Long-Term Economic Planning

Proceedings of the IIASA Task Force Meeting April 3-7, 1978

Pradeep K. Mitra, Editor

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PREFACE

This publication is a record of the meeting of the International Institute for Applied Systems Analysis (IIASA) Task Force on Long-Term Economic Planning, held at Schloss Laxenburg in April 1978. It was natural that IIASA, having a collaborative East-West Basis, should sponsor a meeting that could promote an exchange of experience among centrally planned and market economies. Fourteen leading specialists were invited to present their ideas in a seminar-like setting; no formal papers were solicited. The result of these informal deliberations is presented here in the form of a progress report.

Pradeep K. Mitra
Task Force Organizer

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INTRODUCTION

P.K. Mitra

The study of long-term economic planning, i.e., of systematic attempts at resource allocation covering 10 years or more, may require justification. The task is both complex and demanding. Its execution draws upon a range of multidisciplinary skills of which economic analysis forms only a part. The exercise itself might seem too remote from reality to be relevant to policy makers concerned with the resolution of day-to-day matters. And yet, it is this last consideration that accentuates the relevance of long-term planning. This is because some (albeit imperfectly articulated) views about the future necessarily underlie much short-term decision making, and there is much to be gained from making such views precise.

It is evident that long-term planning exercises can and do serve a variety of purposes in different societies, ranging from the creation of a stable macroeconomic environment within which resources may be efficiently allocated, through the informal multilevel exchanges traditionally associated with indicative planning, to the relatively centralized programs of development broadly characteristic of socialist economies. This encourages the belief that such diverse allocation and such control mechanisms cannot be fitted into a general framework that is productive of useful insights into the planning process. Nevertheless, it is true that many of the problems faced by planning authorities transcend national boundaries and socioeconomic systems. The small group of economists from East and West who formed IIASA's Task Force on long-term economic planning were accordingly concerned with some of the issues that a reflective look at both the theory and practice of planning brings to the fore. Prominent among these concerns were the scope of formal models in economic planning; the incentive compatibility of national planning procedures; forecasting models as aids to consistent thinking about the future; and applications of a unified planning framework to the analysis of specific allocation problems.

THE SCOPE OF LONG-TERM PLANNING MODELS

It is convenient to describe plans dealing with horizons at least as long as 10 years as being long term in nature; in certain fields, such as energy, health care, social security, and population, the relevant planning horizons are substantially longer. The imperfect nature of information about future possibilities implies that a long-term plan cannot be regarded as

a firm description of an economy ten or more years hence. Its role instead is to promote disciplined thinking about the future, and to highlight the implications of alternative developments for current action.

Any attempt at formulating a long-term plan has to contend with some familiar difficulties. Much of the detailed sectoral information is unlikely to be available to a central planning authority. The computation of a national plan of reasonable size over a number of years might be very expensive. An effective planning authority could therefore usefully concentrate on aggregative models that indicate the more prominent features of structural economic change over the next 10-20 years; typically they will sketch profiles of capital accumulation, intersectoral migration, changes in a country's pattern of foreign trade, etc. Such an approach presents a panoramic view of strategic long-term options; the underlying assumptions and methodology can then be subjects for discussion among the individuals and agencies involved in the planning process. The desirability of making clear the consequences of implicitly held views about the future has already been noted. Several interrelated questions were raised in this connection at the Task Force meetings, and they are briefly catalogued below.

Which features of structural change should be highlighted in an aggregated perspective plan? This is a problem for which economists alone are not equipped to provide solutions. Perspective long-term planning models, if they are to be both manageable and easily understood, can feature only the more important structural changes that a society is likely to undergo, and economists can expect much guidance from sociologists, historians, and political scientists on the matter. Considerable imagination and prescience must therefore inform the most formal perspective planning exercise; any attempt to substitute a mechanical enumeration of a large number of possible scenarios for an imaginative leap of intuition will deserve to fail. Augustinovics and Porwit in their respective contributions dwell on this set of issues.

