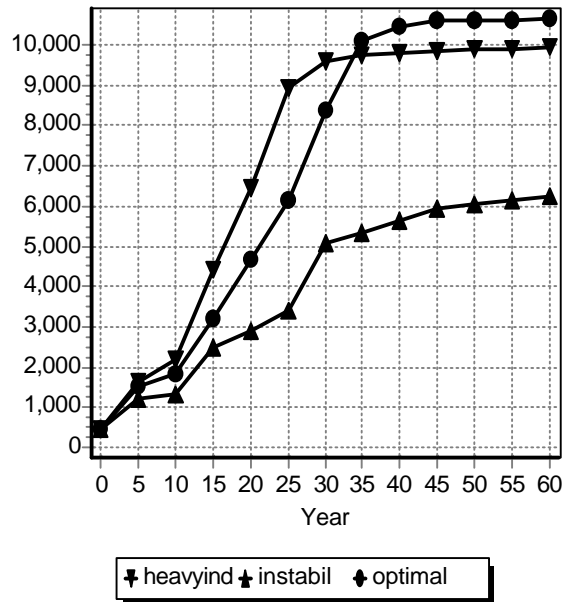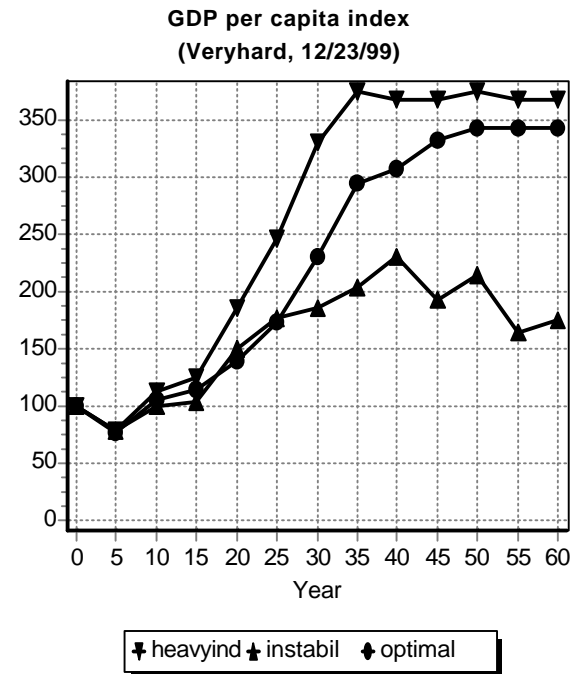(Veryhard, 12/23/99)**

**Clean capital
(Veryhard, 12/23/99)**

Population Index
(Veryhard, 12/23/99)
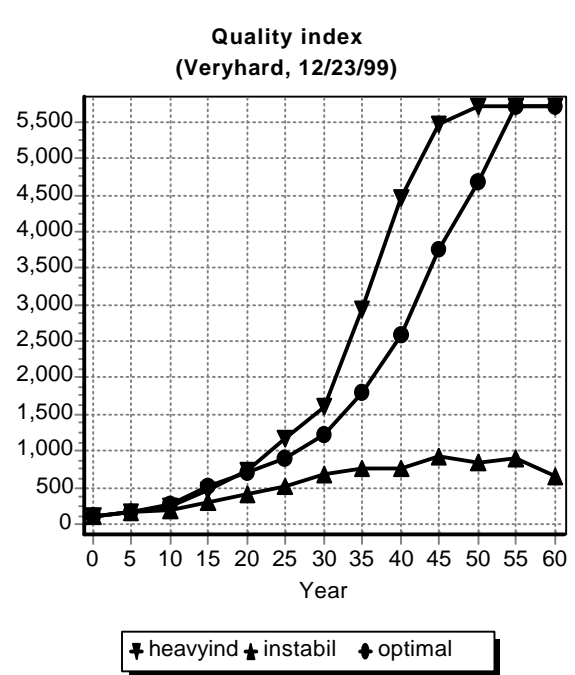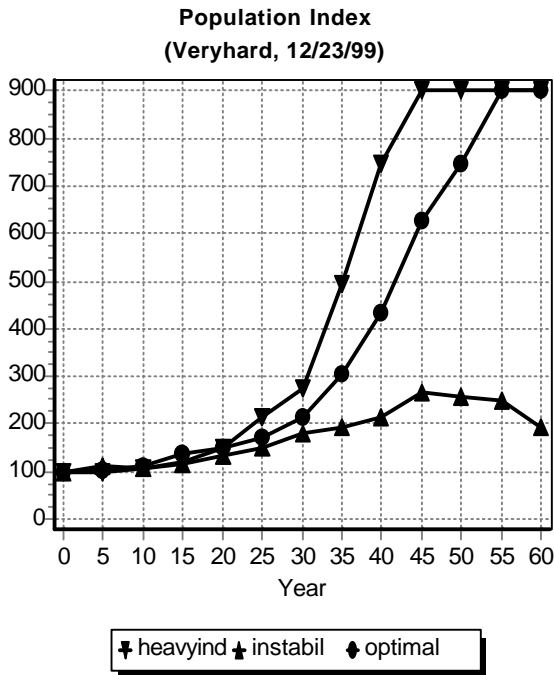

