

CHAPTER TWENTY-ONE

ALTERNATIVE FUTURES: AN EXERCISE IN FORECASTING

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I. INTRODUCTION

It is somewhat ironic that in this volume on forecasting in international relations, few of the contributors have engaged in actual forecasts. So far, we have only talked about the problems attending forecasting and reviewed these from different perspectives, noting alternative methods and procedures. This irony is due partly to the shared lack of experience with actual forecasting in international relations, partly to the complexities of international realities, and partly to the difficulties involved in disciplined speculation—let alone systematic inquiry—into the structure of alternative futures. Even more salient are inhibitions resulting from the high probabilities of being in error: “wrong” forecasts are invariably more frequent than “right” ones. And, while the criteria for evaluating the validity of forecasts are still being debated—with dif-

ferent criteria relevant for different purposes—considerable uncertainty remains regarding optimal means of validation. It is, thus, with appropriate caveats and qualifications and with pleas for tolerance from friends and colleagues, that the authors of this chapter summarize their efforts in forecasting alternative futures for the United States, focusing specifically on sources of foreign expansion.¹ In so doing, we shall draw upon the theoretical directives presented in Chapter 1, on the substantive issues described in Chapter 12, and on the research procedure and methodology discussed in Chapter 13. In this limited fashion, we present specific forecasts to illustrate the application of an integrated approach to forecasting in international relations and the research program that has guided this work.²

The forecasting exercise is presented in five major sections. The first presents a brief descrip-

tion of the process of expansion and isolates the important elements of the underlying theory; the second describes the essential components of a forecasting model of lateral pressure; the third describes the interrelationships among the determinants of national growth and foreign expansion, presenting a simplified causal loop diagram and noting the major linkages throughout; the fourth compares the performance of the model against historical data; and the fifth section describes the use of the model for forecasting and presents some specific forecasts. The chapter concludes with a summary of the overall forecasting endeavor.

Our procedure is to operationalize recent thinking about domestic sources of foreign policy, develop a feedback model of these determinants of expansion, obtain key parameters from empirical data, employ the historical record as an initial validator and, on this basis, to undertake systematic forecasts into the future, observing the consequences of alternative policies or decisions. The validation method is to compare retrospective forecasts against the historical record from 1930–1970. The ensuing forecasts to the year 2000 are derived from a series of experimental analyses of the implications of national growth for international behavior. These investigations illustrate some aspects of the research program in international relations forecasting at MIT.

II. SOURCES OF EXPANSION AND THE THEORY OF LATERAL PRESSURE

Despite impressive theoretical advances in the study of international relations, many uncertainties remain regarding the sources of foreign policy. Some theorists argue that international behavior can be accounted for primarily by variables like power, capability, force, or coercion; others maintain that bureaucratic factors, public opinion, and administrative capabilities are more relevant; others emphasize ideology, preferences, and values; still others argue for the preponderance of aggregate societal factors like the level of technology. Our own contributions to ongoing debates focused on the processes that shape national dispositions toward foreign activity and the ways in which structural variables in society determine propensities for external expansion. This chapter develops a model of the process of expansion and makes

some forecasts regarding alternative futures for the United States.

Perhaps one of the most important developments in recent years is an emerging recognition that the behavior of nations is as much shaped as it is constrained by their resource endowments, by their level of technology, and by the size and composition of their population, and that these factors provide the parameters of permissible behavior, and assist in determining their priorities and aspirations. The phenomenon of national growth, then, is an important underlying determinant of foreign policy behavior since the growth process directly affects the demographic and technological characteristics of a society as well as its resource needs. As a nation seeks to satisfy its domestic needs by interacting in the international arena, it is likely to exhibit a wide range of behaviors including trade, foreign investment, diplomacy, and military activity. Certainly, different modes of international behavior have varying implications and not every expansionistic activity will necessarily lead to international violence. But it is important to note that this propensity for expansion is a necessary precondition for conflict and, as such, its underlying dynamics become a critical concern. The importance of this process is amplified when we note the fact that these dynamics are common to all nations and, therefore, as their interests expand, it is increasingly probable that opposing interests will collide. So while the propensity for expansion does not inevitably entail conflict and violence, its consequences are potentially disruptive. We use the term "lateral pressure" to refer to this propensity for foreign expansion.

The *substantive* question, therefore, is whether nation-states—particularly the advanced industrial societies—can continue to grow without expanding outside their territorial boundaries and generating potential conflicts of interests. The *theoretical* question involves defining the interrelationships among the constituent determinants of growth and expansion. The *policy* question involves the identification of decisions and instrumentalities that would affect the nature and extent of a society's lateral pressure. The *structural* question is the extent to which policies designed to affect population, resources, or technology result in an increase or decrease of a society's lateral pressure. And the *methodological* question is the specification of the

appropriate functional form of these relationships, including their dynamic feedback linkages.³

The idea of lateral pressure and of the underlying dynamics it seeks to represent is not new. Its origins lie in classical theories of imperialism⁴ and in modern economic theory.⁵ From the former has emerged a clarification of the expansionist process and the factors that predispose nations to establish spheres of control or influence. From the latter has come an attempt to formalize both the economic factors that underlie such behavior and the governmental efforts to cope with and manipulate a society's productive capabilities. The synthesis of these two approaches has been provided by the first attempt to specify the dynamics underlying expansion in ways so as to accommodate the determinants that go beyond simple economic factors, on the one hand, and purely structural ones, on the other.

There are five aspects to the process of extending national activities outside territorial boundaries that must be distinguished:

1. the societal *demands* engendered by processes of national growth;
2. the *capability* to engage in behavior beyond national borders;
3. the *disposition* to extend behavior beyond territorial boundaries;
4. the particular *activities* that result from this disposition;
5. the *impact* these activities have on the external environment.

Lateral pressure refers to the disposition to extend behavior beyond territorial boundaries. It is the product of the interaction of societal demands and capability. Societal demands are determined by the society's demographic and resource characteristics, its surplus economic capacity, and the influence of the military on the determination of national priorities.

A country has capabilities on many different levels of organization, purpose, and activity. The *national capability* of a society refers to a country's overall operational potential in terms of its general level of knowledge and skills, the capital and other resources that are available to it, the size and broad characteristics of its labor force, and so forth. A country's national capability is roughly synonymous with its technological and economic base and the

ability to employ this base productively. National capability defines the limits of what a country can do in the short to intermediate run if it chooses.

The *type* of external activity undertaken by a society depends upon the nature of the demands being generated domestically and the characteristics of a nation's capability. A nation will likely respond to its resource needs in a different manner than it would respond to pressures generated by excess economic capacity; similarly, the nature of this response will depend upon the specialized capabilities that a nation has at its disposal. These differences will generate different modes of lateral pressure, that is, different forms and types of foreign behaviors.

The term *specialized capability* refers to any major instrumentality that is available for the carrying out of a society's public and/or private goals. Agriculture, light industry, heavy industry, banking, shipping, armed forces, educational establishment, health facilities as well as the military are examples of specialized capabilities. Specialized capabilities define the limits of what a country can do *right now*. The array of a country's specialized capabilities at any given time, together with their respective levels, determine the range and scope of possible activity that a nation may undertake to satisfy societal demands. A country cannot exert lateral pressure on a mode in which the appropriate specialized capabilities and demands are not present.⁶

Still another way of explaining the issues at hand is by viewing lateral pressure as the outcome of the interactive effects of structural, behavioral, and value attributes. The *structural* characteristics of a society are conceived primarily in terms of the levels of population, resources, and technology; the *behavioral* attributes in terms of patterns of economic production and consumption, national investments in economic activities, and the size of the military; and *value* attributes in terms of national priorities such as supporting continued economic growth as opposed to constraining growth, and the proportional allocation of resources and expenditures to the military and civilian sectors.

Some sources of demands and capabilities can be manipulated at relatively low cost, others are basically nonmanipulatable, or manipulatable only at high cost. For example, the proportional expenditures to the military or to the civilian sectors might

be altered more readily than any changes in the general knowledge and skills throughout the country. The proportional effects upon lateral pressure might differ considerably. But it is not entirely clear what the precise nature of the difference is, or how changes in individual components of lateral pressure would shape the nature of the resulting pressure and, by extension, the foreign activities undertaken.

The theoretical specification of lateral pressure is summarized in Table 21.1.

III. A FORECASTING MODEL OF LATERAL PRESSURE

The United States provides an excellent example of the processes of expansion discussed thus far: The country's continued growth, in conjunction with an increasing burden upon indigenous resources, is becoming an issue of national concern. Identifying policies that might lead to the reduction of lateral pressure, possibly by decreasing resource consumption and placing lesser loads upon the environment, emerges as an important corollary of this concern. And specifying the determinants of expansion is a necessary prerequisite for such an effort.

The dynamics of lateral pressure—as the interactive outcome of societal demands and capability—are modeled as five separate sectors, representing the demographic, economic, resource, military, and technological factors influencing the propensity for expansion. As presently specified, each sector is in fact a model in its own right, and their interaction contributes to overall system behavior, which generates the resultant lateral pressure. A sixth sector seeks to combine the interactive effects provided by the other five in order to calculate the disposition for expansion.

In computing lateral pressure, we have employed the gross national product as the index of national capability. However, we have not modeled individual indices of specialized capability. Since the measure of capability presently employed is undifferentiated, we have also used an aggregated measure of demand. Demand is modeled as a multiplier on lateral pressure.⁷ This aggregate multiplier is determined by individual multipliers from the five separate sectors of the model. In this way, it is possible to monitor the

Table 21.1 Theoretical specification of the process of expansion.