What is the most useful aggregation over various parts of the economy for the purposes of the perspective plan? To which traded and non-traded sectors should such a plan pay special attention? The answers to such questions depend on what are judged to be key sectors in the development of the economy, from the domestic point of view and from that of foreign trade. Not only do limitations of data and computational facilities impose constraints on the extent of disaggregation; theory lends no support to the notion that more disaggregation is better. Or, to put the point another way, long-term planning models, while being most useful as reconnoitering devices for determining broad policy options, are relatively ill-suited to handle the detail attending multisectoral planning. A complicated economy-wide model may defeat its own methodological purpose by obscuring rather than illuminating future possibilities. A related point

applies to "price" aggregation. Long-term macroeconomic planning models can be used to derive shadow wage rates, exchange rates, and accounting rates of interest. These are summary statistics that convey information about future possibilities open to an economy more readily than disaggregated intertemporal price systems from which they should ideally be derived. An interesting methodological problem here is to devise a framework within which the costs and benefits of greater disaggregation can be assessed [1].

In which ways can the study of alternative objective functions help to clarify the nature of long-term choices available to planners? Reference has been made above to planning as a method of exploring the domain of feasibility. Indeed, a number of stylized iterative dialogues for eliciting technological information from producers have been analyzed in the literature. The introduction of societal objective functions into these procedures focuses attention on the technical choices that a society has to make in order to realize its goals. When considering future developments it is clearly more efficient to concentrate on plans that help further societal objectives rather than on the entire set of feasible plans. But there is another advantage. Assume that for every objective function there are corresponding feasible plans maximizing its value (mathematical economists will want to satisfy themselves of the continuity of the objective function and the nonemptiness and compactness of the feasible set before agreeing). The planning authority can then examine the response of optimal plans to different specifications of objective functions. Such an exercise could, for example, help planners to assess the consequences of adopting objective functions characterized by different degrees of inequality that a society is prepared to tolerate, before they decide on a reasonable value for the latter parameter. This point is elaborated by Milleron in his presentation to the Task Force.

How can a perspective plan help to emphasize the effect of uncertainty on possibly irreversible long-term investment decisions? It is clear that the longer the time horizon contemplated, the larger the number of variables that planners would consider endogenous. This applies in particular to investment decisions that have long gestation periods; it is particularly important to predict the circumstances in which such acts of investment will come to fruition. One consideration adding substantially to the importance of these exercises is that the decision, for example, to engage in commercial development of a scenic wooded area, or to develop a nuclear-based energy program is, with a positive rate of time preference, almost irreversible. Should such decisions be taken now, or at a later date when more information about the future might become available? The intrinsic uncertainty surrounding the future and the possibility of becoming better informed might provide an argument in favor of keeping options open. Long-term planning can help calculations of option values and hence improve the timing of decisions that have irreversible consequences [2,3].

INCENTIVE COMPATIBILITY

Whether or not a proposed resource allocation procedure, be it competition, market socialism, or a negative income tax system, has any desirable properties depends on the institutional environment in which it is expected to operate. Many societies are not characterized by a degree of cohesion that encourages individuals to identify national (or central planners'?) goals as their own. This creates incentives both to withhold and manipulate information, as well as to depart from the rules of behavior laid down from above. The analysis of the institutional viability of resource allocation mechanisms dates back at least as far as Edgeworth, and has been the subject of much recent interest. Hildenbrand and Kirman [4] offer a convenient exposition and bibliography. Consider an allocation of resources and a coalition of individuals in an economy. A coalition that is able to redistribute resources among its members to achieve allocation Paretowise superior for them is called a blocking coalition. The most celebrated result available to date argues that (a) if the information and communication costs of forming blocking coalitions are negligible enough to permit their creation whenever an opportunity arises, and (b) if the number of economic agents becomes very large so that no agent can exercise a significant degree of power, then the set of allocations that cannot be blocked by any coalition is reduced to the set of competitive equilibria. The assumptions about information and communication used to derive this conclusion are unlikely to be fulfilled in most societies; the above theorem may therefore misjudge the institutional fragility of the competitive mechanism. Nevertheless, it clarifies why it is necessary for the number of agents to be large for competition to "work" in a particular class of cases. And, to take the traditionally most discussed example, it can be expected to shed light on the circumstances in which market socialism is an incentivewise satisfactory planning procedure.

The need to explore incentive problems, though widely recognized did not find formal expression in the Lange-Lerner and related approaches to decentralized planning [5,6]. These exercises, which are in the nature of iterative dialogues, are undertaken by a planning authority to generate information about technological and other possibilities open to the economy. It therefore becomes necessary to model the information gap between planners and other agents and to examine the incentives to misrepresent information to which such a gap gives rise. This also has implications for the choice of control instruments: what combination of taxes, quantitative licensing, and moral exhortation is deemed to be the most effective in any particular society? A general treatment of these questions, which are basic to the economics of organizational behavior, is likely to be quite difficult, and theorists have found it convenient to proceed in stages.