Quality index
(Veryhard, 12/23/99)

GDP index
(Veryhard, 12/23/99)

GDP per capita index
(Veryhard, 12/23/99)
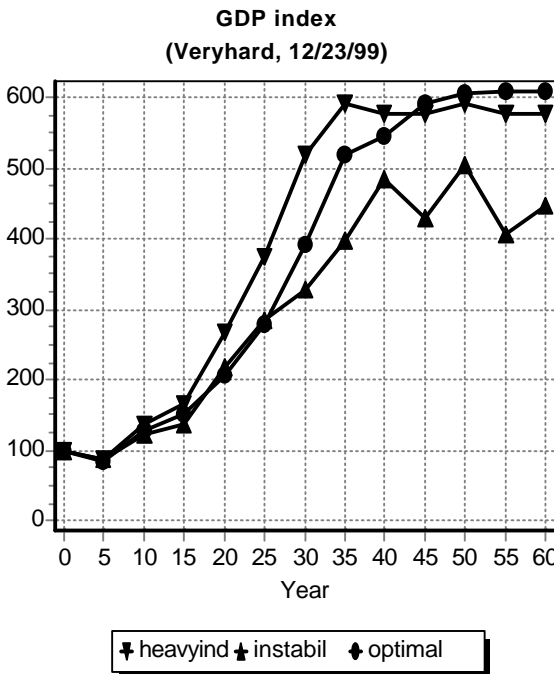
APPENDIX H REGRESSION TEST

The correct functioning of the program can be checked by using a standard input set that is described below. The resulting output should be like the output form shown below.
The INI-file used is STANDARD.INI

The **input** has been as follows:

		ALLOCATIONS			INVESTMENTS			INT. TRADE
Food domestic	:	0	food prod	:	0	foreign aid	:	100	
exports	:	3300	env. protect	:	0	new loans	:	0	
Goods domestic	:	0	goods prod.	:	0	repayments	:	200	
exports	:	3500	humservices	:	0				
investm.	:	0	energyprod	:	0				
Energy			energyef	:	0		IMPORTS		
foodprod	:	0				for energy	:	14700	
goodsprod	:	0				for food	:	1000	
exports	:	10000				for goods	:	1000	
carryover	:	4500							
						sanctions	:	500	

The **output** form should read as follows:
Country : TEST, Status at the start of period : 5 - 9, the year : 5

POPULATION AND HOUSEHOLD CONSUMPTION

The population is 180, resulting from a growth rate of -9.5% .
This percentage is based on :
  an annual birth rate of 1.49 * 28   => 42 per 1000;
  an annual death rate of 1.01 * 60   => 61 per 1000.
Last period each person received per year :
  Food: 0.00 (range: 0-5); Goods: 0.00 (range: 0-15).
Human services capital per person was: 2.25 (range: 0-20).

Available for use in this period:
FOOD   : 910, of which ..... is for consumption, and ..... for export;
GOODS : 1090, of which ..... is for consumption, ... is for export, and
          ..... for investment (total depreciation was 350).