The theoretical dependencies representing the process of expansion can be distinguished as follows:

1. the *demands* engendered by the processes of national growth;
2. the *capability* to undertake activities outside national boundaries to meet demands;
3. the *disposition* to extend behavior beyond territorial boundaries;
4. the *activities* that result from this disposition;
5. the *impact* of these activities on the external environment.

Processes represented in 1–3 refer to the antecedents of actual behavior. Processes specified in 4–5 represent such behaviors and their consequences. In each case we are dealing with dynamic processes that are characteristically interactive. The constraints of verbal specification preclude an adequate description of this interaction: Feedback effects are always at work and are of fundamental importance in the determination of behavior. For this reason, even an approximate representation of this process requires formal analytical specifications. Toward this end, we have employed system dynamics.

This chapter is concerned with the determinants of behavior, defined as the product of demands and capabilities that generates the disposition for foreign activity. We term this disposition “lateral pressure,” specified as follows:

Lateral pressure	=	(Demands) • (Capability)
Demands	=	A combination of four component multipliers on lateral pressure.
Multipliers	=	The sectoral influences of the individual demands generated by growing population, resource constraints, surplus economic capacity, and the military.

The model of the determinants of national behavior represents the processes generating individual sectoral demands, their interaction with national capability, and the resulting lateral pressure.

contribution of the individual demand multipliers to the aggregate *demand* variable. The lateral pressure variable, computed by the sixth sector, is a generalized measure of a society's overall propensity for expansion. This means that we can (1) forecast future trends in the level of external activity; and (2) examine both short- and long-term effects of various policies upon the general propensity for expansion as well as any fluctuations in the individual demand multipliers. This feature will gain added importance when the model is developed further to forecast specific modes of lateral pressure. The model is thus composed of:

1. A *population sector*, which represents the interaction between birth and death rates and total immigration. Together they determine population size. The larger the population, the more extensive its basic demands are likely to be; and the more technologically advanced the society, the greater will be the impact of population size in terms of the burdens placed upon available resources.

2. A *resource sector*, which models the impact both of resource needs and of resource availability upon lateral pressure. For our modeling purposes, resources are conceived primarily in terms of energy and, more specifically, petroleum. Thus, the resource sector generates a dual impact on lateral pressure. On the one hand, the need for resources serves as a multiplier, increasing propensities for expansion. On the other, resource scarcities and constraints create a dampening effect upon a nation's base capability and thereby reduce lateral pressure. Moreover, resource scarcities can introduce a second-order effect on societal demands by reducing potential economic output, hence decreasing the level of investments available for expansion.

3. Two *economic sectors* designed to represent a society's productive activity (GNP), as well as its potential output (potential GNP). The gap between the two produces an excess multiplier upon lateral pressure; the greater the excess, the greater will be the impact on lateral pressure. These sectors also embody technological growth and specify its impact upon national productivity.

4. A *military sector*, which generates the level of military expenditures and derives a measure of the influence held by the military in the society. It is hypothesized that the propensity for expansion is

positively associated with the size of the military establishment. This sector calculates only a military demand multiplier, and does not incorporate the military as a specialized capability since the model considers only undifferentiated national capability. In future work, we will incorporate specialized capabilities in the model, and the influence of the military will certainly be included.

Each of these sectors generates a separate multiplier upon lateral pressure. The combined effects of these multipliers are observed in the behavior of the lateral pressure sector which constitutes the integrative module, pulling together the impacts of demographic, resource, economic, technological, and military factors to calculate lateral pressure. Thus, the sixth sector of the model is lateral pressure.

5. The *lateral pressure sector*, seeking to model the interactive effects of these four sets of determinants, taking into account countervailing trends, nonlinearities, and feedback effects. The linkages of the preceding sectors to lateral pressure are provided by the four separate multipliers, whose combined effects represented by the aggregated demand multiplier, when considered in tandem with national capability, determine the resulting pressure.

An extremely simplified diagram of the design of the model is presented in Figure 21.1. It is to be viewed as a guide to the following discussion only, and is not an adequate representation of all the interrelationships modeled. These are specified, still in an oversimplified manner, but more accurately, in Figure 21.2. They represent the disaggregated specifications of the propensity to extend activity outside the national domain. These processes constitute a more complex theoretical specification in dynamic nonlinear terms of the relationships presented in the first equation of Table 12.1. Figure 21.2 thus presents greater theoretical sophistication than the expansion process specified in Chapter 11 of *Nations in Conflict* (1975).

IV. THE MULTIPLIERS ON LATERAL PRESSURE: DYNAMIC FEEDBACK RELATIONS

The functional relationships among variables in the model, the numerical values of key parameters, and the data employed are all based on empirical

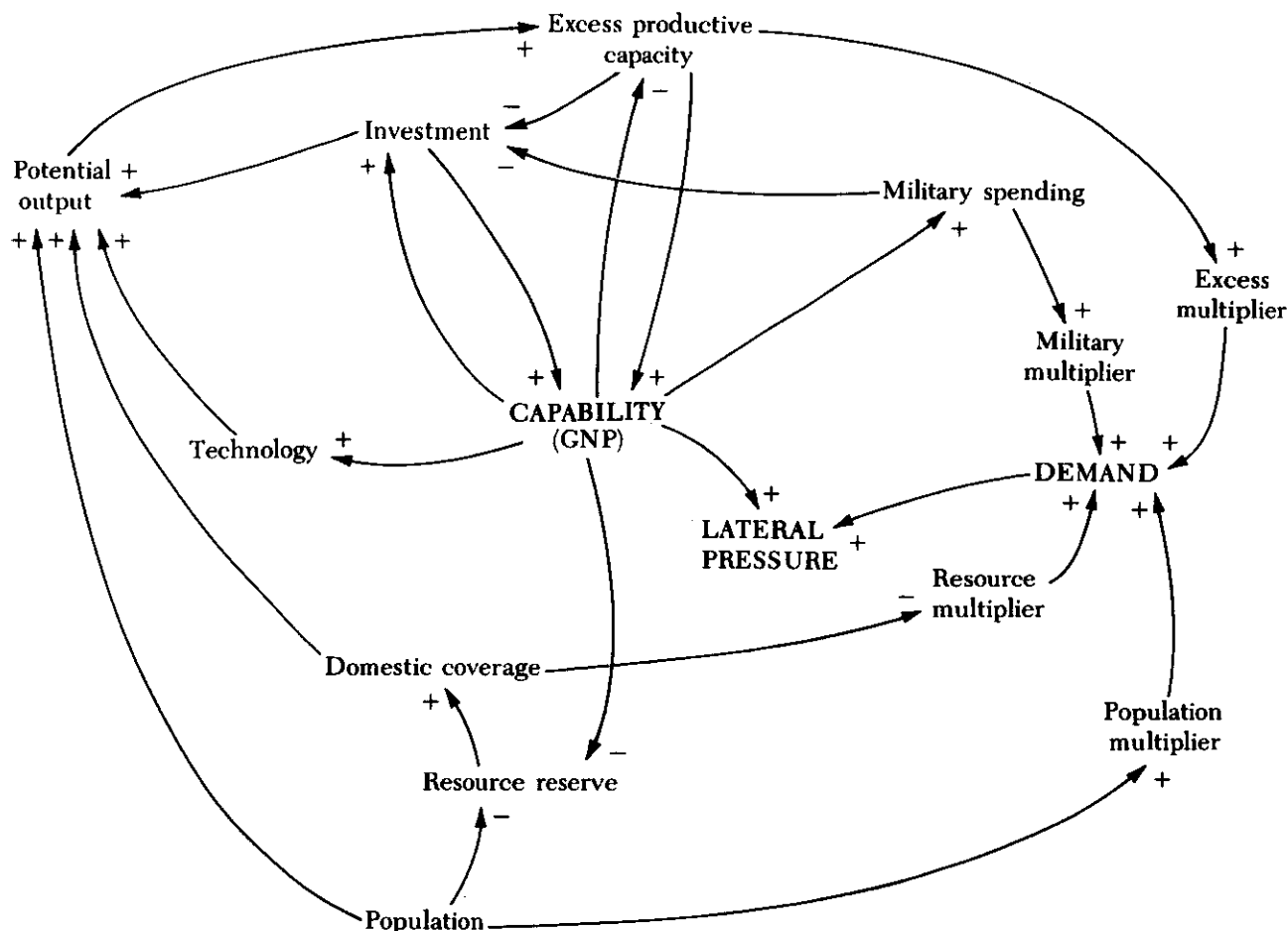


Figure 21.1 Processes generating lateral pressure: major causal relations.

observations for the United States from 1930–1970. Our procedure has been to employ the historical record as a validator of functional relationships, testing our results against known values. Thus, the period between 1930–1970 constitutes the reference mode for this model. The estimated values provide an input into simulation for comparison with historical data. In view of the complexities at hand, a brief description of the model, sector by sector, is presented here for illustrative purposes. Constraints on space make it difficult to present as detailed and technical a description of the model as would be desirable. (A listing of the computer program can be obtained from the authors.)