A particular organization that has proved amenable to economic analysis is the "team" [7]. All members of a team, while sharing the same goals, have access to different information. The resulting lack of intraorganizational conflict allows a simpler treatment of the possible gains from information pooling and of the effects of alternative planning instruments on social outcomes. Such a team-theoretic framework has been used to assess the relative superiority of pricing policy (taxes) versus quantitative regulations (licenses and quotas) in the decentralized control of environmental pollution under technological uncertainty, and to provide solutions to these issues in certain special cases [8,9].

The study of teams, however, can provide only a partial solution, because incentive problems arise most naturally in situations where agents subscribe to a multiplicity of goals. What kind of behavioral rules can possibly be implemented given imperfect information? Public economists have recently studied similar questions in designing redistributive tax-subsidy mechanisms. The lump sum redistribution, central to the fundamental theorem of welfare economics, is unlikely to be incentive compatible [10,11]. The properties of planning procedures that help to support an optimum allocation of public goods in the face of incorrect revelation of preferences have also been examined within the framework of noncooperative game theory [12,13]. This approach can also provide a first cut at the general problem of the design of incentive-compatible planning procedures in a society comprising a plurality of interests, and where the government has access to imperfect (and possibly manipulated) information.

The preceding paragraphs have outlined some difficulties that a satisfactory treatment of incentive-compatible allocation would aim to overcome. However, the reader who is left with the impression that the problem is of interest to economic theorists alone is reminded that similar preoccupations have underlain the economic reforms in the Soviet Union and Eastern Europe during the last 15 years. Tardos in his paper considers some of the problems that have encouraged Hungarian planners to reexamine certain incentive schemes. Thus, to focus on one specific example, it might be in the interest of an enterprise in a centrally planned economy to understate its true production possibilities to the planning authorities in the hope of being asked to meet a modest target; in this way the enterprise can overfulfill it with ease, and earn a large bonus. A parallel problem arises in intertemporal planning, where an enterprise would not wish to be conspicuously successful in the present period, fearing that observed current successes might elicit high targets for the next period. Some insight into what the new economic reforms seek to achieve is provided by the following analysis, which represents Soviet planning as proceeding in three stages [14].

In the preliminary phase the central planning authority (CPA), which is partially informed about true production sets, proposes a tentative output target, $\bar{y}$, to an enterprise, together with a bonus fund, $\bar{B}$, to which it would be entitled if the target were achieved. The enterprise responds in the planning phase by selecting a target, $\hat{y}$, in accordance with its production possibilities, realizing that the bonus fund, $\bar{B}$, announced in the preliminary phase, will be revised to $\hat{B}$ as follows: $\hat{B} = \bar{B} + \beta(\hat{y} - \bar{y})$. At the implementation stage, the enterprise produces an output, y, and receives an actual bonus B given by

$$B = \begin{cases} \hat{B} + \alpha(y - \hat{y}) & : y \geq \hat{y} \quad \text{(overfulfillment)} \\ \hat{B} - \gamma(\hat{y} - y) & : y < \hat{y} \quad \text{(underfulfillment)} \end{cases}$$

where $0 < \alpha < \beta < \gamma$.

This three-step procedure insures that production targets are set by enterprises rather than the CPA and that deviations from those targets attract penalties. The system therefore encourages enterprises to set targets ($\hat{y}$) that they hope to achieve, i.e., $\hat{y} = y$; this example, more generally, is a simple but elegant application of incentive-theoretic ideas to planning problems.

Reference has already been made above to the profession's interest in the design of incentive-compatible mechanisms for remedying inequality in general and the redistribution of income in particular. The recent exploration of these problems has clarified our understanding of the efficacy of different policy packages in securing redistributive ends; an assessment of what has been achieved, together with suggestions for further research, appear in the paper by Stiglitz. Indeed, the lively, contemporary interest in the relationship between planning and income distribution could profitably center on three properties of public policy instruments: efficiency, equity, and incentive compatibility. But it is worth reiterating that solutions to these income redistribution problems are not "technical" in the narrow sense: whether or not a mechanism is incentive compatible, for example, depends on the institutional framework in which it is embedded.

