Part I
The Optimum Structure and Management of World Society

1 Survey of Concepts

1.1 CONCEPTS NEEDED

This chapter sets out the concepts needed to design an integrated socio-economic and security order and its policy, to be discussed in the later chapters of Part I. A traditional socio-economic system, a traditional security and an integrated setup will be discussed. This means that we first examine the economist's position, then the peace researcher's, and finally set out our proposed integration of the two. Another way of expressing this is that, as economists, we internalise into the economic setup the security aspect. Of course, the security side might equally call this the internalisation of the socio-economic aspect into their setup. Either way we want to present an interdisciplinary analysis.

A main distinction we propose to make is that between *qualitative* and *quantitative concepts*. Qualitative characterisation of the concepts always constitutes the first step. Quantification may follow, but is not always possible; if it is, it is the second step, yielding supplementary information about the range of the phenomenon under discussion. This information opens up opportunities for further research not possible without quantification. Part of scientific development consists of quantifying or measuring something not measured so far. In physics the colour spectrum was first distinguished qualitatively only (red, orange, yellow, etc.) and later quantified as the wavelength of light. Temperature was first understood as something qualitative (hot, warm, etc.) and later measured in degrees. In economics we first speak of rich and poor people then refine that characterisation by measuring incomes.

Similarly a socio-economic order may be characterised by its *aims* either qualitatively or quantitatively. A qualitative identification of a set of aims may be full employment and balance of payments equilibrium. These aims may be quantified by specifying them as at most 3 per cent unemployment and a figure for the total of imports in the widest sense. Quantified aims are also called *targets*. Similarly the means used to attain the aims—for instance, tax rates—when quantified will be called *instruments*. The same terminology will be used in describing the security order.

In this book the socio-economic and security problems will be approached in a qualitative rather than a quantitative way. Partly we are forced to do so for lack of quantitative data. Where quantitative data are available and relevant we shall use them. Where they are not available or relevant some attempt will be made to fill the gaps. But some of the important problems we have to consider are mostly qualitative. In the terminology of the theory of economic policy (Tinbergen, 1956) it is *reforms* rather than year-on-year economic (or security) *policy* that we propose to deal with. In other words, the social (and security) order will be given the main emphasis, illustrated with the instruments to be used. We justify this choice using an example from civil engineering due to Goudriaan: it is more important to build a sufficiently strong bridge (based on static physics) than to study the dynamics of too weak a bridge's collapsing. Our research too is an attempt to find an order of peaceful stability.

This chapter's list of concepts may be compared with the list of *dramatis personae* in front of a play's text or the list of variables preceding an economic model. The order chosen follows the order in which the concepts enter the analysis. As a consequence the structure of this chapter is roughly the same as that of Chapters 2 to 4 inclusive. Some duplication is unavoidable, as Chapters 2 to 4 constitute an elaboration and refinement of the present chapter.

Before starting an ordered treatment of our subject we want to draw the reader's attention to the massive uncertainties it is beset with, largely because of its nature. Some examples may illustrate this. Among western scientists, politicians and military leaders enormous differences of opinion exist about the aims of Soviet leadership. Some hold the view that the occupation of Western Europe is among their aims, others deny this emphatically. Then, among scientists, a wide divergence of opinion exists about the possibilities of finding a technology to protect us against missile attacks. President Reagan's advisors are optimistic about such technological development. Most independent scientists—for instance, those united as 'Concerned Scientists'—are highly sceptical, and call the Strategic Defence Initiative (SDI) 'bizarre' (Rathjens and Ruina, 1985). Equally wide differences of opinion exist about the stability of the balance created by ballistic missile defence (BMD).

Very concrete uncertainties also exist, such as the question of the 'missile gap': for a long time US military leaders maintained that the Soviet Union had many more missiles than the United States. Once spy satellites were available to check the number of missiles, it was found that a gap did exist—but one which favoured the US.

1.2 QUALITATIVE SOCIO-ECONOMIC CONCEPTS: IDEOLOGIES, AIMS AND MEANS

Since a major role in today's economic and security debate is being played by the superpowers (the Soviet Union and the United States—which for reasons of symmetry we shall indicate in this book by SU and US) ideologies are the first concept we encounter. We define an ideology as a theory or an opinion held not by scholars but by politicians and some of the general public, and is more dated than theories discussed by scientists, although the latter are not completely free from ideologies. The main subject covered by an ideology is the impact of a social order on a population's welfare and security.

The two main ideologies used in the world political debate find their origin with Adam Smith (1776) as the father of 'capitalism' and Karl Marx (1867, etc.) of 'communism'. Put this way the ideologies are oversimplified and the extremes of capitalism and communism are inaccurate terms. Even though libraries of literature deal with these issues which the present authors contributed to, we think it appropriate here to restrict ourselves to this over-simplified and inaccurate statement: the argument of this book would not change significantly if we went into more scientific detail at this stage. We do so later. Targeted aims can be summarised as *optimal welfare*. Welfare or human satisfaction indicates the extent to which human needs are satisfied. Human beings are complex creatures with many needs. The details of welfare and its determinants will be discussed in section 2.2.

The socio-economic order created by a nation's authorities (Parliament and government) constitutes, in principle, the means to optimise the population's welfare. By 'order' we mean a set of institutions which all have a number of specific means or instruments. These institutions include traditional and natural groupings such as families, local communities and more consciously designed organisations such as enterprises (production units) up to government authorities at various levels (municipalities, provinces and the central government in Canada or the Netherlands, and similar institutions with other names elsewhere). A particular group of institutions (e.g. schools at various levels) fulfil separate tasks. Public authorities make decisions about a number of community tasks, such as internal law and order, provision of physical and psychical infrastructure, such as means of communication, information and policing, as well as the collection of the taxes and social security contributions needed to implement the authorities' statutory tasks. These concern *collective* or *public goods* whose characteristic is that one individual's use of them does not reduce the possibility for other individuals also to use them. The quantities of these goods needed must be such that the sum of all citizens' marginal utility equals the goods' marginal costs. (The authorities estimate the individuals' marginal utilities.)

A nation's institutions may also include private organisations, from productive units, mentioned before, to consumptive associations of many kinds, sports clubs, arts associations, religious communities, at both the local and international level. In many countries citizens are free to organise themselves in political parties, trade unions and employers' associations, often with superstructures, such as a congress of trade unions, or of employers' federations. In other countries less or little freedom prevails and more of these tasks are considered to be within the government's sphere.

1.3 QUANTITATIVE SOCIO-ECONOMIC CONCEPTS: MODELS, TARGETS AND INSTRUMENTS

As observed, part of the aims and means can be quantified and their interconnections indicated with the help of mathematical relations. In several respects these figures (usually called *variables*) and their mathematical *relations* can be seen as a framework determining the main appearance (German: *Gestalt*) of a nation's economy. Together they are called a model, to underline the simplified nature of such a framework. The variables may be distinguished in four categories (cf. Tinbergen, 1956): data, targets, instruments and other variables. Data are variables whose value is determined outside the socio-economic sphere, for instance scientific development or nature. In this book it is important that variables determined in the security sphere belong in this category.

Models can be used to analyse or to manage an economy—in more detail or more accurately over short periods, or only the main features over long periods. In this book management is chosen as our subject rather than analysis or explanation. This implies that we take as given the data and the targets, and as unknown the instruments and other variables. Important targets for a long-run socio-economic policy are population, production, employment, consumption, investment, income distribution, price levels. This is a minimum list for nations preferring a decentralised policy and leaving many decisions to private employers and markets. Nations with a centralised policy need a large number of targets referring to a considerable number of industrial sectors (in the wide sense of also including primary production (agriculture and mining) and tertiary production (services, from transportation to teaching)).

More features of the models discussed may be taken from economies half-way between complete centralisation and complete decentralisation. Such economies can be found in Western Europe, Japan and some developing countries, whereas the SU and US are more extreme. In such economies stable markets can be left unregulated, but unstable markets are better planned. Examples of the latter are several raw material markets, but possibly also some labour markets. The main cause of the instability of such different types of market are the long lags in the supply relations. A high price for rubber works through an over-supply only after the newly planted trees bear latex. It takes some time to train the increased number of students for a highly skilled type of labour (e.g. a computer programmer). Investment in large buildings and heavy equipment requires planning in order to avoid over- or underinvestment *vis-à -vis* what seems the most desirable rate of growth from various points of view, including environmental considerations. Another cause of market instability is *low elasticities* on both the demand and the supply sides. An aspect to be taken up in more detail in Chapters 5 and 6 is the need to plan for large parts of the world if not for the world as a whole.

The important mathematical relations in socio-economic models are: *balance equations, production functions* and *demand equations*. Balance equations are important because of the desirability for the economy to develop along a *balanced path*, meaning in many cases the avoidance of over- or underproduction of goods or of skills. Production functions in the widest sense are important since they represent *technological constraints* but also *choices*. Demand equations are important if a maximum of consumer satisfaction is desired.

1.4 SOLUTION OF THE OPTIMUM PROBLEM

We propose to discuss first the concepts used in an exact solution of the optimum order problems. Later we add some remarks on possible approximations. The solution starts by expressing the nation's welfare level in terms of the possible means and instruments to be used. For non-quantified means the relation between welfare and means can only be expressed verbally, or in a table showing qualitative characteristics. The optimum is the maximum of welfare within the frame of the restrictions on the economy. A simple example why restrictions occur is the following. Generally welfare experienced will be higher the more goods are available. Welfare for most people will also be higher the less they have to do onerous work. So at first sight most people will opt for as many goods as possible and as little unpleasant work as possible. But these two options are incompatible, because access to a large quantity of goods requires that a large quantity of unpleasant work be done. This relationship between quantity of goods and quantity of labour—known as a production relationship or *production function*—is one of the restrictions we are facing. The optimum is the point where one more unit of product provides as much satisfaction as the additional labour dissatisfaction. Beyond that point total satisfaction declines.

Other restrictions are to be found in our environment. More production also causes more pollution. Here again a point is reached where the additional pollution provides dissatisfaction equal to the satisfaction derived from the polluting activity.

The education process an individual chooses introduces its own restrictions. Learning more will enable that person to get a job providing more satisfaction—either psychologically or by a higher money income. But a point is reached where more learning is too difficult, depending on the person's capabilities.

Still other restrictions are the balance equations, mentioned before. They express the fact that no more of some input (e.g. energy) can be used than is available. This naturally applies to all inputs. The restrictions will be discussed in more detail in Chapter 3. There are different methods to find a maximum of some variable—welfare, in our case—within a framework of restrictions. In our illustrations for mathematically trained readers we shall choose the method known as 'Lagrange multipliers'. More advanced readers may prefer newer methods. We shall also offer a more advanced method, in some cases. Elsewhere, simpler methods will be used. Sometimes the exact method will be approximated only, instead of being applied strictly. Some applications of the quantitative models described in section 1.3 are based on the assumption that the policy planner knows what values a number of targets have in the optimum, for instance the employment target and the balance of payments discussed in section 1.1.

Some examples of more concrete elaborations of the solutions discussed are shown elsewhere (Tinbergen, 1985). In Chapter 5 of that book a static model is used to find the structure of an economy with I consumers, H producing firms, J private or individual goods and K (part) collective goods. The economy's government estimates the marginal utility of collective goods (which may be part-collective) and collects the taxes to finance their production. Consumers maximise their welfare and producers their profits. The quantity of capital is given; the social order is one of free competition.

In Chapter 14 a dynamic model is used to find an optimal mobile social structure. One good is considered, part of which is consumed, another part invested in physical capital, and a third part in human capital (i.e. education, which transforms each individual's innate quality into a higher quality). Total production depends on capital and on the quality of all I individuals.[1]

1.5 SECURITY: QUALITATIVE AIMS AND MEANS

After discussing the concepts used in a traditional socio-economic setup to find an optimal order and its policy we now consider a traditional polemological setup. The aim may be defined here as *optimal security* with respect to the rest of the world. In the simplest setup only two countries will be considered. This may be interpreted in two ways. One is that the rest of the world is considered as one other nation. The other interpretation—not so far from reality—is to consider only the two superpowers, US and SU. Security has been called an 'underdeveloped concept'. This is illustrated by the fact that some experts (Röling, 1984) consider it to have no less than four dimensions (to be discussed later; see section 2.2), whereas others (Fischer, 1984) see it as one-dimensional. This lack of agreement also appears in the question of whether we consider security as a commodity (a good) or a state of mind of the dimension of welfare. Security refers to the situation of one's nation: its functioning should not be threatened, but, on the contrary, be assured. The feeling of security is narrowly connected with national pride (also called patriotism or nationalism). Most citizens feel happy, when returning from abroad, to be back in their own country. An important aspect of this sense of well-being is the ability to communicate freely with others, who can understand the language spoken. Most people only have one or two languages and they feel lost wherever these languages are not spoken or understood. Another aspect of patriotism is that their education has contributed to the belief that their own nation and its population are better than other nations and their populations. Finally, even if in some respect their country has been shown not to be better—in whatever sense—than some other nation, they may nevertheless feel: 'my country, right or wrong'. All this illustrates the strong emotions generated by nationalism and hence also by the country's security.

The means available to maintain or maximise a country's security consist of various institutions. One considered very important by many, is the country's sovereignty. This implies freedom of determination without recourse to any other nation or institution. Within this freedom, however, treaties with other countries may be concluded. Other institutions making for optimal security may be internal or external political institutions. An internal political institution may be made in matters of trade and development cooperation. An external political institution may be the acceptance of a decision by the International Court of Justice or of another international court. In addition to political institutions military institutions exist and are considered as a means of attaining optimal security. Military institutions are characterised by their human production factors and their arms categories. Broad categories of the latter are conventional and nuclear arms. Another subdivision of great importance is offensive *vs*. defensive weapons.

Galtung (1984) derives defensiveness and offensiveness from the range of the weapons in a system and their impact area, and hence from geographical criteria: if the point of impact is a country's own territory, the system is defensive. Both are designed to serve the own nation's security, but offensive weapons reduce other nations' security, which is not true of defensive arms. Whereas for some types of weaponry defensive arms are well known and numerous, this not (yet) true of rockets. Mines and anti-tank guns can be quite effective, but defence systems against rocket attacks hardly exist. A defensive weapon known to one country, but not to the other, may be dangerous to the latter, however, as explained in section 3.5 in a discussion of the Strategic Defence Initiative.

An institution of decisive importance is a form of cooperation called common security. This means security based on a complete sharing of all technological knowledge about defensive weaponry. With the present distrust between the superpowers' military and political leadership it seems completely illusory. Among scientists it is not illusory. Top scientists prefer international cooperation over nationalism. The threat created by nuclear energy has strengthened scientists' conviction that their traditional attitude is the only guarantee of real security. There seems to be a beginning of understanding between civil servants (Spoor, 1985; Boutwell and Long, 1986).

1.6 SECURITY: QUANTITATIVE TARGETS AND INSTRUMENTS

As in the case of socio-economic policies, details of security policies can be treated in a quantitative way only. Concrete decisions always require figures. That means the setting of targets and the application of instruments. A long-term optimal security order may have zero targets for offensive and low targets for defensive weapons, with the latter only for policing services. Non-military targets in trade may be the absence of import quotas and budgets for financial transfers to countries in difficulties. It is virtually impossible to deal with this subject at present, with the lack of information over long periods.

We consider it more useful to treat a subject linked to quantitative targets and instruments, for a shorter-term discussion as will be presented in Part II of this book. Quantities can be given only after categories have been defined and for readers not familiar with security literature—presumably a substantial number—something may be said about weapon categories and the source of their names. These have their origin in the natural sciences.

Weapons may have a fixed location (mines, anti-aircraft guns) or be mobile. They may move along the surface (tanks, warships) above the surface or below (submarines). The greatest variety is in weapons moving above the surface.

Oldest are *ballistic weapons*, launched from guns and moving along the well-known parabola-like curve, starting at the gun's end and finishing at or near the target. The first ballistic weapons presumably were bullets; early developments consisted of increases in the bullet's size and corresponding increases in the energy used to propel the projectile. In the 1930s the Nazis developed rockets (the V-1 and V-2s), launched in a more complicated way: i.e. with more than one launcher. After World War II some of the German missile engineers were kidnapped by the US and some by the SU, and again size and power were increased. Also, the distance between launching base and target increased. *Strategic missiles* are now able to cross the Atlantic.