Population

The population sector seeks to model only population size and performs two functions. First, it delineates the impact of population size on national productivity and resource utilization; second, it

generates a demographic multiplier on lateral pressure, representing the impact of numbers on propensities for expansion. *Size* is determined by the net effect of birth rate, death rate, and immigration. Birth rate is defined as births per 1000 population and determined, in turn, by per capita gross national product. The functional relationship is derived from cross-national empirical data. As per capita output increases, the *birth rate* has been observed to decline. The quantitative values of the relationship between output and birth rate are based on empirical data. *Death rate* is specified as a function of average lifetime. Average lifetime is modeled to increase slowly over the period modeled. The quantitative value of average lifetime is taken to be just over 60 years in 1930 (based on empirical data), and it is specified to increase steadily to 76 years by 2000. While birth rate and death rate are linked endogenously, immigration is provided as an exogenous input, being purely a function of time. The values for the period 1930–1970

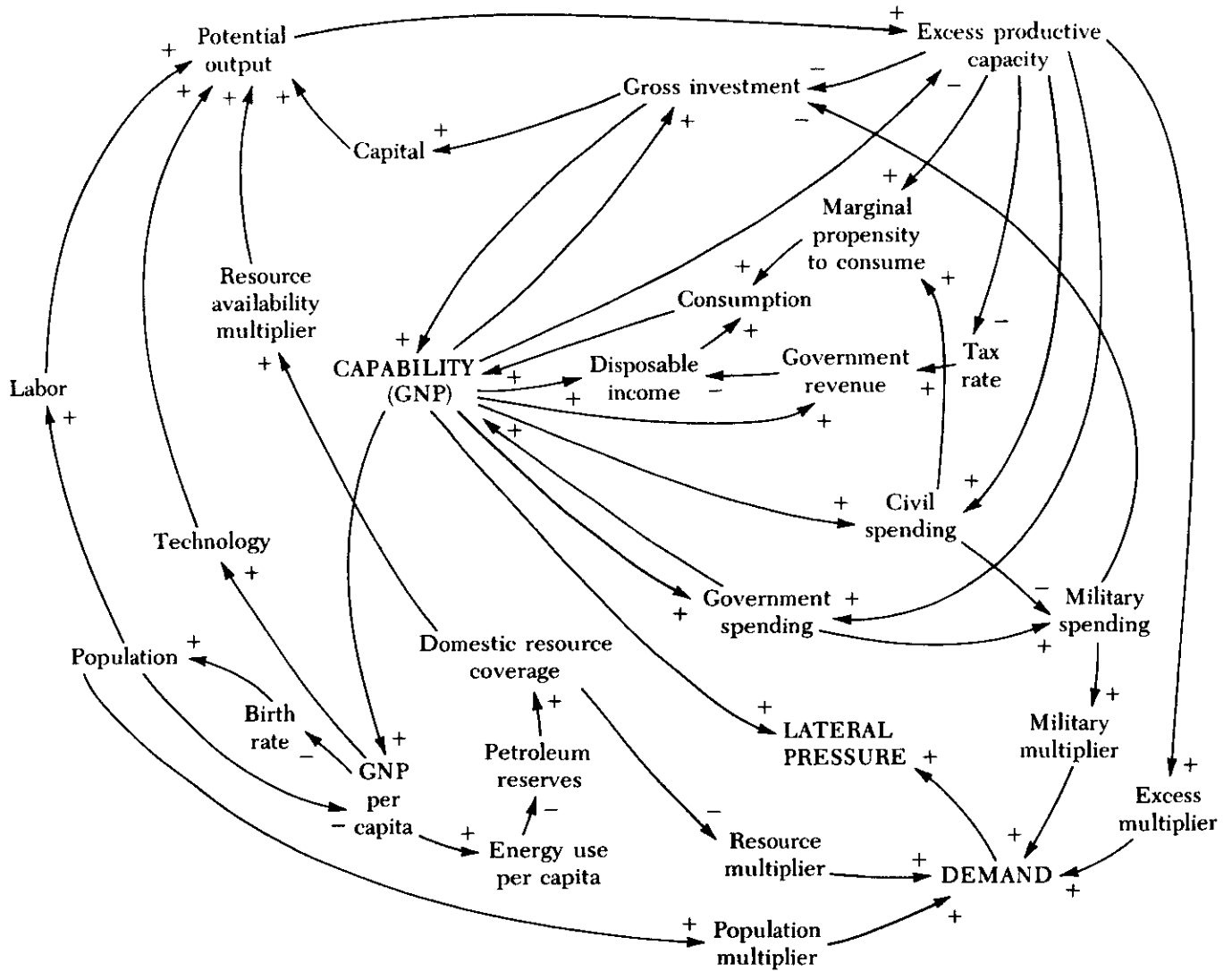


Figure 21.2 Lateral pressure specification.

are based on empirical data; subsequent values are predicated upon recent demographic estimates. It must be stressed that our purpose is not to model the causes of population growth, but the consequences. However, the latter can be represented accurately only if the interrelationship among the variables that determine population size are well specified.

Resources

The focus of this sector is primarily upon petroleum, taken as a fraction of total energy usage in the United States. The demand for energy is derived by multiplying population size and the per capita energy usage variable. Per capita energy usage is specified as a function of per capita GNP.

Like the birth rate, above, the quantitative values for the relationship between output and energy usage is derived from historical data (controlling for exogenous influences like major wars that distort time trends for short periods). Once the yearly value for petroleum demand is computed, it is then subtracted from the level of resource reserves. By comparing petroleum demand to the reserve level, we derive *domestic coverage*. Domestic coverage is a key variable in the model since it determines the resource multiplier on lateral pressure. The value of the coverage variable in any given year represents the number of years that reserves could last, given the petroleum demand for that same year. Domestic coverage may change quite dramatically. When petroleum demand increases through time and reserves are initially fixed, domestic coverage

will decline exponentially rather than linearly. Changes in either demand or reserve or both will effect domestic coverage. It is presently hypothesized that when domestic coverage is greater than 20 years, the resource multiplier on lateral pressure will be zero. When coverage drops below 20 years, the multiplier gradually increases until it reaches a maximum of 1.0 (and coverage equals 0 years).

Technology and Potential Gross National Product

The surplus productive capacity of a society—that which is producible over and above that which is required for domestic consumption—provides another factor contributing to lateral pressure. In those periods where the actual economic output is less than the economy's potential, surplus investment capital is generated. It is this surplus that is critical as an indication of *excess* capability. "Potential GNP" (PGNP) refers to the society's potential for economic output; it is conceptually independent of its actual economic production. Potential GNP is derived primarily by employing the Cobb-Douglas production function. PGNP is thus dependent upon the levels of industrial capital and labor in the system (labor being a fraction of total population size). Drawing upon Robert Solow's work on technology (1957, pp. 312–320), we conceptualize technology as a multiplier on the efficiency of labor and capital and, as such, is included explicitly in the production function computing PGNP. It is fairly well established empirically that technology is positively related to per capita GNP; the rate of technological growth is also related to the rate of growth of GNP. We have provided an implicit constraint in this sector, preventing technology from declining absolutely, allowing only for possibilities of stagnation. This is important because while GNP may decline, technology—which refers to a whole array of factors related to efficiency, knowledge, and skills—rarely declines. In reality, the effects may stagnate or lessen; but an absolute decline seldom occurs. In the case of the United States all empirical indications point to increasing rather than declining technology. The output of this sector is one side of the calculation yielding the gap between potential GNP and actual GNP. This sector, then, includes the impact of technology on a society's production

potential, and that potential will be subsequently compared to the actual productivity. To the extent that potential GNP is greater than actual GNP, the excess multiplier on lateral pressure will rise.

Gross National Product

The actual economic production sector of this model is derived entirely from modern economic theory.⁸ The modeled representation of GNP is quite standard, in that GNP is specified as the sum of consumption, investment, and government spending. (Net exports are not taken into account in this simplified version of the model). "Consumption" is calculated by multiplying disposable income and the marginal propensity to consume. At any point, disposable income is determined by subtracting government revenue from the value of national income during the previous period; the marginal propensity to consume varies slightly as a function of general welfare. The variable representing welfare is defined as the percentage of GNP allocated to civilian spending. "Gross investment" is calculated as a fraction of GNP in the previous period. This variable constitutes the "normal" investments of a society. From this value, two variables are subsequently subtracted. One is the fraction of the expansion investment derived from excess production capacity (if any); the other is military spending. These two variables provide a drain on gross investment. "Government spending" is derived in a similar fashion. It is specified as a fraction of national income during the previous period. This "normal" fraction increases over time. In addition, it will also rise in times of war (World War II, Korea, and Vietnam) and when actual GNP is below potential. The latter specification amounts to an endogenous policy assumption that stipulates that in slack economic periods the government will increase spending in the effort to stimulate demand.

The purpose of incorporating GNP specifically in the model is to compare actual output (GNP) against potential output (PGNP) in order to derive a measure of excess capacity for the *excess multiplier* on lateral pressure. In addition, GNP is the structural variable that is multiplied by the demand multiplier to yield the amount of lateral pressure generated by a society, in this case the United States. Thus, actual production (GNP)

fulfills two tasks in this model: (1) it assists in generating the excess multiplier on lateral pressure; and (2) it constitutes a basic capability indicator that, in combination with the demand multiplier, influences propensities for expansion.

Military Expenditures

This model takes account only of the internal determinants of military expenditures. The effects of arms race, external rivalries, competitions, or tensions are not taken explicitly into account, although these influences are accounted for in times of war. Thus, World War II, the Korean War, and the Vietnam War are included as exogenous specifications and expenditures increase accordingly. In non-war years, exogenous influences such as threat perception or arms-race effects (which we have considered elsewhere as determinants of military spending) are not included in the model. The primary reason for their exclusion is that this model expressly seeks to represent the internal determinants of lateral pressure. This assumption is justified not only by the fit with historical data (as will be observed below), but by the success which other studies have had in explaining levels of military expenditures using expressly internal, domestic determinants (see Choucri and North, 1975, Chapter 13). Generally, the amount allocated to the military is a fraction of national income. The actual fraction is based on empirical observation. It is stipulated to increase during war and, at other times, to remain as a fairly constant fraction of national income. However, in any recessionary period we assume that the government will attempt to stimulate demand by increasing dollar allocations to the military as well as to civilian sectors. This sector yields the *military multiplier* on lateral pressure and is equal to the fraction of per capita government spending allocated to the military.