FORECASTING MODELS

Macroeconomic models have been extensively used in recent years for short-term forecasting purposes (1 to 3 years) in many of the "market" economies. These models have not to date played an important role in longer-term planning, but that situation may be changing. The recent economic slowdown and the perceived need for a new international economic order necessarily

affect the conditions under which the formulation and implementation of long-term plans can be carried out. This implies in particular that more attention must be devoted to problems of demand forecasting and capacity creation in the public sector, even in long-term planning, than has hitherto been the case. The contributions by Klein and Witcomb, representing the Wharton and Cambridge (UK) modeling efforts respectively, demonstrate what can be achieved given our current state of knowledge.

It is natural to ask what purposes models as sophisticated as those of the Wharton and Cambridge groups are designed to serve. Those engaged in constructing and manipulating the models would probably answer that they are aids to consistent thinking about the future. This supposition, if correct, suggests that the models are most useful when they are constructed to illuminate specific ends to the possible exclusion of others. Examples of such ends are: the presentation of an overview of a particular economy in the year 1990; the long-term consequences of domestic macroeconomic policies on employment and capacity creation; and the sensitivity of projections to assumptions about the behavior of trading partners. Another application of forecasting models, explored by Nagy in his paper, is the simultaneous treatment of the export and import sectors of a system of trading countries to arrive at mutually consistent long-term forecasts; these exercises can stimulate discussion about international economic policies.

This is not the place to embark upon a detailed critique of econometric forecasting models. But it might be instructive to illustrate some points already made on the scope of plan modeling in the present context. Forecasters need to have a feel for structural change: that is a herculean task for elusive economic relationships, as demonstrated by the possible sensitivity of predictions to slight alterations in the specification of a model. A preoccupation with these matters, important though they are, is, however, additional to the need to anticipate changes in the social environment within which the economic model functions. Secondly, the degree of aggregation in the model is tailored to the availability of reliable data and to the requirements of the problem at hand. Thirdly, prescribing specified targets in a forecasting model helps to highlight the long-term choices that a society must make in order to attain those targets. And, finally, the exercise itself can promote a dialogue about future developments by incorporating feedback from a panel of users; this is certainly true of the Wharton model and increasingly so of the other major efforts.

APPLICATIONS

Three applications of the use of a planning framework for tackling specific problems were presented at the meetings of the Task Force. Although seemingly diverse, they shared the property

of reflecting the profession's growing concern with the relationship between long-term planning and economic inequality. This relationship is particularly important in the design of educational and social security systems, as the papers by Weiss and Sheshinski make clear. Both of these areas of economic planning are characterized by long time horizons and have important implications for the distribution of income and wealth between and across generations. The third example, developed in Bell's paper, illustrates the use of a macroeconomic model to derive distributional weights and other summary statistics for application in social cost-benefit analysis in a developing region of the Third World.

CONCLUSION

In conclusion, it is worth noting the two major themes that preoccupied participants from both East and West during the meetings of the Task Force. The first was concerned with delimiting the extent to which formal models could provide useful aids to decision making about the future and with the need to combine them with qualitative and perhaps more informal considerations. The second emphasized the importance of examining the institutional viability of planning viewed as a resource allocation mechanism. If IIASA can create a network that encourages economists in its member countries and elsewhere to undertake selected cast studies designed to elicit general lessons in these two areas, these meetings will have served a useful purpose.

REFERENCES

[1] Mirrlees, J.A., and N.H. Stern, On Fairly Good Plans, *Journal of Economic Theory*, 4, 2 (1972).

[2] Arrow, K.J., and A.C. Fisher, Environmental Preservation, Uncertainty and Irreversibility, *Quarterly Journal of Economics*, 88, 2 (1974).

[3] Henry, C., Option Values in the Economics of Irreplaceable Assets, *Review of Economic Studies*, special symposium issue, 1974.

[4] Hildenbrand, W., and A.P. Kirman, *Introduction to Equilibrium Analysis*, North Holland, Amsterdam, 1976.

[5] Heal, G.M., *The Theory of Economic Planning*, North Holland, Amsterdam, 1973.

[6] Heal, G.M., Planning, in K.J. Arrow, and M.D. Intriligator, eds., *Handbook of Mathematical Economics*, forthcoming.

[7] Marschak, J., and R. Radner, *Economic Theory of Teams*, Cowles Foundation, Yale University Press, New Haven, 1972.