The discovery of *nuclear energy* constituted another development. Among the latest developments is the installation on such a missile of more than one vehicle directed at different targets, which required the construction of *multiple independently targetable re-entry vehicles* or MIRVs. Apart from these various developments the accuracy and reliability were improved.

Alongside missiles, *satellites* are used either for peaceful purposes or passive military purposes (e.g. observation). To keep an object such as a satellite in an *orbit*, it has to be launched in a specific direction. A satellite may have orbits in different planes and with different periods. If the plane coincides with that of the earth's equator and the circulation time is 24 hours, the satellite will remain above the same point of the equator (geo-stationary orbit).

The moving forces of ballistic missiles and satellites are the force used for the launching and gravity.

As a defence against ballistic missiles or against observation ('spying') satellites, anti-ballistic (ABM) or anti-satellite (ASAT) missiles may be launched. Both have been tested with varying degrees of success.

Missiles may have auxiliary missiles attached able to change the direction of trajectile. This is not only a characteristic of the much more complicated hardware such as space labs but also for extremely accurate warheads equipped with a terminal guidance system, such as the submarine-launched Trident D-5, now under development in the US.

Finally, delivery vehicles for nuclear weapons include bombers and cruise missiles, which travel close to the earth's surface.

1.7 SECURITY OPTIMUM IS ITS MAXIMUM WITHIN A FRAME OF RESTRICTIONS

Considering security as a collective state of mind reflecting the assumed *probability that now and in the future the functioning of the nation is guaranteed* we shall discuss what the optimum level of security is. As with welfare, the optimum is the maximum level within a framework of restrictions. Before specifying the restrictions the nation is facing, a few remarks on an optimum (and a maximum) are necessary. They represent an *equilibrium*, but a distinction can be made between *stable* and *unstable equilibria*. An equilibrium position is the outcome of movements—in our case of the two countries' security position. These movements in the security field are reactions to previous movements of the other country. If the movements converge they lead to a stable equilibrium; if they diverge, the equilibrium is unstable and can only be maintained by external forces. Left to itself the system may engage in an arms race with dangerous implications.

Two forms of instability have been distinguished: *arms race instability* and *crisis instability*. Arms race instability means that the two conflicting sides have an incentive to spend ever larger amounts on weapons. Crisis instability means that in case of a crisis a conflict tends to escalate rapidly, particularly when both sides have an incentive to strike first. The two forms of instability may go together, but they need not.

The restrictions under which security is generated depend to a high degree on the *scenario* we consider. As a consequence of the enormous threats with which we are faced, we shall consider a wide variety of scenarios, in the hope of finding one more attractive than today's. It is characteristic of today's international anarchy that an almost unrestricted sovereignty exists and is even advocated by political leaders. This means the virtual absence of restrictions and the existence of an enormous over-armament, since sovereign nations think that more armaments make for security. In actual fact our security has declined and so has our welfare.

A better scenario is one in which a number of *treaties* have been concluded and are being respected, such as bans on certain types of armaments or on testing new types. The restrictions of the system evidently are the limitations agreed on in the treaties. They may imply a somewhat less dangerous optimum level of security.

In the longer run much better scenarios may become possible, scenarios to be discussed in this book. They introduce the creation increasingly efficient supra-national institutions, whose purpose is an *optimally managed planet.* To achieve it, parts of national sovereignty have to be transferred to a world level.

In the conventional approach (optimal security only) the institutions deal with security, disregarding socio-economic welfare—for instance, an ideal UN Security Council—without considering supra-national institutions in the fields of trade or financial and monetary aims.

1.8 INTEGRATION OF TRADITIONAL SOCIO-ECONOMIC AND SECURITY STRUCTURES AND POLICIES

As announced in the Foreword, the main objective of this book is to integrate the socio-economic and the security search to present an optimal structure of society and the optimal policies characteristic of such a structure. Another way of defining this objective is to call it the internalisation of security policies into socio-economic policies (or, the other way round, the internalisation of socio-economic policies into security policies). This implies not only that the aims and the means of the two have to be combined in an integrated structure and policy, but also that the *cross-impacts* of each component's means on the other component's aims are considered. Because of the increased militarisation of the superpowers, in particular, but also of the rest of the world (including the Third World) these cross-impacts are considerable. The result of this integration means that, in the long run, a considerable contribution to the world's welfare and security can be attained if the mutual suspicion of East and West can be tranformed into a spirit of cooperation.

NOTE

1. On pages 155 and 157 of this chapter some errors have been printed; the correct formulae (14.4), (14.12), (14.13) and (14.14) can be obtained at request from the author.

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2 Aims: Optimal Welfare-Cum-Security

2.1 WELFARE-CUM-SECURITY AS A GENERALISED CONCEPT

As announced in section 1.8, this chapter deals in more detail with the integration of socio-economic and security optimal orders and their policies into one combined optimal order and its policies. The main reason for this integration is, of course, the disastrous impact a war would have on human welfare. But even in years of peace between the leading countries the resources spent on war preparation are no longer negligible, especially in the SU and the US, and amount to many times the amount spent on development cooperation. So far the only exceptions to this are Japan, Brazil and Mexico, where only 2 per cent or less of GNP is spent on military purposes. Yet this is about twice the amount spent on official development aid. In comparison to the superpowers and the European Community this low military budget makes available to investment, and hence to growth, sizeable amounts, explaining the high rate of growth of the Japanese economy.

Symbolically the integration we are going to study may be said to combine the *problématique* considered by two well-known Independent Commissions of experts with political experience, presided over, respectively, by Willy Brandt and Olof Palme, and known as the Brandt Commission and the Palme Commission. The Brandt Commission reported in 1980 and 1983 under the titles *North–South* and *Common Crisis*; these reports deal with the North–South problem. The Palme Commission reported in 1982 under the title *Common Security*, and deals with the East–West problem.

As a matter of course a combined analysis constitutes an enrichment to all parties concerned. Far better solutions to

North–South problems, including today's most pressing debt problems, would be possible if, simultaneously, a solution—or a half-way solution!—of the East–West problem were implemented. At the same time, some of the tensions in the undeveloped continents would be reduced if more resources were spent on development cooperation, and at least some of the possible reasons for confrontation between the superpowers might be eliminated. The role economists might play in the security debate by integrating it into their field of responsibility would produce additional arguments in favour of a considerable redirection of resources instead of leaving the discussion to military experts alone. If we would only analyse the combined *problématique* as a problem of optimal management of our planet new perspectives would emerge.

The aims the optimal order must set itself may now be formulated as optimal welfare-cum-security or optimal generalised welfare. In this chapter these aims will be considered in more detail.

2.2 WELFARE: ITS COMPONENTS AND DETERMINANTS

A nation's welfare is composed of the welfare of its citizens. Our interpretation of this statement (which is not shared by all economists) is that the nation's welfare is the sum of the welfare of the citizens. This interpretation implies the possibility of measuring an individual's welfare. Welfare may be said to reflect the degree to which each of a number of the individual's needs is considered to be satisfied. Humans are complex beings and have many needs. These can be grouped in various ways. We propose to make a distinction between *individual* and *social needs*. The former depend on the individual's situation in isolation, and the latter on his relation to other individuals. Next, individual needs may be either *material* or *spiritual*. Examples of material individual needs are the need for food, for protection against extremes of climate, or against other environmental forces. This need is satisfied by clothing, dwelling or workplace, and climate. This list can be expanded and each item can be subdivided.

Spiritual needs are those for some degree of freedom, for understanding the environment, the need to perform a task, and so on.

Social needs concern good relations within the family, with colleagues, and friends, etc. up to good relations with certain groups in society, or what might be called the need for a good social climate in which the individual or relatives and friends are living. The word 'relations' reminds us of the importance of the respect each person receives from his or her fellow citizens. In countries where basic needs are satisfied the welfare of each citizen is almost entirely determined by his or her acceptance within the reference group and hardly ever by the absolute level of well-being (cf. Kapteyn, 1982). In countries where basic needs are not fulfilled, the absolute level of satisfaction does of course codetermine the level of welfare.

In this book three models will be presented in order to illustrate the concepts introduced. Readers not interested in the mathematical approach may skip these sections without the risk of not understanding the general argument.

In *Model A* we consider a 'world' consisting of two nations of equal size and level of technology. Their welfare depends on their economic prosperity (measured here by the production of civilian goods) and on their security, which is determined by the quantity and type of a nation's own armaments and those of the other nation. Purely defensive armaments are defined here as those which increase a nation's own security without reducing the security of the other nation. Purely offensive arms are defined as those which reduce the security of the other nation without contributing to the security of the nation acquiring those arms. We shall also consider intermediate types of arms of varying degrees. It is even conceivable to think of 'super-defensive' arms which increase the security of both countries, and 'super-offensive' arms which decrease the security of both. (This model is described in more detail in Fischer, 1984.)

Model A will be solved in two versions: Problem I and Problem II. In Problem I, decisions are taken independently by each nation, whereas in Problem II decisions are taken at the world level, taking into account the welfare of both nations.

Model A considers development over time, in discrete periods. The two nations are assumed to seek to maximise the growth rates of their economies, of both civilian goods and 'security'. A Von Neumann model (a generalised form of the input–output model) is used to describe the quantities of inputs required for production at the beginning of each period, and the outputs produced at the end of each period. The ratio between inputs

Table 2.1

	Industries operated by country 1	Inputs from country 1 civ.	sec.	Outputs to country 1 civ.	sec.	Inputs from country 2 civ.	sec.	Outputs to country 2 civ.	sec.
1.	civilian	1	0	b	0	0	0	0	0
2.	military	1	0	0	c	0	d	0	0

civ. = civilian goods, sec. = national security

and outputs in each sector is equal to the growth factor (=1 + growth rate) of that sector. The goal is to make the smallest of all growth rates as large as possible.

There are two industries in each country, the civilian and the military, and two goods, civilian goods (for both consumption and investment) and 'security'. Both industries use only civilian goods as inputs from the domestic economy, since weapons can neither be consumed nor used to produce other goods or weapons. The required inputs include consumption by workers and their families. For one unit of inputs, the civilian industry produces b units of output (where $b > 1$ for a growing economy). The military industry produces c units of 'security' as domestic output, and uses d units of 'security' as input from the other country. If the arms are purely defensive, $d = 0$. If the arms are purely offensive, $c = 0$. In general, the larger c and the smaller d, the more defensive are the arms produced.

The following coefficients describe the inputs and outputs of the industries operated by country 1, if an industry is operated with 'unit intensity'. If an industry is operated at higher or lower intensity, all coefficients are multiplied by a constant factor greater or less than 1. A symmetric table describes the technology of the industries of country 2.

The policy instruments available to each country are the fraction of each period's civilian outputs it devotes to the civilian and military industries, and the type of armaments it builds.

For Problem II, we have a single table describing the input and output coefficients for the world. The negative externalities of operating the military industry, the reduction of security of the other country, become internalised. The following table describes this situation:

Table 2.2

	Industry	World civ.	Inputs sec.	World civ.	Outputs sec.
1.	civilian	1	0	b	0
2.	military	1	d	0	c

Restrictions and optimum conditions will be discussed in section 3.9 and the solutions in section 4.8.

In *Model B* we assume that a nation's welfare ω_i depends on four variables, where $i = 1$ or 2:

y_i the nation's average income
z_i the inequality of income distribution
u_i the rate of unemployment prevailing in that country, and
e_i the state of the environment, where the latter three are expressed in terms of income:

$$\omega_i = y_i - z_i - u_i + e_i \tag{2.2}$$

Now we turn to a third model, *Model C*. We offer it in two versions: Problem I and Problem II. Problem I deals with decisions taken by sovereign nation 1 in a world of two sovereign nations; Problem II with common decisions of these two nations, hence at 'world level'.

The variables for nation i ($i = 1, 2$) are, for both versions:
x_i total production of goods and services
y_i total expenditure on consumption, investment, export surplus, except v_2 (see below)
a_i expenditure on offensive armament
b_i expenditure on defensive armament
v_2 expenditure on goods of special importance to nation 2 and made available by nation 1 only during peace periods.

For version Problem I, $i = 1$ only, but for nation 2 we have
$a_2 = a_2^o$
$b_2 = b_2^o$, i.e. the armament expenditures are considered to be predetermined.

Also in Problem I nation 1 aims at maximising its welfare-cum-security function.

$$\omega_1 = \ln(y_1 - v_2 + 1) + \alpha_{11} \ln(a_1 + 1) - \alpha_1 \ln(a_2^o + 1) + \beta_{11} \ln(b_1 + 1) + \beta_{12} \ln(b_2^o + 1) \tag{2.2·1}$$

where α and β are coefficients indicating the impact of the logarithms concerned on welfare of the country considered (reflected by the first index attached to the α or β). The second index refers to the country whose armaments impact the term specifies. Welfare in the traditional sense is represented by the terms in y_1 and security by those in v_2, a_1, b_1 and the given a_2^o and b_2^o. The restrictions which country 1 faces will be discussed in section 3.9 where the optimum conditions will be discussed. This applies also to Problem II for which the aims are to maximise:

$$\begin{aligned}\Omega &= \omega_1 + \omega_2 = 1n(y_1 - v_2 + 1) + \alpha_{11}\, 1n(a_1+1)\\ &- \alpha_{12}\, 1n(a_2+1) + \beta_{11}\, 1n(b_1+1) + \beta_{12}\, 1n(b_2+1) \quad (2.2{\cdot}2)\\ &+ 1n(y_2+v_2+1) - \alpha_{21}\, 1n(a_1+1) + \alpha_{22}\, 1n(a_2+1)\\ &+ \beta_{21}\, 1n(b_1+1) + \beta_{22}\, 1n(b_2+1)\end{aligned}$$

Here Ω is total welfare of both countries. All (Greek) coefficients are positive and the aim function reflects the theory that offensive weapons of the other country affect security negatively, but the other nation's defensive weapons affect security positively. Making available v_2 to country 2 by country 1 constitutes a non-military security instrument. The countries are supposed to have about the same size population.

2.3 SECURITY, OR THE PROBABILITY OF PEACE

Human happiness not only depends on socio-economic welfare as described in the preceding section. In today's world, composed of a number of independent, sovereign nations, some powerful, others with modest or hardly any power, the individual's happiness also depends on his or her nation's security. It is not easy to define the concept of security. Its main elements can be summarised by the probable level of independence or sovereignty of the nation; that is, the probable extent to which the *functioning of its institutions can be determined by the nation's inhabitants.* We also call this the *probability of peace.* This probable level of sovereignty will have a greater impact on the citizens' happiness the more ardent is the country's patriotism or nationalism.

This relatively simple definition of security reflects the role played, in the formulation of this state of mind, by sovereignty and by patriotism. Both these elements contain dubious or irrational aspects. Thus, it is believed that sovereignty means more control over a nation's role; but this is a misconception. A sovereign country's position is also dependent on other sovereign countries' acts. Sometimes it may be better for a country to be party to an alliance with countries that otherwise might act to its detriment.

Patriotism or nationalism may be defined as the belief that one's own country is superior—in whatever sense—to other countries. This cannot, however, be true of all countries. Thus patriotism or nationalism are in part irrational.

Both the misunderstanding of sovereignty and the irrationality of nationalism raise doubts about the 'real' relevance, in terms of human happiness, of security. Security as a mental state can be easily influenced by ideologies, indoctrination and propaganda instead of by real human needs.

So far we have discussed security as a one-dimensional probability of a nation's independent or autonomous functioning in a given period. We shall come back to this when, we discuss the possibilities of measuring security in section 2.5.

Another definition of security is based on the probability of avoiding war and the probability of survival in case of war (Fischer 1984).

Some experts (cf. Röling, 1985) think of a concept of more (in his case four) dimensions: Röling speaks of economic, ideological, enemy and weapon security, where the latter two together are also called military security. Economic security refers to the probability that economic needs can be satisfied, especially the needs for basic commodities (fuel, food). Ideological security depends on whether the nation's ideology is threatened by counter-propaganda in one way or another. Enemy security possibly comes closest to what we discussed under the terms 'sovereignty' and 'patriotism'. Weapon security, in Röling's words (ibid., 158), depends on the nature of the weapons available: insecurity being maximal when these weapons invite a 'first strike' ('use them or lose them').

This brings us close to the basic question of whether security should be defined as a state of mind, comparable to welfare, or as the commodities determining that state of mind. The latter is comparable to defining welfare as the quantities or value of the consumption goods determining welfare. For some purposes (for instance, a simple illustration of the main structure of a social order) the latter approach is appropriate.