Lateral Pressure

Lateral pressure is a function of a society's productive capabilities and the propensity multiplier. It is derived by multiplying demand and capability, represented here by the gross national product. Demand, in turn, is composed of four variables: the *population* multiplier, the *resource* multiplier, the *excess* multiplier, and the *military* multiplier. Each

of these multipliers is scaled from 0 to 1. This scaling convention is necessary for standardizing differences in units. The population multiplier is derived by dividing the level of the United States population by total world population. It will be recalled that population size is modeled as the outcome of the interrelationship among birth, death, and immigration. The resource multiplier is a function of domestic coverage; if coverage is greater than 20 years, it will assume a value of zero. The excess multiplier is specified as the difference between total production and total demand, or between actual production (GNP) and potential production (PGNP). However, if demand is greater than full-employment output (termed "negative" excess), this multiplier will not go below zero. The military multiplier is a function of per capita government expenditures to the military.

Thus, the sectors of the model are integrated in the lateral pressure sector by the following specification:

$$\text{Lateral pressure} = D \times \text{Capability},$$

where D is the demand multiplier representing sectoral influences on lateral pressure (LP) specified as:

$$D = (1 + C1 \times \text{POPMLP}) (1 + C2 \times \text{URRMLP}) \\ \times (1 + C3 \times \text{XSMLP}) (1 + C4 \times \text{MILMLP})$$

where POPM = population multiplier

URRM = usable resource multiplier

XSM = excess multiplier

MILM = military multiplier.

The coefficients $C1$, $C2$, $C3$, and $C4$ are scale factors to weight the effects of these multipliers. These are determined largely in an experimental manner, through trial and error, according to theoretical stipulation that the greatest effects come from population, followed by excess productivity, resource needs, and the influence of the military. We recognize the tentativeness of this specification. Unfortunately, little empirical evidence exists regarding the specific (or even relative) magnitudes of the expected individual effects. Furthermore, attendant theoretical specifications are not as precise as would be desirable. Thus, there are few alternatives other than experimentation with different weights.

A simplified causal loop diagram of the entire model is presented in Figure 21.2. Its purpose is to

indicate the major linkages throughout, rather than to present a detailed statement of all modeled relationships. These are presented elsewhere, with detailed discussion and attendant rationale for the choices made. Here we note only the more general linkages.

V. RETROSPECTIVE FORECASTING AND THE HISTORICAL RECORD

An important indication of the validity of the model is the extent to which it tracks historical data. While replicating known values is only one criterion for validation, in the case of complex models it is generally a rigorous test of model structure and robustness. Figure 21.3 presents the estimated

values and historical data for United States population, again 1930-1970. The fit between the model output and known values is excellent. In view of the importance of the population variable in the overall structure of the model—having a direct impact on the lateral pressure multiplier, potential GNP, and resource usage—the close fit with historical data improves the performance of the model and increases our confidence in its forecasting capabilities.

Figure 21.4 presents historical values and retrospective forecasts for United States GNP and for total consumption, 1930-1970. It will be noted that forecasted GNP tracks historical values quite well. The same is true for forecasted consumption: The replicated series tracks historical values well. Since

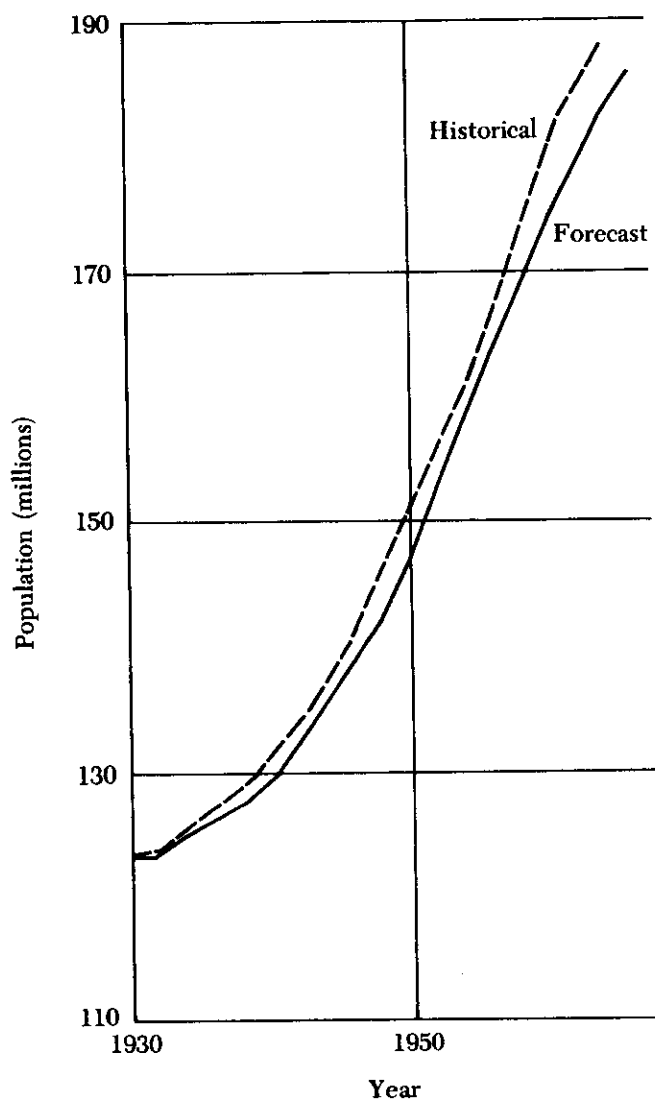


Figure 21.3 United States population: retrospective forecast.

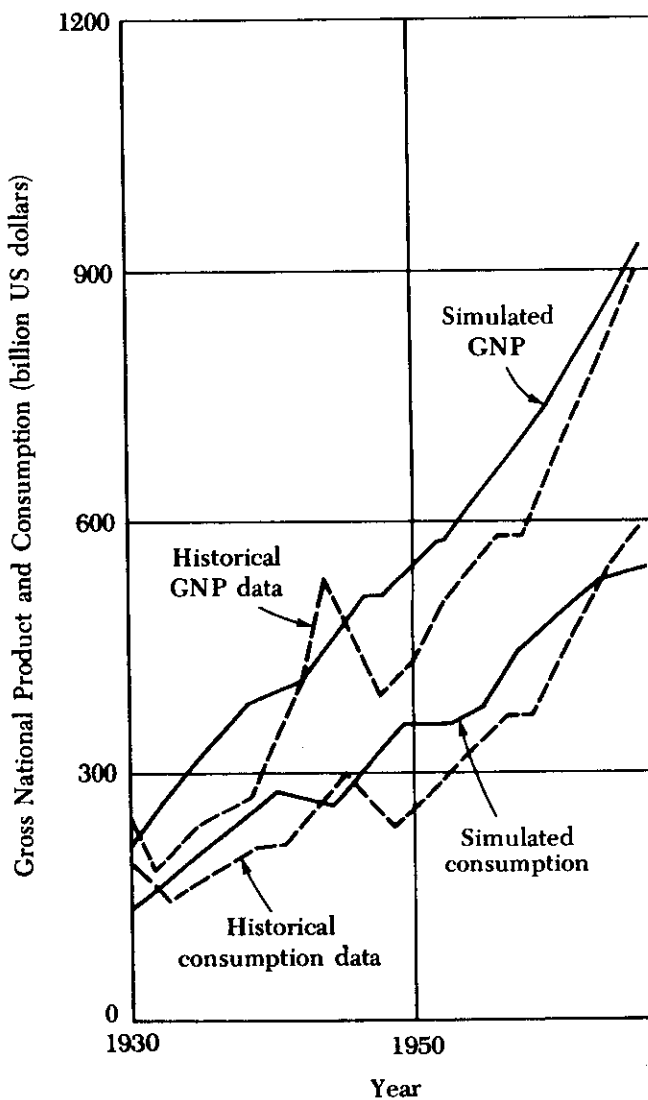


Figure 21.4 US gross national product and consumption: retrospective forecast.

the purpose of the validation check is to forecast general tendencies, the numerical discrepancies between forecasted and historical values do not shed doubt on the performance of the model. However, it is possible that with added experimentation, more precise "fits" could be obtained. Accurate point prediction, however, is not the purpose of this analysis.

Figure 21.5 presents estimated and historical values for U.S. military expenditures throughout the same 40 years. Again, the fit is good, particularly since critical breakpoints are well tracked. The war years are clearly reflected in the retrospective forecasts and their behavior corresponds closely to the known record. This goodness of fit is accounted for partly by the exogenous introduction of a "war" expenditure influence, and partly by an accurate specification of the dependence of military expenditures on national income.