IMF SANCTION TOOK 10% OF YOUR GOODS PRODUCTION FOR REPAYMENT OF YOUR DEBTS.

ENERGY PRODUCTION AND EFFICIENCY

Last period 12000 energy units were produced. The import was 14700;
carried over were 4500 units. So 31200 energy units are available.
This will be used as follows :
    domestic energy use   (.....)   (0 was required last period)
    food production   .....   (8000 is required for full capacity)
    goods production   .....   (4800 is required for full capacity)
    export   .....   (last period you exported 10000)

carry-over ..... (last period you carried over 4500)

The average energy consumption multiplier is 1.00 this period (range: 0.3-1),
so for one period you need :
 12.5 units of energy to operate one food production capital unit,
 20.0 units of energy to operate one goods production capital unit.

This period 9500 energy units will be produced by 640 capital units (an
average of 14.84 units of energy per unit energy production capital stock).
From this capital stock 130 will be depreciated at the end of this period,
leaving 510 units, unless you make new investments.

The energy efficiency capital is 0 of which 0 is depreciated
at the end of this period, leaving 0 capital units, unless you make
new investments.

In this period you will place under construction :
   .... units of energy production capital,
   .... units of energy efficiency capital.

FOOD AND ENVIRONMENT

Food production last period was 0,
the import was 910, so 910 units of food are available.
Last period the capacity utilization in the food industry was 0.00
and the consumption multiplier on food production was 0.40

The food capital stock is 640, of which 130 will be depreciated
at the end of this period, leaving 510 capital units, unless you make
new investments.

The environmental protection capital is 0 of which 0 will be
depreciated at the end of this period, leaving 0 capital units,
unless you make new investments.

Expected food production =	constant *	MFC *	MFP *	QE
3050	6250.00	1	0.64	0.76
(ranges:)		(0.4-1)	(0-5)	(0-1)

In this period you will place under construction :
   .... units of food production capital,
   .... units of environmental protection capital.

GOODS PRODUCTION AND HUMAN SERVICES,

Goods production last period was 200.
IMF SANCTION TOOK 10% OF YOUR GOODS PRODUCTION FOR REPAYMENT OF YOUR DEBTS.
The import was 910, so 1090 units of goods are available.
Last period the capacity utilization in the goods industry was 0.00
and the consumption multiplier on goods production was 0.40

The goods capital stock is 240, of which 50 will be depreciated
at the end of this period, leaving 190 capital units, unless you

make new investments.

The human services capital is 400 of which 40 will be depreciated
at the end of this period, leaving 360 capital units, unless you
make new investments.

Expected goods production =   constant * LF *   MGC * MGP * MHS
                  2800   5.775   45   1   5.07   2.1
             (ranges:)   (0.4-1) (0-20) (0-5)

In this period you will place under construction :
   .... units of goods production capital,
   .... units of human services capital.

TRADE AND INTERNATIONAL FINANCE

At the start of this period the debt is 1930, the interest rate 10 %/yr.
Last period you paid 650 for interest charges.
Last period you received 100 foreign aid.
The maximum loan in this period is 4340.
YOUR DEBT EXCEEDS A CRITICAL VALUE, SO 10% OF YOUR GOODS PRODUCTION
HAS BEEN SEIZED BY THE IMF FOR REDUCTION OF YOUR DEBT !
Your GDP growth was -97 so your GDP index is now 3.
The GDP per caput index was 3.0

Your balance sheet:
money from energy export: (.....)
money from goods export: (.....)
money from   food export: (.....)
money from foreign aid   .....   (determined by game operator)
new loans: .....
                                 ---------- +
SUM OF THESE: (.....)
repayments: .....
                                 ---------- -
AVAILABLE FOR IMPORTS   (.....), divided as follows:

   for energy .....   (the import price is 1.00)
   for food   .....   (the import price is 1.10)
   for goods   .....   (the import price is 1.10)