2.4 CORRECTION OF PREFERENCES

It is characteristic of socio-economic policy that citizens' preferences are manipulated by their governments while formulating that policy. That means that actual policy is not based on existing preferences but on *corrected preferences*. Important examples are corrections on too short-sighted (myopic) preferences. We know several examples where individuals would later have regretted it if they had stuck to these shortsighted preferences. They will even be pleased that their government stopped them yielding to their own myopia. The clearest example is compulsory schooling, which is now applied almost universally. Other examples are the taxation of unhealthy consumer goods, such as alcoholic beverages or tobacco products, or the prohibition of smoking in public buildings (as in Seattle, Washington). Positive corrections are the making available at low, subsidised, prices, of healthy goods or services: school lunches, less polluting forms of transportation, etc.

Correction of myopic preferences may very well constitute one of the means of a policy aiming at optimal welfare-cum-security. The present policies of the superpowers and the alliances around them are based on preferences in which patriotism and sovereignty play an important role. These preferences are partly determined by irrational views, as we saw, and partly on misconceptions. It is not clear whether, in these cases, citizens' or governments' preferences need correction, and who or what institution is able to apply the correction. The possibility exists that citizens and governments alike are shortsighted or misled. In that situation the International Court of Justice might be the appropriate institution to correct preferences. In other cases a non-government organisation such as a peace movement, or scientists such as peace researchers may make the correction. The preferences of a part of public opinion expressed by the slogan 'better dead than red' may need such a correction, since it seems to underestimate to a considerable degree the horrors of modern war. Of course a communist who prefers war to living in a capitalist society may also need more information. It is International Physicians for the Prevention of Nuclear War that has to be credited for the information it has provided on modern warfare, and nuclear wars in particular, by pointing out that medical help would fall far short of what would be needed. The Nobel Peace Prize this organisation received in 1985 was quite rightly awarded to them.

At present (1987) it is certain governments' preference rather than the populations' which needs to be corrected.

2.5 MEASUREMENT OF WELFARE AND SECURITY: TWO MODELS

For an integrated welfare and security policy it is important to compare changes in welfare and changes in security that may result from changes in institutions or in policies. Such comparisons can be made with more precision if the concepts of welfare and security have been measured. Within the narrower field of conventional economics the question of the measurability of welfare is a contentious issue. In the last half-century most economists denied the possibility of measuring utility or welfare and followed those who had shown that for a large part of economic science such measurement was not necessary. A number of problems whose solution does require welfare measurement were declared not to be soluble by economic science, but perhaps by other sciences. An important example is the problem of maximising a nation's welfare by income redistribution (through taxation, for instance). The maximum requires the equalisation of marginal welfare, which requires welfare measurement. Alternatively, solutions offered by some authors were declared to be subjective opinions of the author.

In the last decade the number of economists holding the view that welfare is measurable and who are in fact making measurements is increasing. Three groups of authors, an American, a British and a Dutch group, dealt with the problem, and two made measurements. The American group counts among its members Dale W. Jorgenson, Laurits R. Christensen and Lawrence J. Lau. The main publication we are familiar with will be quoted as Jorgenson and Slesnick, 1983. The British group consists of G.W. Mackenzie and I.F. Pearce and their main publication will be quoted as McKenzie, 1983. In contradistinction to the two other groups the British group did not apply its theory to numerical material.

Among the Dutch group, headed by B.M.S. van Praag, we find A. Kapteyn, A. Kouwenhoven, Th. Goedhart, T.J. Wansbeek, F.G. van Herwaarden, J. Buyze and others. The essence of their work consists of direct interviewing of large numbers of European consumers; an example may be found in Van Praag and Kapteyn, 1973. The question refers to welfare attached to the level of income and consists of indicating the income levels at which the interviewees would feel, respectively, excellent, good, sufficient, etc. down to very bad (ten levels). This one-dimensional concept of welfare constitutes one of the simplest approaches, which makes it very appropriate for the purpose of this section. Its one-dimensionality does not imply that the determinants are limited to one determinant only. Fairly satisfactory explanations can be given by five determinants: income after tax, occupation, years of schooling, capability to take independent decisions and age (cf. Tinbergen, 1980).

In view of the 'underdeveloped' character of the concept of security attempts to its measurement may be started with the aid of a similarly simple concept as used by Van Praag in his early attempts to measure welfare. This means that we start with a one-dimensional draft-definition as discussed in section 2.3: the probable extent to which the functioning of its institutions can be chosen by the nation's own inhabitants. The underdeveloped character of the concept of security is reflected in the many questions arising with an analysis of this draft-definition. In fact we present this formulation with the purpose only of generating these questions and will add our own questions with the hope that better questions will be formulated by others. In the tentative approach of this chapter we are going to use the definition of a nation's welfare ω_i chosen in formula (2.2), section 2.2.

We assumed that welfare in the conventional sense ω_i depends on: average income y_i(positively), income inequality z_i(negatively), unemployment u_i(negatively), and an optimal environmental condition e_i(positively). If z_i,u_i and e_i are measured in terms of income conventional welfare, measured in terms of income, will be

$$\omega_i = y_i - z_i - u_i + e_i \tag{2.3}$$

The means considered for the conventional socio-economic order are a choice between three orders, capitalist, mixed and communist, characterised by differing values for y_i, z_i and u_i.

We further assume that the security aspect can be introduced by multiplying ω_i with a factor p_i that we call security or peace probability, itself composed of four multiplicative factors (if the events concerned are independent):

$$p_i = w_i m_i n_i b_i \tag{2.4}$$

where w_i is the probability of peace if decisions about war or peace are made at world level rather than at national levels

m_i is the probability of peace if the ABM-treaty is adhered to

n_i is the probability of peace if the NPT (Non-Proliferation Treaty) is adhered to, and

b_i the probability of peace if a new treaty banning weapons of mass destruction from outer space is concluded.

Welfare-cum-security ω will then be determined by the formula

$$\omega_i = p\omega_i = w\, m\, n\, b\, (y - z - u + e) \qquad (2.5)$$

In order to measure ω we must have numerical values for all the symbols appearing in this formula. Such values may be obtained from public opinion polls, where the value to be given to y_i must be chosen by the organisers of the poll at 100 for a typically developed country, say the United States, whereas all the other variables must result from the poll.

As an example how this operation may work out we have chosen the values of all variables as follows

y_1 = income under communist regime = 80
y_2 = income under capitalist or mixed regime = 100
z_1 = income inequality under communist or mixed regime = 20
z_2 = income inequality under capitalist regime = 30
u_1 = unemployment under communist regime = 0
u_2 = unemployment under capitalis or mixed regime = 5
e_1 = environment under perfect environmental policy at world level = 10
e_2 = environment under imperfect environmental policy = 0
w_1 = probability of peace if war decisions are made at world level = 1
w_2 = probability of peace if war decisions are made at national level = 0.25
m_1 = probability of peace if ABM treaty is adhered to = 1
m_2 = probability of peace if war decisions are not adhered to = 0.5
n_1 = probability of peace if NPT* is not adhered to = 1
n_2 = probability of peace if NPT is not adhered to = 0.5
b_1 = probability of peace if treaty banning arms in space is concluded = 1
b_2 = probability of peace if treaty banning arms in space is not concluded = 0.1

In Table 2.4 the values of generalised welfare, or welfare-cum-security obtained with formula 2.5 are shown. The security concept involved is the equally tentative 'probability of peace' as expressed in formula (2.4), where quantitative values are shown in Table 2.3.

Obviously our example reflects a number of subjective

NPT stands for Non-Proliferation Treaty

Table 2.4 Values of welfare-cum-security for specified values of its determinants listed above

				e_1						e_2					
b	m	n	mnb	w_1			w_2			w_1			w_2		
				cap	mix	com	cap	mix	com	cap	mix	com	cap	mix	com
b_2	m_2	n_2	0.025	1.9	2.1	1.8	0.47	0.53	0.44	1.6	1.9	1.5	0.41	0.47	0.38
		n_1	0.05	3.8	4.3	3.5	0.94	1.06	0.88	3.3	3.8	3.0	0.81	0.94	0.75
	m_1	n_2	0.05	3.8	4.3	3.5	0.94	1.06	0.88	3.3	3.8	3.0	0.81	0.94	0.75
		n_1	0.1	7.5	8.5	7.0	1.9	2.1	1.8	6.5	7.5	6.0	1.63	1.88	1.50
b_1	m_2	n_2	0.25	18.8	21.3	17.5	4.7	5.3	4.4	16.3	18.8	15.0	4.1	4.7	3.8
		n_1	0.5	37.5	42.5	35	9.4	10.6	8.8	32.5	37.5	30.0	8.1	9.4	7.5
	m_1	n_2	0.5	37.5	42.5	35	9.4	10.6	8.8	32.5	37.5	30.0	8.1	9.4	7.5
		n_1	1	75	85	70	19	21	18	65	75	60	16.3	18.8	15.0

Table 2.3 Values of 'probability of peace' or security according to equation (2.2) for the values of its determinants listed before

b	m	n	w_1 (1)	w_2 (0.25)
b_2	m_2	n_2	0.025	0.00625
		n_1	0.05	0.0125
	m_1	n_2	0.05	0.0125
		n_1	0.1	0.025
b_1	m_2	n_2	0.25	0.0625
		n_1	0.5	0.125
	m_1	n_2	0.5	0.125
		n_1	1	0.25

elements, and the results may vary considerably if the values of the determinants are changed. To begin with the results reflect the authors' preference for a mixed economy, or in political terms, a democratic socialist view. Income inequality is considered a serious drawback, unemployment less serious and a bad environment in between. Here even democratic socialists may have different opinions. Opinions of conservative Americans (at present a majority, but not necessarily in the future) and of communists will deviate from our example.

A diehard preferring death to communism may show values in the 'com' columns twenty times as low as those shown. His opposite number in the SU will reduce to similar figures the 'cap' columns' figures.

Our choices for y_1 and y_2 should not be rejected on the basis of income estimates for the US and the SU. The two superpowers are not comparable with respect to climate and to level of development. Figures about India and China should also be kept in mind. Perhaps figures about the two German states are the best basis. Moreover variables in the field of human rights should have been introduced.

Our probability of peace figures must be guesswork anyway.

The present section should be seen as an invitation for alternatives and as a starting point for public opinion polls. By ways of example one alternative method of measurement of security may be an attempt to define security as a function of (i) the quantity of the nation's own armament, distinguishing offensive and defensive arms, (ii) the quantity of another nation's weapons, where defensive weapons have a positive and offensive weapons a negative impact, and (iii) non-military variables, for instance the quantity of grain to be supplied by another country.

2.6 A THIRD MODEL

In *Model C* we consider two nations, say the superpowers, with given total national product or income x_i (i = 1,2). They are supposed to spend these incomes on offensive (a_i) and defensive (b_i) arms and on non-military goods and services (y_i), whereas the more prosperous country 1 (the US) is also supposed to transfer to country 2, as a non-military security instrument, an amount v_2. The utility, or welfare-cum-security, function of the two nations is:

$$\omega_1 = ln(y_1 - v_2 + 1) + \alpha_{11}\, ln(a_1+1) - \alpha_{12}\, ln(a_2+1) + \beta_{11}\, ln(b_1+1) + \beta_{12}\, ln(b_2+1) \quad (2.6)$$

$$\omega_2 = ln(y_2 + v_2 + 1) - \alpha_{21}\, ln(a_2+1) + \alpha_{22}\, ln(a_2+1) + \beta_{21}\, ln(b_1+1) + \beta_{22}\, ln(b_2+1) \quad (2.7)$$

The restrictions imposed on the two countries' spending are:

$$x_1 = y_1 + a_1 + b_1 \quad (2.8)$$

$$x_2 = y_2 + a_2 + b_2 \quad (2.9)$$

and three problems of maximisation will be formulated, I, I′ and II.

Problem I assumes that country 1 maximises

$$\omega_1 + \lambda_1 (x_1 - y_1 - a_1 - b_1) \quad (2.10)$$

and country 2 follows country 1 by making $a_2 = a_1$ and $b_2 = b_1$.

Problem I′ assumes that country 2 maximises

$$\omega_2 + \lambda_2 (x_2 - y_2 - a_2 - b_2) \quad (2.11)$$

and country 1 follows country 2 by making $a_1 = a_2$ and $b_1 = b_2$ (2.12)

In these two cases the countries consider themselves completely sovereign.

Problem II assumes that in one way or another, the countries cooperate or shift part of their sovereignty to a supranational organisation in order to maximise their joint welfare-cum-security. Problem II thus consists of maximising

$$\omega_1 + \omega_2 + \lambda_1 (x_1 - y_1 - a_1 - b_1) + \lambda_2 (x_2 - y_2 - a_2 - b_2) \quad (2.13)$$

The form of the utility functions has been chosen so as to make the contribution of each of the utility 'factors' equal to zero for a factor amount equal to zero. The coefficients α_{ij} and β_{ij}. where i is the country whose security is affected by arms of country j, may be called the sensitivity of country i with regard to country j's arms, α for offensive and β for defensive weapons. All α and β are positive, implying that offensive arms reduce the other country's security but defensive arms raise it.

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3 Optimum Conditions of 'Welfare-Cum-Security'

3.1 OPTIMUM: MAXIMUM WITHIN A FRAMEWORK OF RESTRICTIONS

In this chapter the integrated optimum problem will be dealt with where an optimum 'welfare-cum-security' or 'generalised welfare' is the aim of the policies of two or more countries. As set out in Chapter 1 (section 1.4), the determination of an optimum always requires that we know (i) the aim of the social order and policies in its dependence on its determinants, and (ii) the restrictions which are imposed on society. The solution will be formulated in section 3.8. In the present section the setting of the problem is given.

Two approaches are possible: (a) a simpler approach where security is considered as a good, comparable with a consumer good; and (b) a more complicated approach where security is a state of mind, comparable with welfare, but a collective state of mind for a nation as a whole. In section 2.5 we have interpreted it as the probability of peace (in the minds of the nation's inhabitants). An example of the simpler approach is given by one of us (Fischer, 1984) elsewhere. As observed in section 2.3, more complicated approaches may be desirable where security is a multi-dimensional concept as suggested by polemologists such as Röling. We are operating in a scientific field of rapid development with a potential for readily formulated innovations. In sections 3.2–3.7 the various types of restrictions human society is faced with will be discussed.

3.2 THE NATURAL ENVIRONMENT AS A RESTRICTION

Human activities and hence human society have always been restricted by their natural environment. For most nations, even small ones, the natural environment comprises a complicated set of data, expressed in particular by physical geography. Parts of a nation's territory may be excellent for different agricultural uses. Some areas may be appropriate for the production of a wide range of vegetable crops; others may be more appropriate for animal food production, whether meat or dairy or both. Countries with mountainous regions may be best suited for a variety of products at different altitudes, with corresponding differences in temperature and rainfall, characterising the climates: tropical foodstuffs may be produced as part of the nation's product mix: some tropical goods may be produced in temperate-zone countries in glasshouses. Parts of a mountainous country may be sterile.

Another component of the natural environment consists of the minerals below its surface: ores, or oil and gas deposits. Again the quality of the ores may vary. Many metals from iron to uranium are of great importance to modern industries. The importance of energy for all production underlies the importance of coal, oil and gas deposits. Another energy source is the availability of waterways; here again human intervention may expand capacity by the construction of dams, and similar investments.

It will be obvious that the concept of a natural environment is a highly complicated one whose full significance can only appear in models with a large number of variables.

For a long time the natural environment could be considered as a given, although long-term exhaustion of some natural resources was experienced. Thus, some mineral deposits in Europe have been exhausted and had to be replaced by the exploitations of deposits at greater distances, or substituted by alternative minerals. Iron ore is now being imported from more distant countries; while oil substituted for coal—only to be substituted by coal again after the oil price rises of the 1970s.

In the last decade a new environmental problem of rapidly increasing importance has developed: a changing, and in fact deteriorating quality of some natural resources. This applies to water and air in particular. For a long time pure water and pure air were considered to be freely available and called 'free goods'. There are no restrictions, in other words, to the use of these raw materials or consumer goods. This is no longer true and today restrictions exist on the use of these resources, requiring institutions for the correct management of the limited quantities available. As in many other cases Sweden was the first country to understand the need for international cooperation in this field and offered Stockholm as the meeting place for the 1972 United Nations conference on the subject, resulting in the establishment of the United Nations Environmental Programme (UNEP), with its secretariat in Nairobi, Kenya.