Historical and retrospective forecasts for energy usage and for petroleum consumption are presented in Figure 21.6. The forecasts appear to

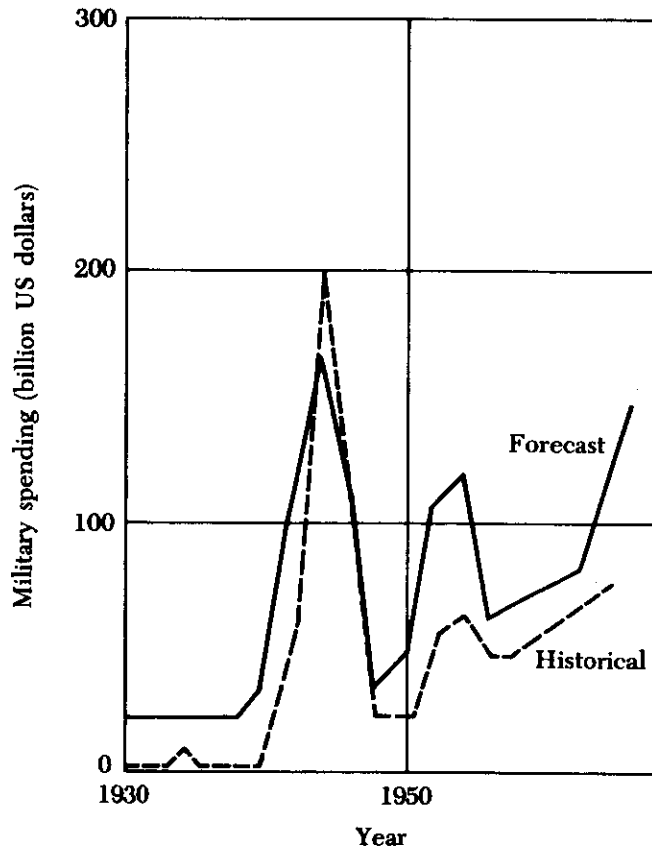


Figure 21.5 US military expenditures: retrospective forecast.

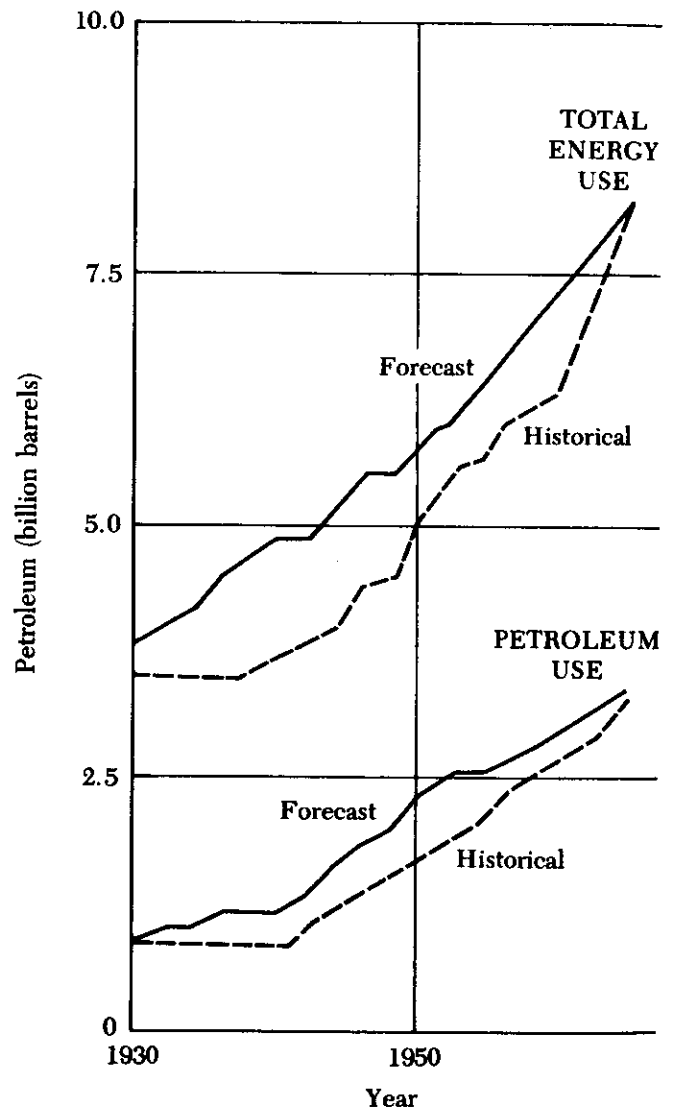


Figure 21.6 US total energy and petroleum consumption: historical forecast.

consistently overestimate resource utilization. However, the overshoot is not dramatic, and the general behavior of the retrospective forecasts is consistent with historical observations.

Considering the overall fit of the simulation output to the historical data, the model effectively represents the processes of national growth underlying expansion. Having no ready empirical counterpart against which to plot the lateral pressure variable, definitive validation of the model as a tool for forecasting modes of external expansion must await further specification. At this stage, we can explore alternative futures for the general propensity for expansion in light of our confidence in the model's ability to represent the underlying processes.

VI. ALTERNATIVE FUTURES

One purpose of this forecasting study is to examine the effects of different policy interventions on United States lateral pressure and identify some of the ways in which changes in governmental allocations, or in demands generated by growth, may influence the disposition for external expansion.

We noted in Chapter 13 that historically based assessments are often used as the standard to evaluate the consequences of different initial conditions and different policy interventions. Policy runs represent the result of alternative decisions postulated by the investigator to identify future impacts. For our model, the standard run to the year 2000 is a "least surprise" forecast based on a past shaped entirely by 40 years of resource abundance. This is certainly an unrealistic situation, in light of the petroleum price increases of October 1973 and the resultant energy crisis; but such forecasts would provide important clues regarding what is likely to happen if trends between 1930 and 1970 were to have persisted. It is a useful standard against which to evaluate alternative, more "realistic" possibilities. We are familiar with the past, and this familiarity is an important asset in helping us think about alternative futures. We know that past trends will not continue; but history may often be an important source of insights into the future.

Abundance and Scarcity

Forecasts of United States lateral pressure based entirely on past trends in demands and capability thus assume continued and unlimited access to energy resources. In such a situation, the future would have the following characteristics: (1) the country's capabilities would continue to grow, GNP will not encounter any significant constraints and potential production will also increase; and (2) pressures from population will remain constant, if not decline slightly, thereby generating little pressure for expansion. On balance, the demand for expansion will decline slightly, but since capabilities continue to grow, the general predisposition will be toward expansion. The interactive effect of growing capability and virtually constant demand will, in fact, result in *increasing* lateral pressure. Thus, a resource-optimistic future is one in which United States disposition for external expansion will con-

tinue to grow over time, but the sources of expansion will come from increasing capability rather than from demand. In such a situation we would expect *more*, rather than less, foreign involvement and expansionist activities.

What would happen if, or when, the United States encounters significant resource shortages? How would the disposition for expansion be affected, and in what ways?

When we introduce a sharp resource constraint in 1970, we observe a dramatic rise in the demand multiplier, solely because of strong pressures from the resource sector. However, pressures from the military remain fairly constant, and population continues to have little impact. Even significant changes in population have no substantial effect on demand; a higher level of population increases the size of the labor force and, by extension, its contribution to productive capacity, but only marginally; and population decreases have only a slight effect on reducing demand. Resource constraints offset any contribution from the labor force and the general effect is to reduce the country's economic capability; a decline sets in over time. Despite the strong pressures for expansion from the resource sector, the disposition toward external expansion will decline because of declining capability. The change is observed most clearly around 1950, when lateral pressure in a "resource-constraint" situation decreases in comparison with the forecast for the "resource-optimistic" case. Thus, confronted with a situation of sharp resource constraints—and no other changes in the model—we would expect the United States to become involved in *less*, rather than more, foreign activity in the future. These constraints may, in effect, seriously limit the country's disposition for external expansion.

Figure 21.7 presents the model forecasts for United States lateral pressure in both situations.⁹ It must be emphasized that the disposition for expansion is the outcome of the *multiplicative* relationship of demand and capability. In any situation, the impact of resource constraints on demand may be different from that on capability. Lateral pressure reflects the *combined* pressures from demand and capability. Figure 21.7 represents the initial runs—one stipulating the continuation of past trends and the other indicating future impacts in a situation of significant resource shortages. For experimental purposes, the critical intervention