STRATAGEM © IVEM University of Groningen 2000

APPENDIX I PRINT OUT OF THE READ.ME AND SOFTWARE.INF FILES ON THE DISKETTE

STRATAGEM - Delphi version 1 December 2000.
version 1.5 , February 1987.
version 2.0 , August 1994.
version 3.0 , April 1996.
version 4.0 , December 2000
(C)   Copyright IVEM - University of Groningen - The Netherlands.
Nijenborgh 4, 9747 AG GRONINGEN - The Netherlands.
Telephone : (0)50 - 3634609; Fax: (0)50 - 3637168

Please send your remarks or requests to:
René Benders,
Centre for Energy and Environmental Studies (IVEM),
University of Groningen
r.m.j.benders@fwn.rug.nl

READ THIS FIRST ! :
On this diskette program codes and data files for the simulation-game STRATAGEM are available. Be sure you have a back-up copy of the diskette. If not, make one now!

STRATAGEM files:
Stratagem.exe   : program
Strat.cfg   : configuration file
Strat.hlp   : help file
*.ini files   : files with initial data (cf. appendix G in the manual)
*.res files &
*.rs2 files   : examples of STRATAGEM runs, they corresponds to the ini-files with the same name

Notes for users:
If you're not familiar with STRATAGEM you should first read the STRATAGEM-documentation.
If you're familiar with STRATAGEM you may start it immediately:

Installation to hard-disk:
There are two possibilities to install STRATAGEM on your hard-disk:
1.   Use the install program on the STRATAGEM disk and follow the instructions
2.   Copy the contents of the STRATAGEM disk to a subdirectory on your hard-disk
-     make your own directory
-     copy the program diskette contents to hard-disk
-     and type STRATAGEM

READ.ME file

The Center for Energy and Environmental Studies (IVEM) has evolved into a major center for energy and environmental research and education employing about twenty natural and social scientists. The Center has a two-year curriculum, with students coming from the natural sciences, after which they can graduate in environmental sciences.
A half-year introductory course on energy and environment is given for students coming from all disciplines.

IVEM computer simulations, models and games

The IVEM has a long-standing experience in resource modelling. This brochure contains a brief description of four of the games presently used in our educational curriculum: Agrosim, PowerPlan, STRATAGEM, Fish Banks Ltd and EAP.

DoMUS
DoMUS is a model about the energy consumption in Households. Energy consumption can be divided in direct consumption (energy needed for space heating, lighting) and indirect consumption (energy needed for the production of a refrigerator or breeding potatoes). Each expenditure of a household is accompanied with some energy use. The way a household spends their income determines the amount of energy used by this household. DoMUS is a model, which can be used in a standalone or in a game setting, which calculates the total energy use as a result of a households lifestyle. The model and the data used are a result of a 10 year research period at the IVEM on Energy analysis, Domestic Lifestyles Household consumption patterns and the ability of change.

Agrosim
In the simulation model for local-scale agriculture, "Agrosim", the player can place himself in the position of a Dutch farmer. Every decision made each year by the farmers has an impact on the market, on the economic position and the environmental quality. The player that ruins the market or the environment, may eventually ruin himself. Agrosim will give you a deeper understanding of the dilemmas that occur if you want to run a farm economically and at the same time want to take care of the environment.
Model and Manual are in Dutch.

PowerPlan
Which routes can a country choose to supply electricity in the future. Many forecasts and scenarios have been published. Every year planning documents try to incorporate recent developments: changing demand expectations, environmental regulations or risk assessment of nuclear energy. The last decades has shown a growing public concern and interest in electric power planning. Energy conservation, hazardous nuclear waste and acid rain have become newspaper issues almost every day. To explore and evaluate electric power policies, the computer simulation model PowerPlan has been developed. In this interactive model the users - or, if you like, the players - shape their own future, and get answers to questions like: can we do without nuclear power and to what extent can wind power contribute to the future electricity supply?

STRATAGEM
STRATAGEM is an operational game that educates players decisions required to achieve a stable, sustainable, high productivity society. The players form a national administration of a developing country and have all information about cause-effect relationships that govern the success of their decisions. There are no exogenous influences and unknown relationships. Consequently, if a team performs well, it can assume full credit. If it performs poorly, there are no outside influences to blame. A not uncommon outcome is stagnation, with growth in population offsetting all gains in economy. It is even possible to 'crash' the society. If players let debt rise out of control, environment deteriorate too far, labor productivity slip, energy shortages mount and population growth is too high, the economic of the region can spiral downward out of control. And you know who is to blame.