Not only are restrictions on the quantities of pure water and air necessary, but also 'defensive measures' (cf. Leipert, 1984) against pollution of the world's rivers, lakes, seas and atmosphere, causing fish mortality or acid rain threatening our forests.

3.3 HUMAN NATURE AS A RESTRICTION

Not only does the human environment restrict what society can do. We ourselves constitute restrictions on what society can do. To a considerable degree we are creating our own difficulties. In a direct and obvious way this is expressed in what we require for our welfare and our security, and hence in our welfare function and our need for security. In other words, the aim of our social order as a function of its determinants—the coefficients appearing in a welfare function—are among the restrictions.

But, in addition, other human features also restrict our optimal welfare-cum-security: our myopia in time and space being one example. Shortsightedness makes us prefer things we later dislike. This is a valid argument for the correction of some short-term preferences by legislation: well-known examples are compulsory schooling, taxes on unhealthy – and subsidies on healthy ('merit') —goods. It may also be an argument for the correction of national policies by some 'higher' authority, such as a United Nations institution; one example being the International Court of Justice.

Geographic myopia occurs if we concentrate our preferences on national interests instead of continental interests. An example is the pollution of the Rhine by France, until an agreement was reached between all nations affected after which France changed its policy. The same applies to other pollution problems such as the acid rain in Central Europe and Scandinavia. Here Britain, the Netherlands and Belgium may have to follow France's example.

Myopia is not the only attitude damaging our own long-term interest. Rigidity or inertia in thinking is another. Extremists (for instance, communists and conservatives) often tend to rigidity in thinking. It partly coincides with a lack of tolerance.

In order to arrive at an optimal international order we must think creatively and be tolerant. Tolerance is also part of scientific thinking. Marx, who rightly claimed to strive for a scientific socialism, was himself creative; but some of his followers tend to be rigid, non-creative and intolerant. The same applies to the believers in *laissez-faire*, the Manchester liberals (liberals in the European, not the American sense).

Restrictions may also be the effect of a lack of learning capacity, and hence of intelligence. In Chapter 10 the role of learning processes in the broadest sense required for optimal policies, and hence for politicians, will be discussed in more detail.

3.4 TECHNOLOGICAL RESTRICTIONS: CIVILIAN

For the last two centuries human life has been shaped increasingly (and for earlier centuries in a more modest way) by technology. Starting with the simple tools of the Iron Age an ever-expanding exploration of natural resources and creativity in constructing machines, means of transportation and other 'means of production', mankind is now able to produce large quantities of an enormous variety of goods which satisfy its ever-increasing and diversifying needs.

The accumulation of this knowledge and its transmission from one generation to the next is largely in the hands of institutes of technology such as the Massachusetts Institute of Technology (MIT)—probably the most famous among them—and thousands of less well-known institutes. At the same time components of this 'human capital' are to be found in production units (factories, transportation systems, workshops).

Even though the potential for producing all sorts of goods and services is very impressive, there are limits. Any social order must remain within these limits. The economist calls these possibilities *production functions* and these constitute a very important intellectual tool for thinking in concrete terms and for producing 'models' of a social order's qualities. The concept of a production function can be extended to education, especially formal schooling, but also the informal sector: family rearing and training on-the-job. The diversity in schools in today's societies is a reflection of the diversity in our 'production apparatus'.

A distinction must be made between the 'state of the art' of production—that is, the total of technological knowledge of humankind (or the portion available in one country)—and the knowledge and ability of each producing individual. The latter can only command a small part, in which that individual is specialised.

For the purpose of this book we make a distinction between civilian production and security production. They share a large common territory, but also have a considerable specialised area. One relationship between the latter two is of particular relevance to this book: the concept of *conversion*. By this term we indicate the transformation of a production unit (a factory, for instance) producing military goods into one producing civilian goods. A simple example is the transformation of a tank into a tractor factory.

3.5 TECHNOLOGICAL RESTRICTIONS: SECURITY

Further restrictions originate in the security sector. Here too many production processes are used, characterised by their production functions. A number of military goods may be distinguished, depending on the degree of detail chosen in the model used. Two aspects are of particular interest: (i) What differences in technological knowledge exist between the parties in conflict? And (ii) What uncertainties exist in the technologies used by the other party now or in the future?

It is a commonplace that the two superpowers each has its stronger and its weaker capabilities. Thus, the US is more advanced in electronic devices, sea-based systems and in satellites (even though the SU was first in this field in 1957 with Sputnik). The SU, in contrast, is more advanced in laser beams, and in mass production of simpler arms: the Warsaw Pact countries produce about twice the number of tanks, five times the number of ballistic missiles and twelve times as many guns as NATO members (1983 figures) (cf. Berkhof, 1985; Holloway, 1985; Stares, 1985).

Uncertainties about the other party's arms exist in particular with regard to arms concealed below sea-level or otherwise, or mobile arms. Uncertainties may also be due to new experiences or insights: the opinion on the efficiency of MIRVs (multiple independently targetable re-entry vehicles) has changed completely; a number of defensive systems were later dismantled.

The greatest uncertainties exist, as a matter of course, about possible future technological development. This is particularly acute with regard to the Strategic Defence Initiative (SDI) proposed by President Reagan in 1983 and made a major point of negotiation in the preparation of the November 1985 meeting in Geneva of General Secretary Gorbachev and President Reagan. SDI is based on the belief that a technological defence against missile attacks will become possible within five to ten years of intensive research. Most independent American and most Soviet experts are highly sceptical about this. Even so military planners must always reckon with the worst conceivable alternative; and if the other party invents an effective defence technology this would give it first-strike capability: this is the reason why Soviet opposition to SDI has been so strong. The only answer then consists of as great an increase as possible in offensive, known technology.

3.6 BALANCE EQUATIONS AND DEFINITIONS

The societal process we are describing is characterised by the feature that each element of any society (human beings of various sorts, goods and services of all kinds) has an origin and a destination. The quantities 'created' must be equal to the quantities 'used', plus those left in stock. For products this is clear. For human beings it may mean (in a macro-model) that in each time unit births are equal to deaths plus the 'increase in population plus the emigration balance'. In a micro-model, similar relations apply to all specified sub-groups, according to age, sex, occupation, territory and so on. The relations discussed are known as *balance equations*.

Another type of 'self-evident' relations among the restrictions are so-called *definition equations*. A very simple example is that the value of a quantity of some good equals quantity × price. Such relations need not occur as restrictions if the value is replaced by the product of quantity and price. The model-builder is free to omit one of the variables and the definition of the variable in terms of other variables used. Such elimination is often possible, but sometimes difficult or even impossible and so is part of the scientific strategy chosen.

3.7 ADHERENCE OR NON-ADHERENCE TO TREATIES

In one of the methods chosen in section 2.5 to deal with the concept of security a qualitative restriction was introduced, namely the adherence or non-adherence to one (or more) treaties. Since this is an important form of peace policy it is worthwhile introducing it *expressis verbis* in a separate section. Methodologically it is important also, since it constitutes a method to deal with problems that at present can only be treated qualitatively.

Treaties are obtained by *negotiations*. This important diplomatic activity may be considered as a production process. A particularly interesting example is the nine-year negotiation that within the framework of the United Nations led to the new Law of the Sea. Systematic research on negotiation as a technique is being done in the framework of the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria.

3.8 OPTIMUM CONDITIONS AND THEIR INTERPRETATION

After having discussed the restrictions under which welfare-cum-security has to be maximised we now consider what conditions the means used by the national societies have to satisfy, in order that these societies constitute optimal structure and pursue optimal policies.

In the most general treatment of our problem the institutions which as a set constitute the optimal order we are searching for are the problem's unknowns. The optimum conditions (conditions for a maximum welfare-cum-security), obtained for a full-fledged quantitative model with the aid of some mathematical methods have to be interpreted as the operation of a number of institutions, which then are the set we are searching for. This interpretation also constitutes the essence of what is known as welfare economics.

Sometimes quantification is not necessary and the qualitative treatment suffices. In other cases it is not yet possible. Mathematical methods have to be used if quantitative approaches are desirable and feasible. There is a choice between various methods, known as mathematical programming and Lagrange multipliers. These may be interpreted as the prices on competitive markets, implying a prohibition of non-competitive (oligopolistic or monopolistic) markets or the levying of import duties, excise duties, etc. and quantitative restrictions (quotas). In order to understand the structure, figures are not always needed: prices of individual goods will change and within limits are irrelevant; Tax rates, however, may be important.

The most general treatment described requires creativity to find the institutions fitting a given set of optimum conditions. The same conditions may be fulfilled by free competition markets and by planning: planned prices and quantities *can* be chosen equal to free competition prices.

Almost the same creativity can be used by proposing some preconceived institutions, though. In Table 2.1 the preconceived institutions are adherence to certain treaties. So here the restrictions are already expressed in terms of institutions and applying the restrictions simply means blocking part of Table 2.2. Another example of such a simple non-mathematical procedure will be discussed in section 4.9 and is part of a very important aspect we shall call the *optimum level of decision-making*.

3.9 OPTIMUM CONDITIONS IN MODELS A AND C

For Model A, Problem I, the restrictions are merely that each country's total inputs at the beginning of a production period must not exceed the total outputs available at the end of the previous period, for each sector of the economy. The goal is to maximise the sustainable growth rate of the economy, which is the lowest growth rate of any sector.

Since the growth rate is unchanged if all inputs and outputs are multiplied by a constant factor, we can, without loss of generality, assume that the quantity of civilian goods available at the beginning of the current period is one unit. The amount allocated to the military industry is denoted by μ_1 and the remainder, $1 - \mu_1$, is allocated to the civilian industry. It would not be efficient to use less than the total available amount of civilian goods for all inputs. Country 2, which starts out with an equal amount of resources, allocates μ_2 to its military industry and $1 - \mu_2$ to its civilian industry. The resulting growth factors (= output/input) for each sector are as follows:

Table 3.1

Sector	Civilian	Security
Input	$(1 - \mu_1) + \mu_1 =$	$d\mu_2$
Output	1	$c\mu_1$
Growth factor	$b\ (1 - \mu_1)$	$c\mu_1/d\mu_2$
	$b\ (1 - \mu_1)$	

In the optimum, the lower of these two growth rates is a maximum.

For Problem II, the amount μ of civilian goods at the global level is allocated to the military industry, and $1 - \mu$ to the civilian industry. The growth rates are

Table 3.2

Sector	Civilian	Security
Input	$(1 - \mu) + \mu = 1$	$d\mu$
Output	$b\ (1 - \mu)$	$c\mu$
Growth Factor	$b\ (1 - \mu)$	c/d

The optimum conditions which have to be satisfied in Model C have to be obtained by putting the first derivatives of the expression (2.10) with regard to each of the unknowns equal to zero for the solutions of Problem I, those of the expression (2.11) for Problem I′ and those of both (2.10) and (2.11) for Problem II.

For Problem I this means that:

$$\partial\omega_1/\partial y_1 - \lambda_1 = 0 \qquad (3.1)$$
$$\partial\omega_1/\partial a_1 - \lambda_1 = 0 \qquad (3.2)$$
$$\partial\omega_1/\partial b_1 - \lambda_1 = 0 \qquad (3.3)$$
$$\partial\omega_1/\partial v_2 \qquad = 0 \qquad (3.4)$$

Similarly, for Problem I we must have:

$$\partial\omega_2\partial y_2 - \lambda_2 = 0 \qquad (3.5)$$
$$\partial\omega_2/\partial a_2 - \lambda_2 = 0 \qquad (3.6)$$
$$\partial\omega_2/\partial b_2 - \lambda_2 = 0 \qquad (3.7)$$
$$\partial\omega_2/\partial v_2 \qquad = 0 \qquad (3.8)$$

For Problem II the optimum conditions are:

$$\partial(\omega_1 + \omega_2)/\partial y_1 - \lambda_1 = 0 \qquad (3.9)$$
$$\partial(\omega_1 + \omega_2)/\partial a_1 - \lambda_1 = 0 \qquad (3.10)$$
$$\partial(\omega_1 + \omega_2)/\partial b_1 - \lambda_1 = 0 \qquad (3.11)$$

$$\partial(\omega_1 + \omega_2)/\partial y_2 - \lambda_2 = 0 \quad (3.12)$$
$$\partial(\omega_1 + \omega_2)/\partial a_2 - \lambda_2 = 0 \quad (3.13)$$
$$\partial(\omega_1 + \omega_2)/\partial b_2 - \lambda_2 = 0 \quad (3.14)$$
$$\partial(\omega_1 + \omega_2)/\partial v_2 = 0 \quad (3.15)$$

In addition the restrictions (2.65) or (2.66) or both must be satisfied.

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4 The Optimal Social Order: Its Means and Institutions

4.1 OPTIMAL SOCIAL ORDER

In this chapter a description of the optimal order is offered as seen by different scholars belonging to different schools of thought and reflected by differences in political convictions. We offer our own interpretation of these views which are not necessarily as they are seen by the scholars in question. In other words, we try to make understandable why differences in political convictions are possible as long as scientific research is not perfect and has not proved beyond doubt the mistaken assumptions made by some schools of thought. Of course we are aware of the possibility and even probability that assumptions falsified by scientific research and no longer adhered to by any scholar may still be held by the public and politicians. Scientific results need a long time to penetrate public opinion and are often opposed by the people and politicians if they threaten the latters' interests.

On the other hand, a number of propositions may be so self-evident that they are held by virtually everybody, whatever their political allegiance. We believe that such propositions exist in the fields covered by our subject and that their number can be increased. World opinion seems to be approaching the conviction that a nuclear war cannot be won and that therefore nuclear weapons cannot and must not be used. The full consequences of this belief are not yet clear.

In the present chapter the most important features of an optimum order will be discussed, but not the way to attain it: that subject will be dealt with in Chapters 9 and 10 of Part II.

For a clear understanding of the main features of an optimal order a minimum number of nations must be considered. The social order in the conventional sense can be studied for single countries. In the sense that it is understood in this book, where the security element is included, at least two countries or two alliances must be studied; if we want to combine this with the problem of development cooperation we must consider at least three 'worlds', as illustrated by the use of the phrase 'Third World'.

A basic feature on which differences exist between various schools of socio-economic research is the degree of centralisation in decision-making needed in an optimal economic order. Those who believe strongly in the self-regulatory capability of the economy are in favour of a relatively small number of means or instruments. The typical example is the school of *laissez-faire*, represented today by the conservatives in the US and in Europe, as well as in a number of developing countries: this applies to the political party or parties in power, and not of course to the opposition. At the other extreme we have the communist-ruled countries, where the leading scholars emphasise the need for a large number of instruments, operating in a system of central planning, and hence a high degree of centralisation of decision-making.

An intermediate position is held by scholars and politicians known as democratic socialists. Their optimal order is often called a *mixed economy*, since it combines a considerable, but not excessive, degree of public intervention with self-regulation of a considerable number of sectors or markets. Comparable, but somewhat more conservative, opinions are held by Christian Democrats and European Liberals.

There is no generally agreed opinion about the relative success of these three main schools. It depends on the criteria used which system is best. Serious observers of the various systems admit that some features in each of the three main orders are better than others. Thus, the overwhelming problem of unemployment constitutes a disqualification of both the capitalist and the mixed systems. Income inequality also constitutes a less favourable characteristic of the capitalist system (cf. Wiles, 1978). In contrast, the average level of prosperity is clearly higher in capitalist societies, associated with greater opportunities for enterprising individuals. The disadvantage of unemployment in the mixed system is partly compensated by the unemployment benefits paid to the jobless. A serious drawback of the communist systems is their authoritarian character, in particular the way in which citizens with dissenting opinions are treated.

4.2 CIVILIAN INSTITUTIONS AND THEIR INSTRUMENTS

In the following sections the institutions and their instruments will be described whose operation is directed at a maximum of traditional welfare, disregarding security. A distinction is made between planning institutions and executive institutions, whose relative importance differs considerably between centrally planned and market economies. In the present section we discuss this choice of the *degree of centralisation* or intensity of central planning. The choice should depend on an evaluation of the advantages and the disadvantages of central planning.

The *advantages* are: (a) that central planning may help to avoid large-scale inconsistencies between important decisions about how to develop an economy. Market economies (or capitalist societies) suffer, periodically, from the consequences of inconsistencies in investment decisions, which may lead to over-capacity in some industrial activities, in particular new activities. During the nineteenth and the twentieth centuries market economies have shown various types of cyclical movements, the avoidance of which will be discussed in more detail in Chapter 6. These cycles brought unemployment of sometimes considerable numbers of workers, losses to enterprises, and other socially undesirable phenomena which rarely occur in centrally planned or communist societies.