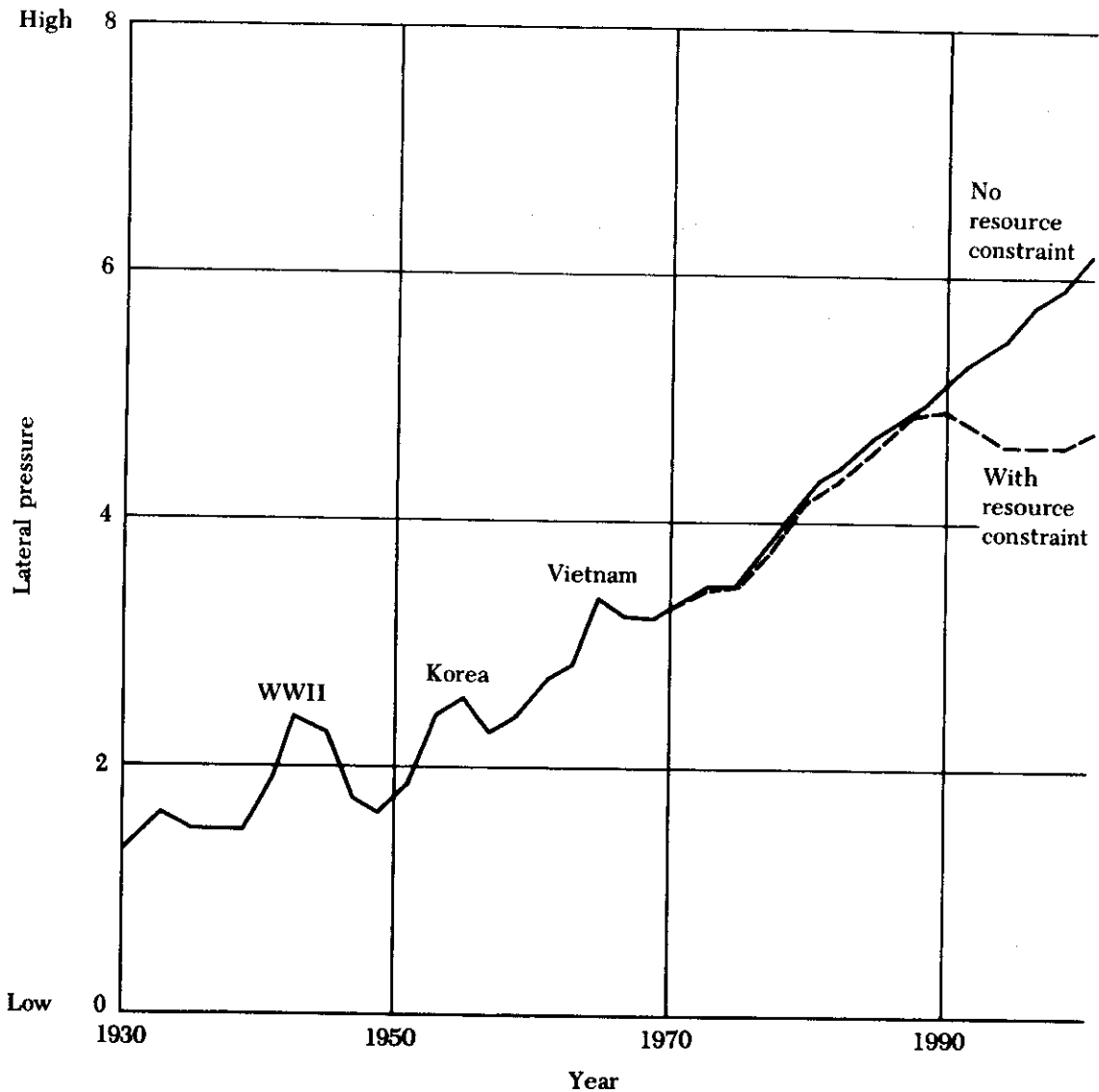


Figure 21.7 Lateral pressure: abundance versus scarcity of resources.

was made in 1970. Thus, the two cases are identical from 1930–1970. These initial runs will be employed to evaluate the effect of (1) technological change and (2) changes in governmental allocations to the civilian sector and to the military—in a situation of resource abundance versus one of resource scarcity.

The Impact of Technological Change

Technology is a critical factor in shaping the capabilities of nations and conditioning their modes of international behavior. Any changes in the level of technology are likely to influence a country's propensities for external behavior. We have ex-

perimented with two interventions—one where rapid increases in technology are postulated; the other where a reduction in the rate of technological growth is hypothesized. In each case, we observe the impact of these interventions in a situation of resource abundance and in one of resource constraints.

If rapid *increases* in technology occur, in a “resource-optimistic” future the demands of the United States will increase, but the country's capabilities will grow at a much faster rate than its demands. In fact, the growth in national capability is likely to be quite dramatic, and the interactive effect of this dual growth will result in a tremendous increase in the country's disposition for ex-

ternal expansion. In such a case, *we would expect more external involvements and greater extension of activities beyond national boundaries*. If the rate of technological growth were to *decrease* substantially, but by the same margin, we would observe the impact of pressures generated by demand; although such pressures will be lower than in the previous situation, their effects on capability will be comparatively much greater. Slower technological growth will have the substantial influence of generating marked reductions in national capability. In large part, however, these impacts will be in the nature of "band effects" as noted in Figure 21.8. Thus, in the absence of other changes, the disposition toward external expansion will be

strongly influenced by the rate of technological change; increases or decreases in the growth of technology will have a substantial impact on lateral pressure.

In a "resource-pessimistic" situation with constraints, any changes in technology will also have only a marginal effect on the disposition for expansion, in that lateral pressure will be shaped by the resource shortages and technological changes will do little to offset such constraints. Thus, higher rates of technological growth will increase pressures generated by demand and influence capabilities somewhat; the net effect will be a slightly higher level of lateral pressure than in a "resource-pessimistic" situation with normal technological

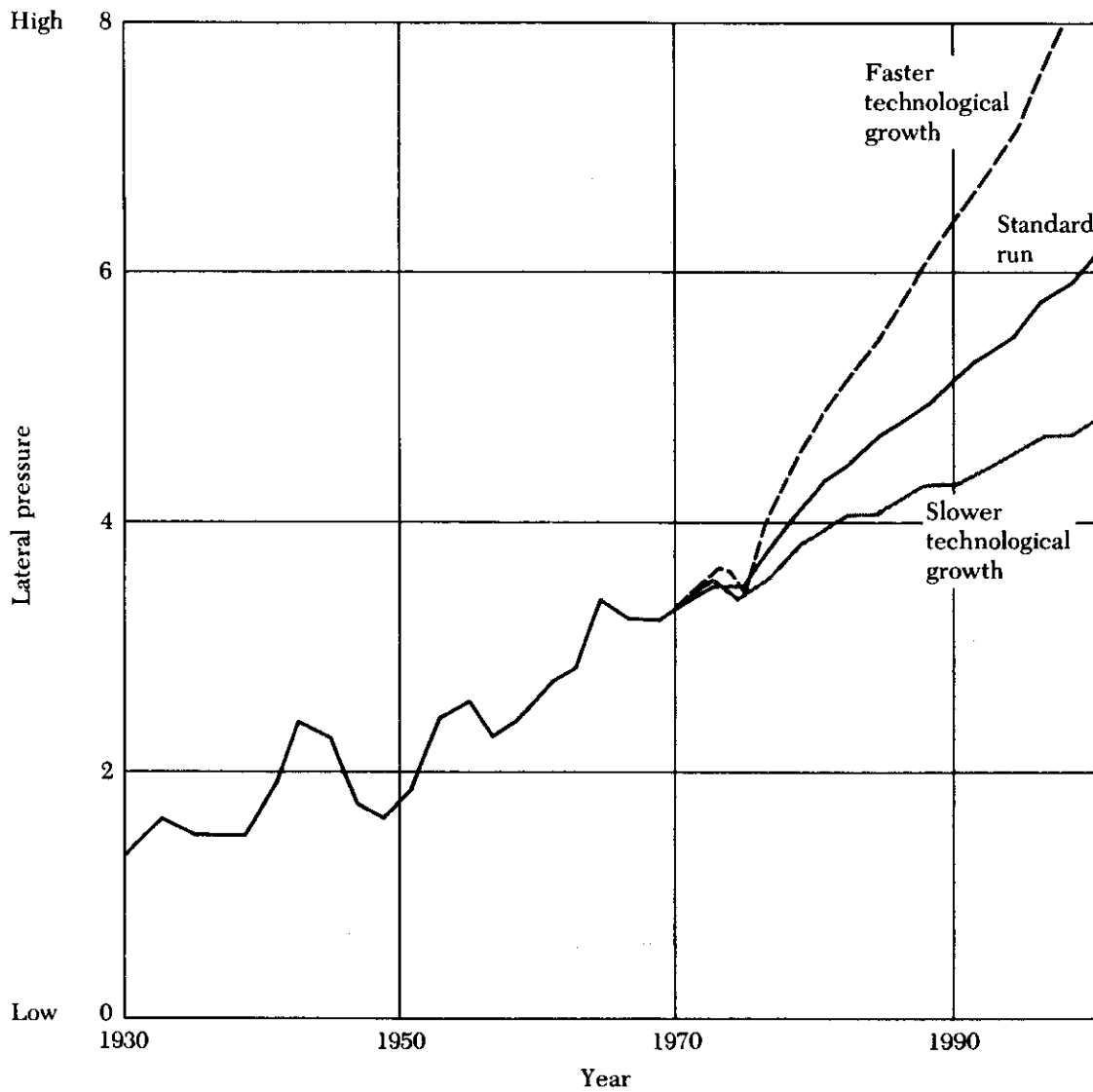


Figure 21.8 Lateral pressure: technological change in a resource-optimistic situation.

increases. Similarly, slower technological growth will result in a reduction of lateral pressure, since both demand and capability will decline appreciably. The important point, however, is that *the impact of technological change on lateral pressure is mediated by the effect of resource shortages*. Indeed, the shortages interjected in 1970 provide an important constraint on lateral pressure, while technological change—in the absence of other changes—is not likely to have an effect. Figure 21.9 presents the forecasts for the impact of technological change in a situation of resource constraints. It will be noted that similar “band effects” are generated; however, the width of the band is considerably narrower than in the “resource-optimistic” case. Technological change may well have an ac-

celerated impact on lateral pressure when there are no significant resource constraints; but when shortages occur, this impact will be overshadowed by what happens in the resource sector. We do not address ourselves here to the impact of technology in reducing resource constraints, but we make some inferences about the impact of technology on lateral pressure in a situation of resource constraint versus one of resource abundance. Figures 21.8 and 21.9 present the resulting forecasts to 2000.