Fish Banks Ltd.
There are many ways to manage a fish population. In this game you will manage one of the principal fishing companies in your country. Together with the other members of the board you will operate your fleet each year according to policies you designed to maximize the profit, in competition with other companies. You have to decide where the ships are going to fish, whether you buy ships from the other teams and order new ships. Will it thus be possible to attain a sustainable fish population? You will know it at the end of the game.

EAP
The Energy Analysis Program (EAP) is a computer program for the calculation of the direct and indirect energy requirements and the corresponding CO_2, CH_4 and NO_X emissions of household consumption items. The calculation method incorporated in the program is a hybrid method, so-called since it contains elements from process analysis as well as input-output analysis - the main methods of energy analysis. EAP contains a common database, which comprises of basic data about energy requirements and CO_2, CH_4 and NO_X emissions of materials, economic sectors, means of transport, etc., for standardizing the application of the method.

SOFTWARE.INF : information

You can order **DoMUS** at a cost of Dfl. 1000 (Dfl. 400 for non-commercial organizations. You receive the DoMUS program on floppy disks or CD Rom, a manual (in Dutch) with a scientific justification of the model, a guided tour, role descriptions and an operator manual.
You need an IBM-compatible PC.
System requirements: Windows 3.1, 3.11, '95 or '98, VGA Graphics card (Super VGA recommended (800*600)).
Version 1.0, March 1999
You can load a demo of **DoMUS** at: http://www.fwn.rug.nl/ivem/soft.htm.

You can order **Agrosim** at a cost of Dfl. 250 (Dfl. 150 for non-commercial organizations). You receive a floppy disk with the Agrosim program and an operator manual.
You need an IBM-compatible PC and a 80-column matrix printer.
System requirements: MS-DOS 2.1 or higher, 640K of memory, Graphics card (Hercules, CGA, EGA or VGA).
Version: May 1996
You can load a demo of **Agrosim** at: http://www.fwn.rug.nl/ivem/soft.htm.

You can order **PowerPlan** at a cost of Dfl. 900 (Dfl. 300 for non-commercial organizations). You receive a floppy disk with the PowerPlan program and a manual, including background information.
You need an IBM-compatible PC and a 80-column matrix printer.
System requirements: Windows 95 or higher, 16 Mb of memory, Graphics card (Super VGA recommended (800*600)).
Version: May 2000
You can load a demo of **PowerPlan** at: http://www.fwn.rug.nl/ivem/soft.htm.

You can order **STRATAGEM** at a cost of Dfl. 600 (Dfl. 200 for non-commercial organizations, an update will cost Dfl. 300 or Dfl. 100 respectively). You receive a floppy disk with the STRATAGEM 3.0 program, an operator manual with role descriptions and a playing board. For further information see chapter 8 of this manual.
You need an IBM-compatible PC, several printers are possible (a.o. Epson FX, HP Deskjet, HP LaserJet).
System requirements: MS-DOS 2.1 or higher, 640K of memory, Graphics card (Hercules, CGA, EGA or VGA).
Version: April 1996

You can order **Fish Banks Ltd.** at a cost of Dfl. 200 (Dfl. 100 for non-commercial organizations). You receive a floppy disk witn the Fish Banks program, an operator manual and a playing board.
You need an IBM-compatible PC and a 80-column matrix printer.
System requirements: MS-DOS 2.1 or higher, 640K of memory, Graphics card (Hercules, CGA, EGA or VGA).
Version: November 1990

The EAP software package is re-implemented for a windows platform and translated in English, the software as well as the manual. You can order EAP at a cost of Dfl. 1000 (Dfl. 400 for non-commercial organizations). You receive the EAP program and an operator manual.
You need an IBM-compatible PC.
System requirements: Windows 3.1, '95 or '98.
Version: Februari 1999 You can load a demo of **EAP** at: http://www.fwn.rug.nl/ivem/soft.htm.

SOFTWARE.INF : Prices and system requirements