Another advantage of central planning is that it enables a country to choose from a larger number of policies: central planning may be directed at the prices and quantities of goods and services that would obtain under free competition, but it may also be directed at numerous other developments: it is not forced to move along the capitalist path, but has considerable flexibility.

Central planning also has its disadvantages. First, it requires a number of workers at various levels of skill, including large numbers of economists, engineers and other academically trained workers, who are not available for other, perhaps more useful, purposes. In the large bureaucracy in which they work conflicts may arise about competence and methods of work, resulting in rigidity in decision-making. In the history of central planning we find examples of rather primitive methods being used. The so-called input–output method used in the early periods of planning in the SU was primitive: production figures were chosen arbitrarily, and consumption treated as a residual; contrasting with the more sophisticated methods developed by the American economist (of Russian origin) W. Leontief. Finally, central planning may be performed in ways whose effects initially look very promising, but eventually work out undesirably, because of over-ambitious targets. One example is what J. Kornai calls 'rush growth' (Kornai, 1971).

The choice of the optimal quantity and quality of central planning made by various economists, politicians or citizens obviously depends on the relative evaluation of these and other advantages and disadvantages of central planning and varies between such widely different systems as used in the two superpowers, which are close to the extremes to be found in economics literature. Of course, the choices change with successive governments. The US under Franklin D. Roosevelt was radically different from Ronald Reagan's US. China in 1986 is very different from under Mao.

Most European countries are in favour of a degree of central planning which falls between that of the superpowers; but variations exist and the differences between Scandinavian countries and Mrs Thatcher's UK are considerable. Yet, the European average is closer to what may be called a mixed economy (as mentioned in Chapter 2, especially section 2.5).

One way of characterising the various shades of central planning is to emphasise the way of storing the information necessary for managing the economy: central planning adherents prefer centralised storage while market economy adherents prefer storage spread over all enterprises with only minor portions in Central Statistical Bureaux and the Ministries.

4.3 PLANNING INSTITUTIONS

As observed, nations in favour of a high degree of centralisation and a large number of means of socio-economic policy are characterised by an extensive planning apparatus. This apparatus is structured hierarchically: at the lowest level planning units exist in single production units and at the highest level a central planning unit is in charge of coordinating the production processes of all production units. In other words, the planning machinery reflects the structure of production with its raw materials, intermediate products and products in the retail distribution system facing the prospective consumers. It shares with the production system its ramifications and linkages, and in particular its division into consumer goods and services and investment goods and services. It also shares with the production system its geographical distribution. The most important inputs into a planning process are human effort, information inputs and research orders. Its main capital goods are buildings and computers. (For planning as a production process, see Tinbergen, 1964.)

This picture does not apply to planning in mixed societies. The links between the elements of such a planning system are hardly comparable to a hierarchy, being voluntary rather than imposed. The central planning office publishes research results in the form of reports, and is available for information; it may also accept research commissions from the government and research inquiries from all sorts of institutions: political parties, research institutes, trade unions, employers' associations and so on. The plans drawn up are not imposed on production units but may serve as a guideline; they are known as *indicative plans*.

For planning at the *world level* econometric models are needed which, in principle, reflect the main features of the world economy. In the United Nations Secretariat in New York a first attempt to construct such a model was developed by Jacob L. Mosak, but never published. It was used frequently for many of the Secretariat's tasks, and was particularly useful for the work of the United Nations Development Planning Committee, established in 1966.

In 1968 an international research programme was established, known as *Project Link*, in which models for a large number of market economies were combined with a model for most of the non-communist world. Models for the developing world were taken care of by UNCTAD (cf. Ball, 1973; Waelbroeck, 1976). Shortly after 1970 a large demand for its use developed following the end of the Bretton Woods System and, a little later, the oil price rises imposed by OPEC.

Both Mosak's model and *Project Link* are economic models in the traditional sense: security aspects are not covered. This is undertaken by the Berlin Science Centre in its *Model Globus* (cf. Deutsch, 1984).

4.4 EXECUTIVE INSTITUTIONS FOR PRODUCTION, DISTRIBUTION AND CONSUMPTION

Now we come to the heart of our subject: what institutions are required in order to realise the optimal conditions which must be satisfied to make welfare as great as possible within the framework of the restrictions mankind is subject to. In the preceding section we saw that the number of institutions is much larger in communist-ruled than in market economies as a consequence of differences on the degree that automatic regulation is able to approach a maximum of welfare. We shall discuss the two main types of social order, but arrive at the conclusion that there is a range of orders rather than only two opposed ones. The education system will be discussed separately in section 4.5.

A centrally planned society consists of a close-knit system of institutions arranged hierarchically with such strong interconnections that rigidity is almost unavoidable. We pointed out that a parallel exists between the planning institutions and the executive institutions. The executive institutions together are a machinery that starts operations after the plan has been approved and the planning period started. These operations are dovetailed as much as possible and so fewer inconsistencies occur than in market economies, but also fewer spontaneous responses to unexpected events are possible; such responses take longer than in a market economy, because the decisions must be made at the top. In particular when the unexpected event takes place at a low level the information has to follow a long chain up and down. Still, this only applies to the more important activities and the decisions they need. And even in existing centrally planned economies large numbers of minor decisions are made in the workplace or at some intermediate level.

Moreover, in these economies a number of important activities are unregulated, such as some personal services, agriculture on small private plots whose products are sold in the free market. Also the system of central planning has been changed several times and the number of criteria a production unit has to satisfy has been reduced. The spatial structure constitutes another element where a choice must be made between different possibilities (cf. Chapter 5).

Market economies, which we shall treat as a type of order opposed to centrally planned economies, prefer a minimum of 'concrete' and a maximum of 'abstract' institutions such as markets and 'absence of intervention' (or 'freedom'). That minimum of concrete institutions consists of the most restricted form of government performing a number of policing tasks, such as the prevention of illegal activities (theft, violence against persons and their property, restriction of competition, etc.) or 'internal security'. Another task of such a government may be described as the management of collective (or public) goods, whose consumption by one person cannot prevent consumption by other individuals. Private management—although conceivable—seems inappropriate. In order to decide about the use or production of collective goods, the utility to all citizens must be estimated and this constitutes a community task. A typical collective good is the 'mobile environment'—the atmosphere, the seas and rivers—protection against floods has been considered a government task for centuries. In modern societies not only dykes to prevent flooding, but also the transportation infrastructure, and many types of information (from libraries, statistical offices, radio and television broadcasting) are examples of collective goods.

This most restricted form of government may, however, be non-optimal if the operation of the abstract institutions of markets do not satisfy the optimality conditions. In particular, the optimum condition of *equal marginal welfare* of all citizens requires an income distribution that does not obtain. This requires a taxation system producing equal marginal welfare. Such a system must differentiate between citizens of different family size, with different health and employment prospects. In brief, important elements of what we call a *social security system* must be present.

So the most restricted system of government appears, on closer inspection, to be more elaborate than proponents of *laissez-faire* imagine. This applies also to what we called prevention of the restriction of competition. Known as anti-trust or anti-cartel policy, this government task also is less simple than may be thought. This may be illustrated by Dutch legislation. This is based on a closer analysis of the phenomenon of cartelisation. This analysis shows that in some industries or in some periods unlimited competition may lead to prices resulting in permanent losses for all enterprises of a branch of industry ('cut-throat competition'). Dutch legislation prescribes that in such cases cartelisation has to be imposed in order to assure continuity of production, whereas in other cases cartel-building has to be prohibited.

Another example of markets which do not satisfy the optimum conditions are *unstable markets*, that is markets whose random disturbances are not followed by a quick re-establishment of equilibrium. This may be due to long lags in the reactions of demand or supply, to inelasticity of both supply and demand, or by speculators' activities. In today's world a number of *commodity agreements* have been concluded in order to regulate some of these markets (tin, wheat, rubber, coffee, cocoa, sugar, olive oil, jute and tropical timber). For a useful summary of how these agreements had worked until 1985, cf. UNCTAD (1985).

These examples show that the optimal social system is not one of two alternatives only: a 'socialist' and a 'capitalist'. There is an almost continuous range of systems between the two. Only the extremes do not exist. This point of view has been expressed clearly by Adler Karlsson (1967). The relative importance of government intervention varies from little (in the US) to considerable (in the SU) with many intermediate positions, in general from Southern to Northern Europe: the Scandinavian countries having quite a lot, as, in another way, does Yugoslavia. Recently in China a rather important shift has taken place. Within Eastern Europe (the Council of Mutual Economic Aid, CMEA countries) there are differences also, with Hungary having somewhat less intervention than Bulgaria, for instance.

The existence of this range shows that preferences vary among nations, because of historical, geographical and cultural differences and makes it easier for all nations to understand each other. If explained to the public this may be used to reduce distrust and be used to raise security.

4.5 THE FORMAL EDUCATION SYSTEM

We have excluded one set of institutions from description so far, the *formal education system*: the system of all schools, whose task is to transfer to the younger generation the knowledge and capabilities thought to be desirable. Subdividing a nation's population into annual cohorts indicates that each year an old generation leaves productive life and a younger one enters it. More generally, deaths and births, and emigration and immigration also contribute to a gradual takeover by the younger from the older and in part by foreigners from nationals, or vice versa. Here we restrict ourselves to the formal education system; i.e.informal education within the family, by friends and at work is largely left out of consideration. For the inclusion of the education system into an optimal order cf. Tinbergen (1985).

In many countries a distinction is made between *primary*, *secondary* and *tertiary* education for children of different ages and different capabilities and interests. Another distinction is that between *general* and *vocational* training. Part of schooling, at present mostly primary and secondary, is obligatory. Youngsters with high levels of intelligence or other capabilities will be encouraged, and mostly also prefer, to go on to tertiary education. This is specialised and implies a preparation for the future job(s). Formal education usually ends by taking exams. This constitutes some sort of screening, facilitating a future employer's selection. However learning process does not finish, but goes on informally and each individual's capabilities are enriched by practical experience. The process of selection goes on too and in this process leading personalities in all walks of life come to the fore. Like every human activity the processes of education, selection and finding a permanent position do not happen without mistakes. Pupils or students may be not correctly assessed; or they may themselves not know what they are able to do or what will satisfy them. The art of teaching has been an ongoing subject of research and in the course of the last centuries important improvements have been made. The effect of teaching depends on the student's attitudes also, however, and not only on the individual student's but also on classroom behaviour. The latter seems to change over time, cyclically as well as trendwise. Much remains unexplained.

The general educational level of the population may be considered a collective good and hence subject to government supervision. Even if private and church schools are part of a country's system, they will be supervised. This supervision often extends beyond school education and covers the practical training organised by production units (training on the job), which usually has to satisfy a number of conditions.

Part of education is devoted, of course, to the development of non-intellectual development: to moral or ethical development. As a rule this also contains a preparation for life in the country's social order. There are differences between countries in the intensity of the indoctrination implied in this aspect of schooling. Western countries show a higher degree of tolerance *vis-à-vis* other orders or at least *vis-à-vis* teachers adhering to another social order. In communist countries less tolerance is allowed which may be seen by future generations as a less desirable feature in the long run.

4.6 SECURITY INSTITUTIONS: POLITICAL

As observed, security may be raised by military or by non-military institutions. The latter may be called *political* institutions and consist primarily of the institutions of the Ministry of Foreign Affairs (in the US the State Department) which coordinates all diplomatic contacts, deals with the nation's membership of international organisations and the nation's adherence to a number of treaties. In addition there are other ministries handling international contacts. Foreign trade constitutes a very important instrument, and so do financial and monetary transactions. Ministries with different names in various countries deal with the former issue and the Ministry of Finance (or the Treasury) with the latter. Trade policies are a very important instrument that can be used to the advantage but also strongly to the disadvantage of other countries. Thus, prohibiting the exports of new technology, such as electronics devices, may negatively affect the relation between the exporting and the would-be importing country. Continuing the exports of wheat to the SU was, in contrast, a positive gesture by the US.

The role that may be played by non-military institutions in an attempt to influence a country's security favourably was illustrated particularly clearly by our Model C (sections 2.6 and 3.9); we shall discuss this in sections 4.8 and 4.9.

A particularly important set of political institutions contributing to security is the machinery used by the member states of the European Community with the general purpose of integrating them into one union, comparable to the superpowers, except for the overdevelopment of their armed forces. This integration process serves both the socio-economic and the security interests of the member nations. To generalise it may be stated that enlargement of the market will raise prosperity as a consequence of economies of scale and of specialisation, but also by the elimination of a considerable number of unnecessary activities, such as frontier checks of all sorts of documents, and transformations of all kinds because of different traditions, legislation and systems of standardisation.

But of especial importance is the enhancement of security, in particular the reduction of the possibility of an armed conflict between France and Germany, which occurred in 1870–71, 1914–18 and 1939–45.

It should be emphasised that in other parts of the world, and eventually in the whole world, this is a possible approach to enhancing security. This is the reason why it is mentioned: Europe offers examples which may be instructive to other continents and to the world at large. Unfortunately examples of how *not* to do things also can be found.

Finally, the International Court of Justice, located in The Hague, should be mentioned as an institution capable of raising security, on the condition, of course, that its competence is recognised. The recent attitude shown by the present American administration does not constitute an intelligent policy.

4.7 SECURITY INSTITUTIONS: MILITARY

In the pre-nuclear era military institutions were used, by the stronger and more aggressive nations, in order to raise their welfare or security, or what they thought was welfare-cum-security, if political means did not work as they wanted. Armed conflicts were considered to be 'the continuation of diplomacy by other means'. However one evaluates such decisions (much can be argued against the use of arms in the pre-nuclear era), they have to be revised as a consequence of the existence of nuclear arms, since these arms cannot be used; their function is said to be to *deter*, but the true meaning of that phrase is not clear and accordingly military thinking has become inconsistent. This constitutes an autonomous argument against military thinking and activity.

As long as we restrict ourselves to non-nuclear weapons, this additional argument does not apply and military thinking can be consistent. Then, the distinction between *offensive* and *defensive* weapons makes sense for part of today's arms. Following many others we state that offensive weapons may increase the owner's security but reduce the other party's, whereas in some situations defensive weapons enhance *both parties*' security.

Unfortunately we have taken over from Hitler the development of rockets, which are offensive in by far the larger number of applications. Where we have developed defensive arms as a counterpart to offensive arms (anti-tank guns, anti-aircraft guns, etc.), (on both sides) we have only very imperfect defensive weapons to counter a missile (rocket) attack, notwithstanding the research programmes made so far, on both sides. The optimum level of security will be characterised by defensive weapons available to authorities which do not want to attack. The weak point in such an optimum remains the uncertainty about the other side's intentions. Both the US and the SU by their past behaviour give rise to doubts about their intentions.

Perhaps some comfort can be derived from Baer-Kaupert's (1985) statement that 'the intention to attack can be read into military planning only if supporting evidence can be found in the *security policy as a whole*. At the present time, in both East and West, there is no such evidence'. But, as Fischer points out, the only way one can fully trust a declaration of no offensive intentions is if the party making that statement is *unable*, with the arms it has, to attack.

We are far from this situation, however, and both sides will take into account the possibility of the other side's first-strike capability as soon as a near-perfect defensive counterpart to missiles has been found. For this reason most independent experts advise that a race in searching for such counterparts be blocked by a new treaty preventing the use of weapons in outer space. An alternative is to develop, in full cooperation with the other party, all new knowledge so as to attain common security (Palme, 1982). This sounds unrealistic but it is correct that an actual technology for a near-perfect defence against missiles would constitute a higher level of security.

Some American civil servants seem to share this opinion (cf. Spoor, 1985). This aim seems attainable only after both parties have convincingly shown they are not *able* to attack, hence a large-scale *verifiable destruction* of present offensive armament is needed. While this remains the 'optimum optimorum', for the time being the optimum seems to be to ban all weapons from outer space.

4.8 THE INTEGRATED OPTIMAL SOCIAL ORDER

The solution of the main problem Part I of this book deals with (to identify the social order which in the long run tends to maximise world welfare-cum-security) can be obtained in the way set out in the preceding sections of this chapter. In this and the following section we shall illustrate this by using the Models A, B and C of Chapter 2 (sections 2.2, 2.5 and 2.6). We start with Model A.