Changing Priorities in Government Expenditures

Changes in governmental priorities provide perhaps the most counterintuitive impacts on lat-

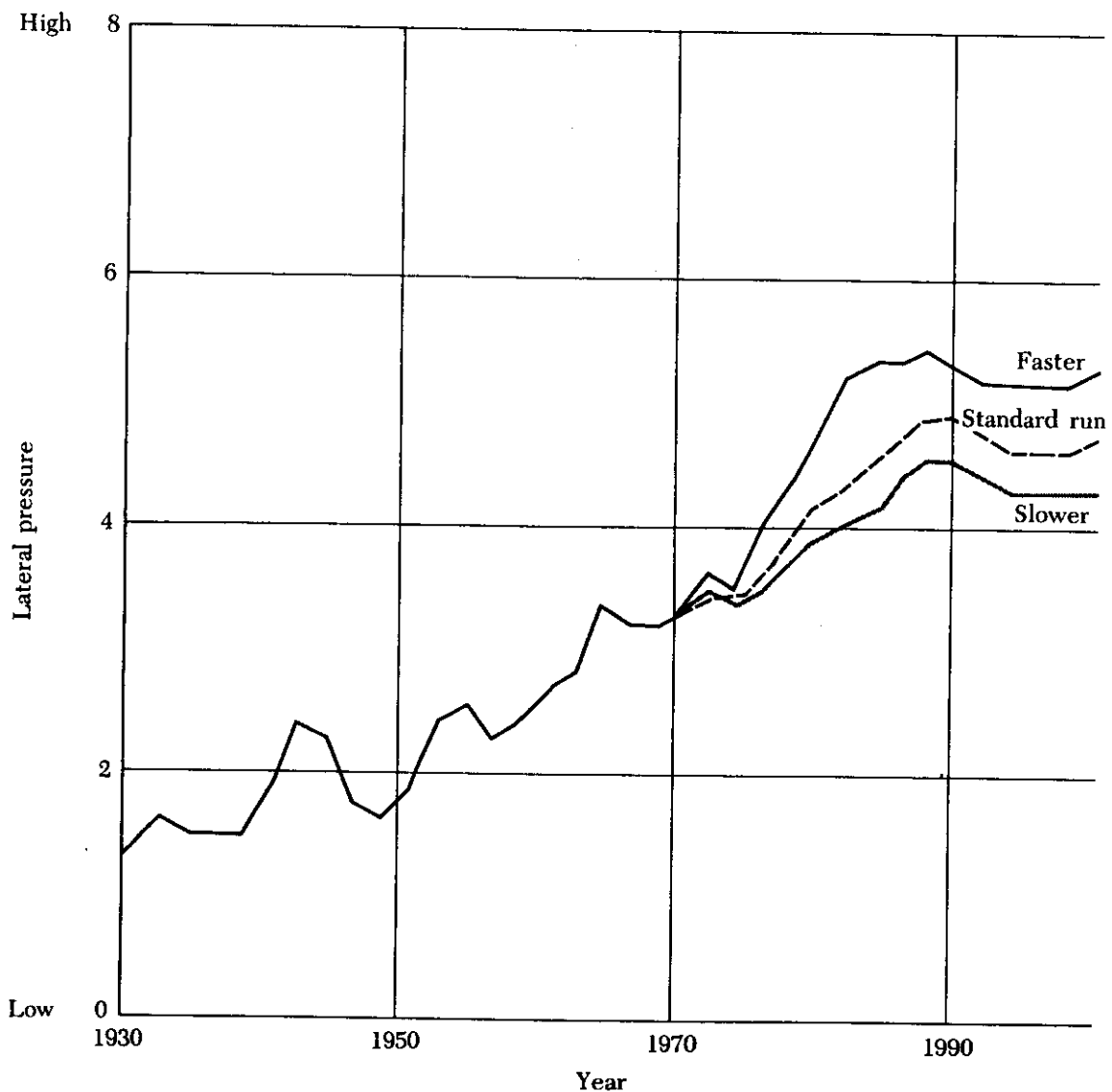


Figure 21.9 Lateral pressure: technological change in a resource-scarcity situation.

eral pressure. It is not so much the magnitude of the effects that are unexpected, but their nature. The net result is to raise substantial questions about the implications of "peaceful" versus more "warlike" governmental priorities. Increasing the government's spending on civil programs at the expense of the military will not necessarily reduce a country's disposition for external expansion.

In the absence of significant resource shortages, a sharp increase in governmental allocations for civilian spending (thus lower expenditures to the military) will result in somewhat lower demands but markedly higher pressures generated by increasing capabilities. An increased governmental concern for welfare will lead to higher consumption, therefore also greater investments and, by extension, a higher level of productive capability. Combined with increased demands, growing national capability will generate greater dispositions for external expansion. In the absence of severe resource constraints, greater concern for national welfare (expressed as a larger fraction of the budget allocations to the civilian than to the military sector) will result in marked growth in lateral pressure. The pressures for expansion generated by the military appear to be less influential than those generated by growth in national capability. Greater allocations to national welfare will allow greater consumption, higher investments, and more productive capacity. The disposition for external expansion will increase accordingly.

If the decision is made to increase the share of the budget allocated to the military (thereby reversing a welfare orientation), the pressures generated by the four multipliers on demand will result in greater demand (by the year 2000 about twice as high as the demands generated in the standard run with no resource constraints noted in Figure 21.7). By contrast, increasing allocations to the military will reduce consumption, detract from investments, and result in generally lower productive capacity than when the government adopts a welfare priority. In the case of increased allocations to the military, by the year 2000 lateral pressure will be *lower* than when the civilian sector is given greater priority. The point is that increasing allocations to the military will result in greater pressures from the demand multiplier, but lower productive capability; the net result is indeed an increase in lateral pressure—quite dramatic—but toward the end of the century appears to taper off because of

the constraints on productive capacity. However, it is when the government makes a greater commitment to national welfare—by increasing the proportion of expenditures allocation to the civilian sector versus the military—that productive capacity increases most dramatically, with the net outcome of an exponential growth in lateral pressure. By the year 2000, *the disposition for expansion is no higher in a situation of greater emphasis on military spending than in one in which welfare is given the higher priority.* Figure 21.10 presents these forecasts.

The effects of changing government priorities will be markedly different in a "resource-pessimistic" future. In the event of significant resource constraints, any decision to increase welfare allocations (at the expense of military expenditures) will result in lower lateral pressure than would be the case if priorities were in favor of the military. It is revealing to observe that increasing military expenditures in a situation of marked resource constraints is likely to give rise to greater pressures from the four multipliers on demand; however, the effects on capability are such that constraints on consumption and investments result in declining production. However, since the pressures from the demand multipliers are increasing, the outcome is higher lateral pressure than in the standard resource-pessimistic situation. Over time, when the full impact of such shortages become realized, the result is a sharp decline in the country's propensity for external expansion. By the year 1985, a significant decline in lateral pressure sets in, occasioned by the combined effect of resource constraints and declining productive capacity. The first is occasioned by an exogenous intervention; the second by the impact of increasing military expenditures. In the long run, that is, toward the last decade of this century, in a situation of resource constraints, *any changes in governmental priorities will result in a decline in lateral pressure*, relative to the standard resource shortage run presented in Figure 21.7.

In sum, greater allocations to the military will generate more pressure from the demand multipliers, but there will be marked constraints on productive capacity. Therefore, dispositions for external expansion will eventually decline. And any increases in allocations to the civilian sector will reduce demands comparatively, but allow for more rapid growth in productive capacity. In the ab-

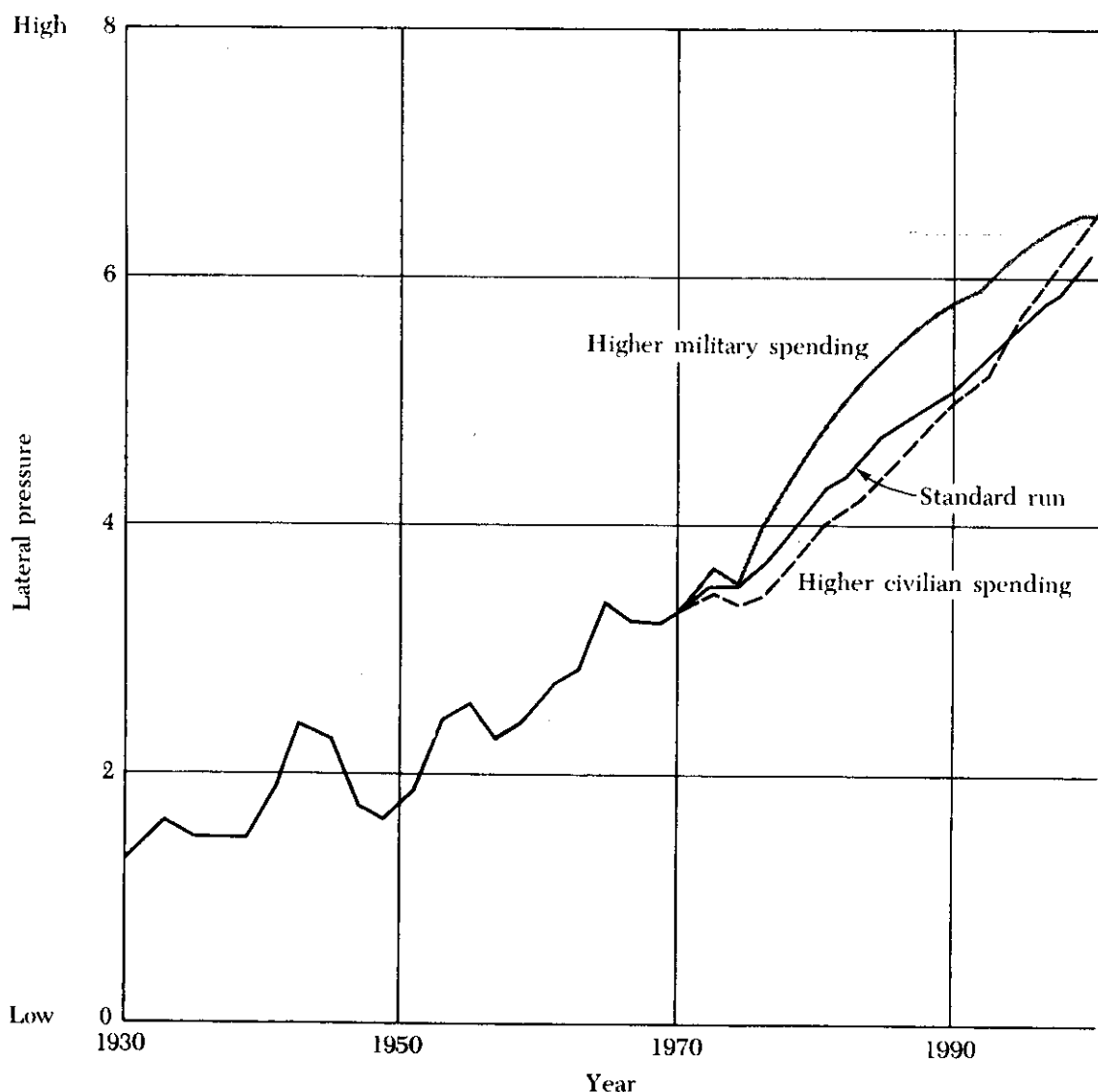


Figure 21.10 Lateral pressure: government priorities—military versus civilian in a resource-optimistic situation.