For Problem I: Country 1 faces the following dilemma: the larger the fraction μ_1 of its civilian goods it allocates to the civilian economy, the faster its civilian economy grows, but the less secure it will be if it is threatened by an adversary. The more it allocates to the military industry, the more secure it will generally be, but the lower is the growth of its economy, and in the end it will not even be able to sustain the production of arms, if its civilian economy lags behind. It is assumed that it will seek a solution of balanced growth, where the slowest growing sector grows as fast as possible. In general, this will imply that all sectors grow at the same rate.

It can be seen that if μ_1 is chosen so as to maximise the lesser of the two growth factors in Table 3.1, the two growth factors are equal:

$$b\,(1 - \mu_1) = c\mu_1/d\mu_2,$$

or

$$\mu_1 = \mu_2/(\mu_2 + c/bd)$$

Since country 2 faces the same problem, we also have:

$$\mu_2 = \mu_1/(\mu_1 + c/bd)$$

Using the abbreviation $e = c/bd$ and inserting μ_2 in the expression for μ_1 yields a quadratic equation $\mu_1^2 - (1 - e)\,\mu_1 = 0$ with the two solutions:

$$\mu_1 = \mu_2 = 1 - e$$

or

$$\mu_1 = \mu_2 = 0$$

Each of those two solutions represents a Cournot–Nash equilibrium. To see whether these equilibria are stable, we calculate the first derivative

$$d\mu_1/d\mu_2 = e/(\mu_1 + e)^2$$

If this derivative is greater than 1, a small deviation in the arms expenditures of country 2 from the equilibrium level will induce country 1 to undertake an even larger change, and vice versa by symmetry. This means that the equilibrium is unstable. The slightest deviation leads to a progressive race away from it. If the derivative is less than 1, the equilibrium is stable.

$$\begin{aligned} &\text{Since } d\mu_1/d\mu_2 = 1/e \text{ if } \mu_2 = 0 \\ &\text{and } \quad d\mu_1/d\mu_2 = e \quad \text{if } \mu_2 = 1 - e, \end{aligned}$$

we can observe that

if $e < 1$, $\mu_1 = \mu_2 = 1 - e$ is a stable equilibrium and

$\mu_1 = \mu_2 = 0$ is an unstable equilibrium.
If $e > 1$, $\mu_1 = \mu_2 = 0$ is a stable equilibrium and
$\mu_1 = \mu_2 = 1 - e$ is an unstable equilibrium.

For Problem II, we see from Table 3.2 that the growth factors are $b\ (1 - \mu)$ for civilian goods , and c/d for security (if the military industry is operated with positive intensity) or indeterminate (if $\mu = 0$, i.e. if no arms are produced). The optimal solution in this case is not to produce any weapons at all, and to allow the civilian economy to grow from each period to the next with the maximum feasible growth factor b for $\mu = 0$.

The Von Neumann growth model permits solutions in which not all industrial sectors are operated with a positive intensity, and not all goods produced and used. For a detailed description of the Von Neumann growth model, see Morgenstern and Thompson (1976). For the treatment of externalities in such a model, see Fischer (1977).

Now Model B will be used for illustration. Model B is not a fully quantitative model, since its variables can only assume discrete values. The impact on welfare-cum-security of its variables is shown in Table 2.2. The restrictions take the form of excluding groups of cells of this table. If environmental policy is decided on at world level, only the left-hand half of Table 2.2 is valid; if an imperfect environmental policy is followed, only the right-hand half is valid. If the ABM Treaty is adhered to, only the rows where $m = m_1$ are valid within the left-hand or right-hand half. The optimum solution can then be read from the lowest line of the table, meaning that we must have $w = w_1$ (decision on armed conflict at world level), $n = n_1$ (Non-Proliferation Treaty adhered to) and $b = b_1$ (a treaty banning arms in space is concluded).

Taking up Model C (cf. section 2.6) now, which is fully quantitative, the restrictions are introduced with the aid of Lagrange multipliers and the model expressed in a set of equations (section 3.9).

Problems I, I′ as introduced there constitutes the order where the two superpowers follow a sovereign policy; and Problem II the order where they behave as members of an ideal 'United Nations' aiming at common welfare and common security.

We shall illustrate our example in three stages. First, we give the general solutions, then we add a numerical elaboration. Finally we offer a verbal interpretation (in section 4.9).

The general solution to Problem I must consist of four equations for the four unknowns (and one equation to eliminate the Lagrange multiplier). Upon closer inspection it appears that (3.4) cannot be satisfied: it would require that $y_1 - v_1 = \infty$. This means that the maximum with regard to v_2 cannot be a flat maximum, but has to be a boundary maximum. In the present case we choose $v_2 = 0$. Introducing this value as given and carrying out the differentiations we obtain, after elimination of λ_1:

$$a_1 + 1 = \alpha_{11}(y_1 + 1) \tag{4.1}$$
$$b_1 + 1 = \beta_{11}(y_1 + 1) \tag{4.2}$$
$$y_1 + 1 = (x_1 + 3)/(1 + \alpha_{11} + \beta_{11}) \tag{4.3}$$

In Problem I' too we must reject equation (3.8) since it requires that $y_2 + v_2 = \infty$. Moreover, it is not in the power of Country 2 to choose v_2; it seems more realistic also here to take $v_2 = 0$. We are then left with:

$$a_2 + 1 = \alpha_{22}(y_2 + 1) \tag{4.4}$$
$$b_2 + 1 = \beta_{22}(y_2 + 1) \tag{4.5}$$
$$y_2 + 1 = (x_2 + 3)/(1 + \alpha_{22} + \beta_{22}) \tag{4.6}$$

Problem II has seven unknowns and after elimination of the λ_1 and λ_2 we obtain the following seven equations:

$$a_1 + 1 = (\alpha_{11} - \alpha_{21})(y + 1) \tag{4.7}$$
$$b_1 + 1 = (\beta_{11} + \beta_{21})(y + 1) \tag{4.8}$$
$$a_2 + 1 = (\alpha_{22} - \alpha_{12})(y + 1) \tag{4.9}$$
$$b_2 + 1 = (\beta_{12} + \beta_{22})(y + 1) \tag{4.10}$$
$$y_1 - v_2 = y_2 + v_2 = y \tag{4.11}$$
$$v_2 = \frac{1}{2}(x_1 - x_2) - \frac{1}{2}(\alpha_{11} - \alpha_{21} - \alpha_{22} + \alpha_{12} + \beta_{11} + \beta_{21} - \beta_{12} - \beta_{22}) \tag{4.12}$$

where the variable y has been introduced to simplify the formulae.

A numerical example will be added, but only to illustrate orders of magnitude. Empirical research must be undertaken in order to verify the model and to obtain a better basis for further work. This is underway but must be postponed to later occasions. It is perfectly possible that the dependence of welfare on the armament components is different from the relations chosen. Our Model C only constitutes a first orientation about the type of research needed.

The real incomes expressed in US dollars (1980) are of the order of magnitude of 2500 for x_1 and 1250 for x_2. The values chosen for the αs and the βs are:

$$\alpha_{11} = 0.06 \quad \alpha_{12} = 0.05 \quad \alpha_{21} = 0.05 \quad \alpha_{22} = 0.07 \qquad (4.13)$$

$$\beta_{11} = 0.015 \quad \beta_{12} = 0.015 \quad \beta_{21} = 0.03 \quad \beta_{22} = 0.03 \qquad (4.14)$$

These figures satisfy some conditions we considered imperative, namely:

(i) $\alpha_{21} < \alpha_{11}$; $\alpha_{12} < \alpha_{22}$ (cf. Equations (4.7) and (4.9));
(ii) all βs are considerably smaller than the αs, expressing the fact that today both superpowers have much more offensive than defensive weapons.
(iii) $\alpha_{12} = \alpha_{21}$, expressing that the damage to be expected from a unit of offensive weapons is roughly equal in both directions; and
(iv) the SU coefficients are roughly twice the US coefficients, since $x_2 = \frac{1}{2} x_1$; but it remains unclear whether, for the offensive weapons, this should apply to α_{22} versus α_{11} or to $\alpha_{22} - \alpha_{12}$ versus $\alpha_{11} - \alpha_{21}$, as we did. This is the issue most in need of further research.

With the coefficients (4.13) and (4.14) the following solutions were obtained (Tables 4.1 and 4.2).

Table 4.1 Solutions of the unknowns (rounded)

	y_1	y_2	a_1	a_2	b_1	b_2	ω_1	ω_2	$\Omega = \omega_1 + \omega_2$
Problem I	2327	1077	139	139	34	34	7.91	7.30	15.20
Problem I′	2388	1138	79	79	33	33	7.93	7.34	15.27
Problem II	2405	1137	17	34	79	79	7.58	7.85	15.43

Table 4.2 Armament expenditures as a percentage of national income

	1 (United States)			2 (Soviet Union)		
	Offensive	Defensive	Total	Offensive	Defensive	Total
Problem I	5.6	1.4	6.9	11.1	2.7	13.8
Problem I′	3.2	1.3	4.5	6.3	2.6	9.0
Problem II	0.7	3.2	3.8	2.7	6.3	9.0

It should be noted that in particular the figure for a_2 (offensive weapons of country 2) is very sensitive to the value chosen for α_{22}. The model setup implies the assumption that in Problem II the propensity to spend on arms depends on y and that implies that transfers v_2 would be spent partly on arms. In this respect the model needs revision. This appears to hit on difficulties we have not solved so far and their treatment was postponed to later. The model is meant as an illustration. For the situation described in Problem I, where country 1 maximises utility, the figures in Table 4.2 for total armament expenditures are very close to reality in 1985/86.

4.9 THE LIMITS OF SOVEREIGN POLICIES

The results of the integration approach can be expected to be similar to the results of the separate welfare and security approaches, namely that sovereign policies fail to produce an optimal level of welfare-cum-security, as soon as external effects occur. For welfare environmental aspects show such effects and for security such effects are characteristic.

This has been shown by various authors as well as by the models we ourselves constructed.

We saw that in Model A, Problem II, all the resources available are devoted to the civilian economy, allowing it to grow at the maximum feasible rate, without diverting any resources to the production of arms. This is naturally to be expected, when the negative effect of armaments on the security of the other country is directly taken into account in decision-making. Today we observe that provinces within one sovereign country do not arm against one another. This is a strong argument in favour of taking decisions about armament and security at the world level.

In Problem I, where the two countries do not coordinate their activities but act at cross-purposes, taking only their own shortsighted interests into account, they can end up hurting themselves, if they burden their economies with mutual arms expenditures. However, in this model, it is found that if the arms are sufficiently defensive, the two countries spend nothing for arms:

If $e = c/bd > 1$, $\mu_1 = \mu_2 = 0$,

i.e. no resources are allocated to the military sector. This is the case if c, the internal gain in security from the production of arms, is large compared to d, the external loss of security (i.e.

if the arms are predominantly defensive) and/or the potential growth factor b of the civilian economy is small, so that the economy is unable to sustain an extensive arms industry.

With more highly offensive arms, or a higher potential growth factor,

if $e = c/bd < 1$, $\mu_1 = \mu_2 = 1 - e = 1 - c/bd$,

i.e. the fraction of resources spent on arms is the higher, the more offensive the arms are, and the more productive the civilian economy. The actual growth factor of the economy,

$g = b(1 - \mu_1) = be = c/d$

is the lower, the more offensive the arms are. If $c < d$, i.e. the external loss of security exceeds the internal gain, then the growth factor is less than 1, and the economies of the two countries are contracting over time, as a consequence of heavy arms expenditures.

How do countries choose between more or less offensive military technologies, if they do not coordinate their decisions? A country that is only interested in maintaining its own security, without deliberately aiming at reducing the security of the other country, will choose the military technology that gives it the highest amount of internal security per unit of resources spent, without taking into consideration the loss of security caused for the other country. Therefore, if one country discovers a new weapons technology which is inexpensive and highly defensive, it will be in its interest to make that technology available to the other country, out of self-interest. That can induce the other country to shift to a more defensive and less threatening form of arms production. Arthur Cox (1981), for example, has argued that it would be in the interest of the United States to make its most reliable computers available to the Soviet Union for its anti-missile warning system, so that the Soviet Union would not launch a retaliatory strike because of computer error.

Some typical examples of defensive conventional arms are barriers against tanks in fixed positions, land mines, anti-tank and anti-aircraft weapons, and shore batteries in fixed emplacements. They can be used to repel aggression, but cannot be used to carry out aggression.

Some typical conventional offensive arms are tanks, especially when accompanied by fuel tanks for advances over a great distance, bombers, landing craft and aircraft carriers. These weapons can be used for military operations far beyond a country's home territory.

By simultaneously improving its defence capabilities and deliberately reducing its offensive forces, a country can increase its own security against attacks and also reduce the fear of adversaries of being attacked. Such a unilateral shift, which is neither armament nor disarmament, but can be called *trans*armament, enables a country to reduce the danger of war, without risk to its own security. On the contrary, it will increase its own security, as well as the security of other countries.

It is obvious that negotiations for mutual disarmament and for joint measures to reduce the danger of war should be pursued rigorously. But negotiations should never be used as an excuse for not undertaking unilateral steps that can help reduce the danger of war, without a risk to a country's own security. Transarmament from offensive to defensive arms is one such step.

Is the Strategic Defence Initiative (SDI) a defensive system? By itself, it would not pose a threat to anyone, and would be purely defensive, although it is doubtful how effective a defence against nuclear weapons could ever be. Current plans only foresee a defence against ballistic missiles that leave the atmosphere, not against cruise missiles or even nuclear weapons smuggled by terrorists. However, the fact that it may turn out not to be feasible to develop a reliable defensive system would be no reason not to try. But when a defensive system against missiles is combined with nuclear missiles, the combination of the two yields a highly *offensive* system. Without a defence, no sane leader would ever want to launch nuclear missiles, out of fear of retaliation. But with a defensive shield against retaliation, a first strike, or at least the threat of a first strike to win concessions, might become conceivable in the mind of a totally ruthless national leader.

Another problem with the proposed system of space-based lasers is that those laser beams could not only be aimed at an opponent's missiles, but also at its space stations. Whoever fired these laser beams first could wipe out the space stations of an opponent. Whoever hesitated during a crisis would risk losing his space stations. This would introduce a new source of crisis instability.

Furthermore, these space stations would have to react so quickly that human control would have to be eliminated, leaving decisions to pre-programmed computers. Do we want to risk the outbreak of a world war due to a computer error?

For these and other reasons, SDI does not appear to offer a solution to the threat of nuclear war. The solution will more likely have to be found in the political rather than the purely technical domain.

The results obtained with Model C in section 4.8 can be interpreted as follows. Equation (4.12) shows that significant non-military security expenditures are part of the optimum: no less than half of the difference in national expenditures should be transferred from nation 1 to nation 2.

For the military expenditures we can derive from (4.1) to (4.10): the relative importance of defensive to offensive weapons has to be changed in favour of defensive weapons, that is *transarmament* is highly desirable.

From the numerical example summarised in Table 4.1 we see that a considerable reduction in offensive armament expenditure characterises the solution of Problem II, that is, an attempt to cooperate or to shift to a supranational way of decision-making. Our findings are an encouragement to extensive further empirical work and to speed up negotiations on a common policy of security.

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5 Spatial Aspects of the Optimum Order

5.1 INTRODUCTION

So far we have neglected the spatial dimensions. Humankind lives in *three-dimensional space* and the concepts and institutions discussed in earlier chapters may vary spatially. It is not only natural phenomena that vary in space (e.g. temperature) but also economic variables may be different in different *locations*. Wheat production occurs close to the earth's surface and is possible only in limited areas of the earth's surface. Human beings live in cities, in villages or in isolation. Location also introduces the concept of *transportation* from one location to another, and *communication* between different locations. The spatial element considerably complicates society and its institutions, and a number of these complications will be discussed in this chapter. In the real world there are very few nations where space and distance play a subordinate role—for instance, Hong Kong or Gibraltar. Space and distance play a relatively minor role in small countries such as the Caribbean islands, Andorra or Luxembourg and even in the Netherlands or Belgium location and distance play minor roles in comparison to the Soviet Union or the United States, or in an activity like sea transport. In the present chapter the impact on our subject as a consequence of space will be discussed.