sence of sufficiently strong pressures from the demand multipliers, lateral pressure will decline eventually. In each case, however, this decline sets in following an initial rise that continued until the mid-1980's. In each case, the model behavior is similar, but the magnitude of increases and declines differs substantially. Thus, it well appears that, given no other changes, a relative stabilization of the disposition for external expansion toward the end of the century would occur in a situation of high resource constraints (interjected in 1970) and a government commitment of greater allocations to the civilian sector. In the absence of resource shortages, such a commitment will result in *greater* lateral pressure; but with a strong structural constraint imposed by the resource sector, in-

creasing expenditures to the civilian sector may well stabilize the country's propensities for expansion (see Figure 21.11).

VII. SUMMARY

This chapter is in the nature of a progress report and illustrates an integrated approach to forecasting in international relations. In Chapter 1 of this volume, we have identified some of the key issues at the basis of any systematic forecasting exercise. In Chapters 12 and 13 we have described different approaches to forecasting—one statistical and the other functional—and we have compared the advantages and disadvantages of each. We have also tried to employ these different forecasting meth-

odologies for the analysis of the same international problem—namely, forecasting the processes of expansion and the extension of national activity outside territorial boundaries. This process is an important determinant of conflict among nations, and to the extent that we develop some reliable theoretical specifications of the determinants of international behavior, our forecasts of future outcomes will be enhanced accordingly.¹⁰ In the present chapter, we have presented a theoretical specification of the dynamics of expansion in significantly greater detail than the representation of the same processes in Chapter 12. There, the process of expansion was formulated as one equation, the parameters of which were estimated on the basis of empirical data. The same process is presented in this

chapter as a nonlinear feedback model of the disposition for external expansion. Figure 21.2 represents a more complex formulation of only the *first* equation of Table 12.1 in Chapter 12. Through trial and error and through the comparison of the advantages and disadvantages associated with alternative forecasting methodologies, with an accumulation of attendant experience, we hope to develop more reliable means of bounding our uncertainties regarding future outcomes.

This chapter is a progress report in yet another sense. It remains for us to undertake considerably more experimentation with contingency analysis and with alternative policy interventions. More work remains to be done regarding the potential implications of alternative population policies, dif-

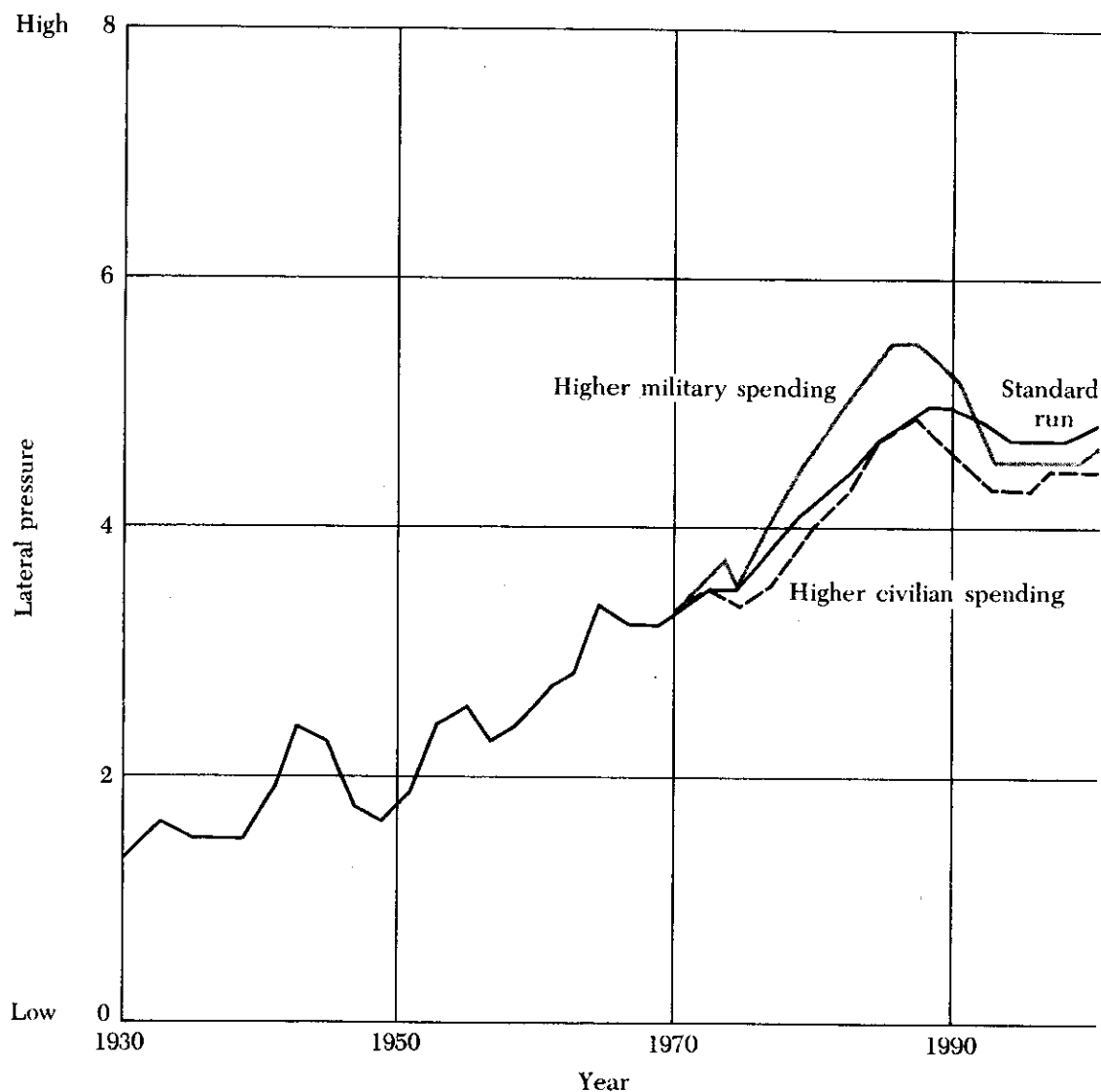


Figure 21.11 Lateral pressure: government priorities—military versus civilian expenditures in a resource-scarcity situation.

ferent policies regarding investments in research and development of alternative energy sources, alternative governmental spending strategies, different labor policies and their impact on national productivity, and so forth. But, most important of all, it still remains for us to model and forecast foreign policy *behavior*. As modeled here, lateral pressure refers to the *disposition* for external expansion; its behavioral manifestations must now be developed into an adequate specification for forecasting purposes. In Chapter 12, we have undertaken some retrospective forecasts of actual behavior generated by lateral pressure and of its implications for conflict and violence among nations. These forecasts (based on the equation specifications of Table 12.1 in Chapter 12) were tested only against the historical record. Such specifications must now be formulated in dynamic, nonlinear terms, and employed for forecasting into the "real" future and observing the implications of alternative decisions and policy interventions. This is the next step.

NOTES

1. For theoretical and substantive background, see Choucri and North (1975). Part I presents a theoretical statement of the determinants of international behavior.
2. Choucri (1976).

3. See Chapter 13 of this volume for a comparison of statistical (econometrics) and functional (system dynamics) modeling procedures.
4. See, for example, Hobson (1938) and Lenin (1939).
5. A useful synthesis is presented in Pen (1969).
6. Conceivably, a country of higher capability could turn inward. It may not require great amounts of resources from the external environment. It might choose to apply its technological capabilities to exploiting indigenous sources of supplies—if they are available—or to make use of old ones (if the resources in question are renewable). But, empirically, one has difficulty identifying countries with high capabilities that are not manifesting lateral pressure. Inward-turning countries have generally been low capability countries. Advanced societies—particularly the industrialized countries of the West—have turned outward and often this tendency has been accompanied by conflict and violence.
7. Economists would be uncomfortable with our notion of "demands." Their concept of demand is tied to purchasing power and willingness to exercise that power. Ours is a broader analytical concept pertaining to all individual claims on society and government.
8. Samuelson (1970). A simplified statement appears in Pen (1969).
9. On all lateral pressure plots, the units have no specific meaning since lateral pressure is the product of two variables that are measured in different units (GNP in dollars and demand measured by the four component multipliers). However, the placement of the zero-value is nonarbitrary and the intervals do have meaning. Therefore, it is a ratio scale.
10. A related forecasting effort modeling relationships in the global petroleum system is described in Choucri and Ross (1975) and presented in an expanded and validated version in Choucri with Ross (in preparation).

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