5.2 THE VERTICAL DIMENSION

Of the three dimensions in which we live, the *vertical* is the most peculiar, partly as a consequence of gravity. Whereas our ordinary life takes place in close proximity to the earth's surface, sinking a mine gives us access to coal or mineral ores, both materials of great importance. Downward exploration into the earth can also give access to water, a matter of immense importance in arid regions. The water may also be forced upward under pressure as in the geysers of Iceland. Under the seas—which cover about three-quarters of the earth's surface—fish are hunted by fishermen; fish may also be 'harvested' on fish farms and so may oysters and other molluscs. Finally, below the seabed we now drill for oil and we have just started to collect manganese nodules from the bottom of the deep seas—possibly a promising new industry (cf. Mann Borgese, 1985).

So much for downward exploration. We have also learned to move upward, at present mainly by aircraft, and the atmosphere is the environment of a flourishing transportation industry for human beings and products.

Earlier we had learned to project objects through the atmosphere describing *ballistic paths*; starting with stones and followed by increasingly lethal objects. Using stronger firepower (gunpowder, dynamite and other explosives, and now nuclear energy) movements other than from earth to earth became possible. We are now able to put *satellites* in an orbit around the earth for both peaceful and offensive purposes. Finally, with the application of still more energy we have succeeded in launching scientific instruments into outer space to observe other planets. Astronauts have even landed on the moon. A directly empirical branch of astronomy was thus added to the existing branches. Some enthusiasts dream of visiting other planetary systems; but we have to keep in mind that even at the speed of light (300,000 km/sec) it takes five years to reach the nearest star.

Unfortunately, as already mentioned, most of the movements in outer space are devoted to military purposes. We shall deal with these when discussing security issues.

In comparison to the vertical movements described above some modest additional vertical movements are those necessary or desirable in mountainous countries. Switzerland is the obvious European example of course, but each continent has its mountain ranges. Civil engineering and transportation systems have developed impressive technologies, especially for recreational purposes. Similar activities are involved in skyscraper construction, with the United States as the pioneer.

5.3 THE HORIZONTAL DIMENSIONS: GEOGRAPHICAL ASPECTS OF SOCIETY

The other two dimensions which are the basis for geography and the larger part of the socio-economic and security activities occur in a plane that may be described by two coordinates: latitude and longitude. The earth's surface is similar to that of a globe, and cannot be exactly reproduced on a plane. We mentioned earlier that only one quarter of the surface is land. The land surface is divided into more than 150 *sovereign nations*, which have appropriated part of the adjacent sea area, the so-called *exclusive economic zone* (EEZ). There are enormous differences in size and economic importance between the nations. In population the largest, China, is about a million times that of some of the smallest. Consumption per capita varies between the larger ones in a ratio of about 1 (India) to 17 (US) (cf. Kravis *et al.*, 1982). Production of all kinds of goods and services varies as a consequence of differences in mineral deposits, climates, fertility of arable land and skills and preferences of the population. The consumption mix may be very different from the production mix. The differences are bridged by *international trade* or, for large countries, *inter-regional trade*. About half of the goods and services produced in one country (measured in terms of money value) cannot be transported (and hence traded). These are called *non-tradeables* and consist of buildings and their uses, many consumer services (hair-dressing, retail trade services) and cultural activities: primary and secondary education, government services. The other half of production may be—but is not necessarily—traded: large countries' international trade is less than one-half of GNP. Upon some assumptions *free international trade* is part of the optimum economic order.

The introduction of a geographical or locational dimension to economic variables means that an additional index is needed to describe an economy's elements. Production must not only be characterised by the types of good, but also by its location. We only have a one-dimensional list (or vector) if we consider the sorts of good; it becomes a two-dimensional table (or matrix) if we add the location index. This matrix may show, in one column total, the total production of a *branch of industry*, and by one row total, the total production of a geographical area (*region*). Both totals have to satisfy certain conditions. Branch totals have to correspond to the total numbers of workers of various types, with the demand for the branch's products, etc. Regional totals have to satisfy certain relations with the region's total population, for instance. It is possible to organise planning and management of production in two ways: either branch by branch or region by region. Soviet planning experimented with both and finally settled on the branch by branch approach.

Often each member of the managing board of a large corporation deals with one product and with one local unit. This also constitutes the matrix approach.

An interesting additional aspect of the spatial side of an optimal socio-economic order is the distribution of the population over towns and villages of different size and the location of these centres. Centres are agglomerations of production units (factories, schools) of a long list of products each with optimal sizes. These sizes depend on the total costs of production and distribution to the consumer. Villages are small agglomerations built around, perhaps, one bakery, whereas large cities may be agglomerations around a steel-producing and processing complex, with all sorts of typical industries as the possible development 'poles' in between. Recently a considerable amount of research has been devoted to these problems (cf. Bos, 1964; Klaassen *et al.*, 1981; Despontin *et al.*, 1984; Paelinck, 1985).

Because of the lifespan of buildings considerable time-lags may exist between the factors at work and the result of dispersion. Most countries can only partially optimise the location of the *additional production and population*. In rare cases, newly recovered land can be designed optimally. A micro-example is the physical planning of newly recovered land in the Netherlands. A somewhat more macro-physical plan may accompany the construction of a new capital (e.g. Brasilia, Islamabad).

5.4 OPTIMAL LEVELS OF DECISION-MAKING

We stated earlier that the world economy and society consist of more than 150 sovereign nation-states of very different sizes and per capita consumption. Obviously, this state of affairs—in many respects bizarre, if not grotesque—is the outcome of history, and the historical process is composed of a great many unrelated, almost random elements. This is a very appropriate stage at which to specify the main question dealt with in this book. Is the way the world is managed near an optimum; has *laisser-faire* worked optimally? Can we design an optimal way of managing world society? Clearly economic science, and more particularly *business economics* (German: *Betriebswirtschaftslehre*) is able to make a significant contribution. We shall elaborate on what we found with the aid of Model C, in sections 4.8 and 4.9, and generalise some of these findings.

In order to operate the world economy (taken in our generalised sense) its citizens have to make a very large number of decisions, day after day, week after week, and so on. A number of decisions are made by individuals, but the more important ones are made by groups of individuals. There are many sorts of group and a considerable number of them are part of larger bodies organised as *hierarchies*. This applies to single enterprises, but also to large integrated enterprises such as multinationals. There is also a hierarchy of governmental authorities in each nation and there are a few supranational hierarchies, for instance the Coal and Steel Community within the European Community.

Upon closer analysis two questions arise almost automatically. The first is, which is the most appropriate group of decision-makers to decide on a given question or problem to be solved? This question takes for granted the existence of all necessary groups. The second question is whether new groups should be established in order to solve a given set of problems in the best way (optimally). Since the main emphasis in our analysis is on governmental decisions we assume that a hierarchical structure of relevant decision-making groups is necessary. This implies that we can use the concept of level instead of group, since a hierarchy orders the groups at successive levels. In government structures levels are usually related to geographical areas: a nation-state with a national government is composed of provinces with provincial governments; each province is subdivided into municipalities with municipal governments. A higher level then automatically means a larger territory with its population; its representative body or parliament represents the interests of a larger population.

Our first question now becomes: which government level is the optimal level to solve a given problem? Our answer is twofold: (i) the optimal level is the lowest possible level in order that a maximum of participation and a maximum of information be used; and (ii) the level is high enough to entail negligible external effects. By external effects we mean effects on the welfare of individuals living outside the area for which the decision-makers are responsible. Decisions affecting only the local population, for instance, should be made at the municipal level. Decisions affecting inhabitants of all or some provinces should be made at the national level. Decisions to prevent acid rain should probably be taken at the international level. Such authorities may not yet exist, or not have the competence to decide, or not have the power to implement their decisions. Obviously *decisions on security cannot be optimal when made by sovereign nations* as we found in sections 4.8 and 4.9 for Model C.

The second question now applies: authorities needed for optimal solutions to important problems—world security being one—may not exist but have to be created. We shall find that a number of supranational authorities which are badly needed do not yet exist; their creation appears to be urgent.

It is not only authorities at higher levels than those in existence that are lacking, but also at other levels. Management science provides us with some criteria to judge the efficiency of a given hierarchical system. For a hierarchy to be efficient each member at a higher level has to control a number of members at the next lower level. The number which can effectively be controlled by one supervisor is called the *span of control* and usually is of the order of 5–10. It depends, of course, on the nature of the problems to be solved.

With regard to the main problem of Part I of this book—the optimal institutional setup to maximise world welfare-cum-security—we conclude that decisions must be made at a level encompassing at least the two superpowers, and preferably the world at large. Only then will common security be attained.

In Chapters 7 and 11 we shall evaluate in more detail the present system of world management and propose a better structure. Our starting point will be that a General Assembly of over 150 members cannot be a level of decision-making of any use to an optimal management of our planet.

We mentioned also that the subdivision into geographical units of a given area raises questions of optimality. In a hierarchy one aspect that can be chosen is the span of control. There are more criteria for an optimal subdivision: for example, homogeneity in several respects—natural resources, language, history and other cultural characteristics. In an attempt to find the optimal management structure for the world at large, we submit that in contrast to the existing subdivision into more than 150 sovereign nations some twelve to fifteen regional federations of comparable size should be the building-blocks. Some of the most important existing large powers should be among them: China, the Soviet Union, the USA and India, for instance. Another unit might be the European Community. Other potential 'building-blocks' and some related questions will be taken up in Chapter 11.

5.5 SOME OTHER EXAMPLES OF THE NEED FOR SUPRA-NATIONAL DECISION-MAKING

Returning to the spatial aspects of the optimal order we should mention some additional problems whose solution requires decisions at higher than national levels. In passing we have already mentioned environmental problems. Most require decisions at a continental level, and some even at the world level.

In a report to the Club of Rome, *Reshaping the International Order* (RIO), a group presided over by J. Tinbergen (Tinbergen *et al.*, 1976), a number of activities are dealt with whose optimal extent and distribution can be attained by cooperation at the world level. Such cooperation is a weak form of decision-making and so the activities treated are part of this section's subject. They are (in addition to those already treated): running the monetary system, development finance, food production and distribution, industrialisation and international trade, supply of energy and minerals, research and technological development, supervising transnational enterprises. Ocean management has also been dealt with in RIO and will be discussed separately in section 5.7, since it combines all three spatial aspects and, moreover, constitutes the most advanced of all themes concerned.

For each of the activities listed institutions exist whose tasks are related. Thus, the International Monetary Fund (IMF) plays an important role in the world's monetary systems. The World Bank Group, composed of the World Bank (International Bank for Reconstruction and Development), the International Finance Corporation and the International Development Association, plays an important role in co-financing, in different ways, the investments needed for economic development. Food production and distribution are furthered by the UN Food and Agricultural Organisation (FAO) and the International Fund for Agricultural Development (IFAD). Industrialisation of developing countries is supported by the United Nations Industrial Development Organisation (UNIDO). International trade is the area of responsibility of the United Nations Conference on Trade and Development (UNCTAD), whereas negotiations on and supervision of the impediments to international trade are organised by the General Agreement on Tariffs and Trade (GATT).

This list is not comprehensive. The common feature of all these institutions is that they do not have the competence and power needed to constitute, as a set of institutions, an optimal world order to manage our planet. They are, in many cases, a beginning and their competences have developed; but this development is often blocked by powerful establishments whose interests conflict. They are blocked by powerful nations or by transnational enterprises which are, in the present international structure, privileged and want to keep their privileges. This is understandable, but not acceptable to those who want the interests of world population as a whole to be protected. A complication of this conflict of interests is that often the interested groups are better informed about the technical details of the activities concerned. Improvement of the information flows towards interested groups may help to improve mutual understanding as well as the world management structure.

5.6 REGIONAL INTEGRATION

In section 5.3 we pointed out the (at least) two-dimensional character of economies or societies if both the sort of product or activity and its geographical location are to be described. Consequently there is also a choice between planning or managing the total economy in two different ways: (1) managing it as a set of industries with different products; and (2) managing it as a set of geographical units. In the optimal order a two-fold harmony must exist: the relative importance of the industries must match the composition of demand; and the relative importance of the geographical units must match the criteria listed at the end of section 5.4 (span of control, homogeneity with regard to natural resources, cultural aspects, etc.).

Geographical or regional integration is particularly important for security. Experience shows that armed conflicts between the geographical regions of an integrated area are considerably less likely than they were before integration. Integration usually implies the creation of institutions for the solution of conflicts by legal means. Armed conflicts between the provinces of the Netherlands ceased after the Republic of the United Provinces (the Union) was established. Armed conflicts between German states ceased after the establishment of the Reich in 1871. After the civil war, the United States of America changed their ineffective federation into a real federation and no war between states has taken place. The point is that integration almost automatically implies the creation of institutions for conflict resolution among the constituent parts of the integrated territory.

Regional integration also constitutes a system for creating the non-existent but desirable levels of decision-making discussed in section 5.4, and to be resumed in Chapter 11.

5.7 USE OF THE SEAS

In section 5.2, dealing with the vertical dimension of human environment, the seas were mentioned briefly and in section 5.3, dealing with the horizontal, 'geographical' dimensions, we reminded the reader of the large area of the earth covered by oceans and seas. In addition to these important spatial aspects the seas deserve our special attention because of their being the subject of the most advanced ideas about global management already formulated in a new draft Law of the Sea (LoS), attained over a period of nine years of negotiations. These negotiations took place in the Conference on the LoS, convened by the UN General Assembly of 1973. The origin of this greatest accomplishment of the United Nations is the 'historic three-hour address delivered by Dr Arvid Pardo, ambassador of Malta, before the General Assembly of the United Nations on November 1, 1967'—to quote Professor Elisabeth Mann Borgese (1985, p. 135). In this address the concept of 'common heritage of mankind' was introduced, meaning that the seas outside the exclusive economic zone (EEZ) could not be appropriated by any nation, individual or company; and that all the riches in and below the seas should be managed for the benefit of the world population. In addition they should be managed for peaceful purposes, keeping in mind the interests of future generations. This latter aspect will be discussed in Chapter 6, where the time dimension of the optimal socio-economic order is discussed.

In comparison to the main elements of the law of the sea for centuries, free navigation outside the territorial seas (only three miles wide) and conditions of passage through straits, the problems now faced by a proper management of the world's oceans and seas are numerous and complicated. Shipping uses increasingly large vessels including oil tankers which increase the danger of pollution of the seas and coasts in the event of spillages. Fishing has increased to such an extent as to lead to overfishing, threatening the extinction of some species, for instance whales.

Mining is a new activity, first of mineral oil in the seas above the continental shelves, where the seas were claimed by the coastal states and divided by lines at equal distances from the (rectified) coastal lines. Mining has now become possible in the deepest parts of the oceans, in particular in the form of 'catching' nodules containing manganese, nickel, copper and cobalt. Elisabeth Mann Borgese (1985, p. 74) claims that at the time of writing nodules have to contain at least 27 per cent of manganese, 1.5 per cent of nickel, 1.3 per cent of copper and 0.24 per cent of cobalt to be cost-effective.

The outcome of nine years of negotiation was a draft convention in which the management of these many activities was set out. In April 1982 it was approved by 130 nations in favour (with 4 against and 17 abstaining). By 1985 143 nations had signed the convention. Those nations which oppose the convention have the technical know-how to undertake deep-sea mining and hence prefer not to adhere to the principle of a common heritage; some or all of the 17 abstaining nations may be in a similar position. This attitude reflects the political shift to the Right in several industrial countries. We must hope that nevertheless the LoS Convention will be ratified by a sufficient number of governments, in the interest of the world at large. Fifty are needed.

The main new institutions the Draft Convention creates are an International Seabed Authority, with an Assembly setting the general policy, an Executive Council with Specialised Commissions and a Secretariat. In addition an operational arm, The Enterprise, to organise joint ventures with private enterprises, bringing in the technological know-how. Out of the profits, funding for research, conservation of the ocean environment and for development purposes can be made, all of them serving the interests of the world at large. Much will depend on the effectiveness of the newly created institutions. First-rate managers will be needed with a broad vision. A general system for the peaceful settlement of disputes completes the institutional setup.

At the time of writing the Preparatory Commission for the International Seabed Authority and the International Tribunal and one Special Commission are able to undertake activities while waiting for the necessary number of ratifications. During its second session the Preparatory Commission received a proposal from Austria to establish, under its auspices, a Joint Enterprise for Exploration, Research and Development (JEFERAD). In Professor Mann Borgese's view this is the only way for the Preparatory Commission to discharge its responsibilities to take all necessary steps for the early entry into effective operation of the Enterprise (cf. Mann Borgese, 1985a).

5.8 USE OF THE ATMOSPHERE AND OUTER SPACE

There is no clearly demarcated frontier between earth's atmosphere and outer space. Aviation is among the initial activities using the atmosphere. They are supervised by the specialised agency of the United Nations International Civil Aviation Organisation (ICAO). One of the problems ICAO had to face in 1977 was the security of air travel, in particular the protection of passengers and crews against hijacking. The way this problem was dealt with is described in some detail by Kaufmann (1980, pp. 154–8) as an 'example of optimalised decision-making'.

In addition to civil aviation, intensive use has also been made of the atmosphere by military purposes especially in World War II and since then in local wars, but also for 'reconnaissance' (also called 'espionage') purposes in peacetime. The atmosphere was also used for centuries by all forms of firearms (ballistic use).

More recently the atmosphere and outer space have been used by satellites, the first example being the launching of the Soviet Sputnik (1957). At present satellites are used for various peaceful purposes such as meteorological and communication (TV programmes), and astronomical and related research, as set out in section 5.2.

Similar to the new LoS, the use of the atmosphere and outer space (together to be called simply 'space') the optimal management had best be entrusted to an institution representing the world population as a whole and be considered as the heritage of mankind.

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6 Time Aspects of the Optimum Order

6.1 THE NATURE OF TIME; TYPES OF MOVEMENT

Before Einstein's theory of relativity, space and time were considered to be mutually independent coordinates. The world of human history was four-dimensional, but all points in space were thought to show, on their astronomical clocks, the same time. (Societies' clocks show different times for practical purposes of daily life: they have to indicate 12 o'clock when the sun is at its highest position.)

In the theory of relativity astronomical time is no longer the same everywhere: it depends on the velocity with which an object is moving. For practical purposes we can use the pre-Einsteinian view, however, since the time deviations are negligible as long as the velocity of the object's movement is negligible in comparison to the velocity of light.

Changes of a variable's value or location in the course of time are called *movements* and the present chapter will deal with movements of all variables relevant to the optimum order. Before specifying which variable we consider relevant two general observations will be made. First, the distinction between two types of movement: trends or *one-sided* movements are those where the figure indicating a value or a location is either rising all the time or falling, with the limiting case of no movement or constancy. *Cyclical* movements are successions of upward and downward movements, whether regular (like a sine curve) or irregular, as is much more often the case in economic history. Second, the cause or causes of the movement of a variable. Here we make a distinction between *exogenous* and *endogenous* causes or explanations of an observed or an anticipated movement. If a variable of an economy is moving because it is linked to a variable outside that economy we speak of an exogenous causation or explanation. A simple example is a movement linked to the environment's temperature, or another climatic phenomenon (sunshine, rainfall, etc.). Recently the climate is beginning to be influenced by human activities, however. (In section 6.2 more examples will be discussed.) An endogenous movement of an economy's variable is one caused by or linked to the movement of other variables of that economy. One example is movements in wage rates and price levels. Another example is the price of pork and the supply of pork. For a long time both moved in cycles: a year and a half after a relatively high price supply is relatively high. On the pork market this high supply can only be sold if the price falls. This leads to a relatively low supply a year and a half later, and so on. In contradistinction to price cycles caused by seasonal variations the pork cycle finds its origin in a mechanism internal to the economy.

6.2 ESSENTIAL EXTERNAL CAUSES OF ECONOMIC MOVEMENTS

In this section the most important external variables to which economic variables are linked will be discussed. One set of such variables are *climatological*. We have already mentioned temperature, sunshine and rainfall. These variables change over time and are important determinants of agricultural production. For all types of agricultural products the growth process is affected by climatic variables at each phase in their growth. Storms, hail or hurricanes may exert strongly negative influences. Some of these effects can be controlled up to a point by protective strategies, such as the use of glasshouses or planting on the warm side of a mountain range.

A second set of external variables are *demographic*. The size and age composition of a nation's population and its ethnic composition affect a range of economic variables, such as labour supply and composition of the needs and desires and so part of the demand for all goods produced. The age composition is of particular importance to organising education. A further specification of the population's intellectual, physiological and psychological characteristics will enter the picture here.

A third set of external variables are *technological*. The full impact of this set can be seen in leading developed countries, but in most less developed countries too, a complex range of technological know-how is available and codetermines the mix of production processes operating in each nation. Global technological knowledge is continually enriched by new discoveries and inventions. Systematic activities directed at discovering new facts or relationships are the task of laboratories; most of these are attached to industries or universities. Obviously a considerable role is played by good or bad luck. Educational institutions have the dual task of singling out talented individuals to advance the search for knowledge. In addition to the general stock of knowledge a nation's technological force also depends on the skills of all individual workers developed at school and, later, on the job.

A fourth set of external variables significant to an economy (or to the joint economies of the world) consists of the *stocks of resources*, living and dead, from the world's fauna and flora and its reserves of minerals in the widest sense, especially energetic and metal ores. Some resources are *inexhaustible*: those derived from solar radiation and from human inventiveness; others are *exhaustible*, quickly or slowly. Quickly exhaustible resources are fuels of many kinds because they can be used once only; this applies to coal, oil and gas. Slowly exhaustible are the stocks of metals which are not consumed but used in the restricted sense. They can be recovered after the object made from them has become obsolete. In the recovery process a small part is scattered in space and lost. With the aid of new technology we can, however, increase the quantity of satisfaction or *welfare* derived from one unit of resources. We can invent lighter structures or more efficient machines; we can save on the use of energy; and so on.

As a fifth set of external variables we shall introduce a set which is considered to be external in traditional economics, but not in our generalised economics and we call it *international politics*—the possible source of conflicts between nations whose settlement was, in the past, considered the justification of war.

6.3 MAIN SOCIO-ECONOMIC VARIABLES TO BE PLANNED OR ANTICIPATED

Movement over time of the economy (or economies) considered will be described by a number of variables characterising the main features of these economies. A general impression may be obtained by a macro-model and the variables appearing in it. These variables will be important to all countries. Micro-models and their variables will differ much more and reflect each country's specialities. We restrict ourselves to a list of macro-variables.

Population, subdivided into age groups, is fundamental. The age groups can be classified as (i) young people, not yet available for participation in the production process; (ii) people available for employment in the process of production or education; and (iii) people no longer assumed to be gainfully employed.

Employment, working time and *productivity*, apply to the second age group, whose multiplication yields total *production volume*. This constitutes the sum total of *consumption, investment* and *export surplus*; the latter being *exports* minus *imports* of goods and services.

Productivity is highly dependent on the total capital stock; this consists of physical and human capital (i.e. capital invested in the education of the population).

Both consumption and investment can be subdivided into private or individual, and collective consumption or investment; the latter two further subdivided into a civilian and a military component.

So far all concepts have been defined in physical terms. Multiplying them by their *prices* (for goods and services) and *wage rates* (for employment) yields their *money value*. Prices may be *market* prices or *factor cost* prices, in which indirect taxes (minus subsidies) are not included.

6.4 ELEMENTS OF OPTIMALITY IN DEVELOPMENT: WHOSE UTILITY?

Of all the aspects of an optimal order treated in Chapters 4, 5 and 6 the time dimension contains difficulties known from what in all economic problems distinguishes dynamics from statics. In the present section some of these difficulties will be set out and discussed without making an attempt to conclude with one definition of optimal development. The most important authors who have dealt with the subject have not reached a common point of view—the situation we also found when we considered the timeless and spaceless order, discussed in Chapter 4 (cf. Koopmans, 1976).

Obviously optimality always means that some sort of utility or welfare per person has to be maximised, but on closer consideration some questions arise. First, whose utility? Inagaki (1970) rightly criticises theories that implicitly assume the economy for which future development must be planned to be a 'society of immortals'. Human beings have a finite life and in any given time unit only those alive can make decisions. There exists some form of common decision-making with regard to development planning, and Inagaki indicates the result as instantaneous government (IG) making the relevant decisions. This brief summary conceals a host of unspecified details. In a centrally planned economy the government chooses from a number of alternative plans constructed by a central planning agency, possibly based on directives from that government and after amendments of the chosen plan. In market economies the key variable for development—total net investment—is the total of an immense number of decisions by business executives, from big corporation executives to heads of one-man firms and executives of public corporations. A government exists, whose election may be the result of a parliamentary democracy, of which various types exist, but there are and have been other ways of government formation. In a market economy, or a mixed economy, the government only indirectly co-determines the volume of total investment, by the socio-economic policy it follows. This policy implies its total expenditure and the latter's distribution over the many categories of spending and the way this expenditure is financed. Part of the financing will be done through taxes of different kinds; part by loans.

In one of these very different ways, then, the government will formulate policy, keeping in mind that its decision-making affects in very different ways the interests of citizens of different ages, of different incomes and with varying characteristics. The government will also feel responsible—as citizens do—for future generations. Again, many problems arise. What relative weight will be given to the estimated future welfare of citizens now living and of future generations? Will future generations be better or worse off? The answers partly depend on the future course of the external causes of development, listed in section 6.2; climatological, demographic, technological, exhaustible and non-exhaustible resources, and international policies. The government's decisions partly depend also on the size of future generations in comparison to today's population.

We took as the criterion for optimality welfare per capita considerations. This implies that we do not consider it appropriate to select as our criterion something like 'total' welfare—the total for all individuals. We think such a criterion is meaningless.

The preceding argument referred to *one country*. Since there are many countries, all supposed to determine their own future, the main subject of this book—how common welfare and security can be attained—will reoccur, with all its difficulties.

6.5 MAXIMISING WELFARE PER CAPITA OVER WHAT TIME PERIOD?

After identifying the population whose welfare has to be maximised, the question must be answered: Over what period should their welfare be maximised? That period is called the *horizon*; it characterises the period that interests the individuals concerned. People with a short horizon are shortsighted or myopic; people with a long horizon are farsighted. The main reason for myopia is the uncertainty of future circumstances. Clearly myopia has great disadvantages and may cause disasters that might otherwise have been avoided. Investors of all kinds tend to match their horizon with the anticipated *lifetime* of the objects in which they invest. Houses may be kept in good condition over centuries. Investment in human beings (education) aims at enabling the educated individual to be employed in an attractive job, and so the pupil's lifetime is at stake.

Horizons in business or military investment depend on the speed of scientific—and hence technological—development (as discussed in section 6.2). Topical examples are to be found in the discussions on President Reagan's Strategic Defence Initiative. Many experts agree that considerable time will be needed before defence technologies against a rocket attack will be developed. The views in favour of common security also make sense only for the long time needed to reduce mutual mistrust between the superpowers.

Literally, the assumption of a finite horizon means that an individual is fully interested in what happens during that finite period and then suddenly loses all interest. This can only be considered realistic if a sudden change takes place. Such a change may be the individual's death and the absence of other individuals who take the same interest; or it may be the exhaustion of a vital resource, available in a finite quantity.

The finite availability of a vital resource need not entail the exhaustion of that resource after a given time period. It is conceivable that technological development is such that for the maintenance of a given level of welfare a decreasing quantity of the resource is needed, and the rate of decrease is enough to produce the level of welfare over an infinite period. An example is a decrease according to a geometrical series.

In the absence of a sudden change a finite horizon is indeed unrealistic. This is avoided if a *discounting process* is added; the simplest form of which is the assumption that interest for consecutive time units diminishes by a constant factor. Such an assumption is mathematically convenient and even more so, in a number of cases, if simultaneously the horizon is assumed to be infinitely long. This approach made Inagaki characterise the development aimed at to be 'a society of immortals', as mentioned in section 6.4. The approach may be defended, however, as a method to take into account the welfare of *future generations*.

6.6 DISCOUNTING FUTURE WELFARE?

The third question about maximising welfare over time precisely is whether discounting future welfare is an attractive method. It correctly reflects human psychology in cases where individuals plan for their own future. But does it also reflect the way the community should plan for the future? In a way discounting future welfare constitutes a form of discrimination, or of myopia; and myopia in a number of cases definitely is a vice.

An opposing argument is that in a limited portion only of all conceivable possibilities can we solve our problem without discounting future welfare (cf. Gale, 1967). Welfare in all future years constitutes a series of figures, with an indefinitely large number of members. In order to find a maximum of total welfare, the sum of the series must be finite. (We cannot compare infinitely large sums.) A finite sum will only be attained if the successive terms become smaller and smaller. This means that a form of discounting is the precondition for the existence of an optimum, if we assume an infinitely long horizon.

Summarising sections 6.4—6.6, we reach the conclusion that an optimal development process over time cannot always be defined. We found four categories of situations where such a process can be defined: (1) if a vital resource is available in a finite quantity and after a finite period is exhausted; (2) if a technological development implies the possibility to spread the consumption of such a resource over an infinitely long period; (3) if welfare in consecutive time units is discounted; and (4) if a finite horizon is assumed irrespective of the exhaustion of a vital resource.

6.7 SOME FEATURES OF THE OPTIMUM DEVELOPMENT OVER TIME

In this section we shall complete the sketch of the likely shape of the time-path of the variables characterising the optimum socio-economic order in the general sense, that is, including security variables and the instrument variables. We cannot offer more than a sketch, as long as we do not specify a model, with the precision of our illustrative models A, B and C, and as long as the choices discussed in sections 6.5 and 6.6 have not been made.

Trend movements will occur in the population, technology and resource variables and, as a consequence, the socio-economic variables listed in section 6.3. Population will expand, for quite some time to come, in most parts of the world but great efforts must be made to reduce population increase and overall population. Technological capabilities will continue to rise and as a consequence the discovery of additional resources will continue, but the demand for resources will also rise and the result of these two tendencies can only be estimated after extensive studies, now underway. Switching to non-exhaustible resources as well as pollution abatement must be furthered. In large parts of the world education and research should be expanded. Education should match the needs for the type of labour required by technological development and the latter geared to the quality of the total labour force available as a consequence of past education and training of generations available for production. Working hours should be used as one of the instruments for absorbing into the production process all who want to be gainfully occupied.

Cyclical movements around these trends should as far as possible be eliminated. Such elimination signifies the avoidance of unnecessary adjustments to changes in quantities produced and consumed and prices, adjustments requiring labour and possibly also capital. For *endogenous* cyclical movements this is possible, in principle. This may be illustrated by the example of the pork cycle mentioned in section 6.1. Regular information about the trend component and the cyclical component in prices and quantities sold combined with counselling about production planning may contribute to the cycle's virtual elimination. In the case of coffee and rubber, where comparable but somewhat more complicated cycles have existed over a long time period, advice about the planting of new trees is an additional instrument of market regulation.

The ordinary business cycle or Juglar is supposed to be endogenous. After World War II, governments and public opinion were fully aware of the Great Depression of the 1930s and Keynes' views on how to avoid its repetition, namely to work with public finance deficits in times of a threatening depression. For about twenty years cyclical movements of this type were weak, partly as a consequence of Keynes' *General Theory*. Meanwhile economic structures changed, and became less flexible. New forms of disequilibria resulted, especially the phenomenon known as *stagflation*. Stagnation of production and employment was no longer accompanied by price and wage reductions, as in past business cycles, but by price and wage rises; hence inflation. Economists do not yet agree on how to prevent this new type of disequilibrium in future and at what level to decide. One point of agreement is that a sovereign policy is not possible even for middle-sized countries like France.

Exogenous cyclical movements cannot completely be eliminated. This may be illustrated by a closer look at some seasonal fluctuations. Seasonal changes in temperature and rainfall cannot be changed. The consequences are seasonal fluctuations in production of vegetables, fruits, eggs, poultry, etc. and these can only be counteracted in a few cases, for instance by heating and artificial light. Consumption and price cycles may be eliminated, however, by storage or by processing the product into a non-perishable form.

This also applies to fluctuations in annual harvests as a consequence of variations in weather conditions between successive years, variations which may be part of the explanation of the three-year cycles known as Kitchins. Here storage may be the instrument to even out a large part of the quasi-cycle. Partly private futures trade takes care of this form of stabilisation.

Another important example of cycles presumably of an exogenous character are the so-called Kondratiefs with a wave-length of some fifty years. In the course of time several hypotheses on their causes have been made. At present the scholars who have contributed most to their explanation tend to consider the most important cause to be a certain clustering of innovative technological inventions (cf. Freeman, 1982; Van Roon, 1982; Kleinknecht, 1984). It seems likely that an optimal social order will be affected by such clusters, whose origin presumably is to be found in the world of research and development. It is not inconceivable, however, that instruments will be developed to even out clustering and so contribute to smoother economic development.

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