[8] Weitzman, M., Prices vs. Quantities, *Review of Economic Studies*, 16, 4, (1974) 128.

[9] Weitzman, M., Optimal Rewards for Economic Regulation, *American Economic Review*, 68, 4 (1978).

[10] Mirrlees, J.A., The Theory of Optimal Taxation, in K.J. Arrow, and M.D. Intriligator, eds., *Handbook of Mathematical Economics*, forthcoming.

[11] Hurwicz, L., The Design of Resource Allocation Mechanisms, *American Economic Review Papers and Proceedings* (1973), reprinted in K.J. Arrow, and L. Hurwicz, eds., *Studies in Resource Allocation Processes*, Cambridge University Press, New York, 1977.

[12] Groves, T., and J. Ledyard, Optimal Allocation of Public Goods: A Solution to the 'Free Rider' Problem, *Econometrica*, 45, 4 (1977), 783.

[13] Green, J., and J.J. Laffont, On the Revelation of Preferences for Public Goods, *Journal of Public Economics*, 8, 1 (1977).

[14] Weitzman, M., The New Soviet Incentive Model, *Bell Journal of Economics*, 7, 1 (1976).

I. THE SCOPE OF FORMAL MODELS IN PLANNING

METHODOLOGICAL ISSUES IN MODEL BUILDING FOR LONG-TERM ECONOMIC PLANNING

M. Augustinovics

When studying the issues involved in model building for long-term economic planning, it is necessary to ask oneself the following questions:

- What is really meant by "long-term planning"?
- What are the purposes for which mathematical models are used in long-term planning?
- What are the particular problems encountered when constructing long-term models?

An attempt will be made to look into the types of models that have been used in the Hungarian planning process.

THE SIGNIFICANCE OF LONG-TERM PLANNING

Long-term planning can be clarified by examining the necessity of planning; its nature; the methodology involved; and the institutional aspects of the process.

It is necessary because of the long-term consequences of many economic processes, e.g., investment. Planning for a time period of ten to fifteen years does not simply mean taking decisions today about the future course of economic events, but, more than that, it involves thinking in a disciplined way about the future consequences of present decisions. One of two alternative approaches can be taken: to prepare detailed plans for the most crucial sectors of the economy only, e.g., energy, agriculture, or to make general plans for all sectors. Hungary has chosen to combine both approaches; designing detailed projects for the most relevant sectors, which are viewed in relation to future developments in the whole economy. The major difficulty in applying this method in Hungary is the inability and/or unwillingness of different sectors to develop projections of the future. There is also a problem originating from the institutional aspects of the process. The personnel directly involved in planning are usually not well equipped to produce the different long-term scenarios, whereas people with some imaginative capacity do not have the necessary experience in planning. In other words, there may not be much overlap between people with the two qualifications essential for the success of the process.

THE USE OF MATHEMATICAL MODELS IN PLANNING

The actual planning process is iterative. Quantitative assessment of the consequences of alternative paths is needed to assist decision makers in making choices. Mathematical models used in the planning process should initially aim to achieve a macroeconomic synthesis (or coordination) of partial models. The study of simultaneous strategies, by working out the alternative feasible paths for an economy, and by taking into account social costs and rewards, is an aid to decision making.

Models used in the planning process must be operational, yielding quantitative solutions. Two groups of models can be distinguished: planning models, which produce macroeconomic alternatives, and analytical models, which analyze the past, present, and future variants. Large-scale models giving insight into the structure of the economy are useful, but they should not be so complex as to be unintelligible to all but a few people.

In Hungary various models are used in long-term planning, differing in the degree of aggregation over time and sectors. Those that are used to produce macroalternatives are linear programing models, whose principal role is to help explore the nature of the long-run choices available to an economy. The linearity assumption is no severe limitation, since our knowledge of non-linear relations is small. When known, non-linearities can often be incorporated into the linear structure.

THE ENDOGENEITY OF PROCESSES OVER A LONG-TERM PERIOD

An important methodological issue in long-term model building, is that many more processes and relationships become endogenous over a long-term period. The following examples can be mentioned:

- Pure economic changes take place more rapidly than social ones. The latter can therefore, only be taken into account in the long run. However, the connection between desired social goals, e.g., maintaining and improving social security for all members of a society, social mobility, and investment decisions is rather weak, partly as a consequence of inadequate knowledge.

- Foreign trade becomes endogenous, for example, when a country is able to determine the structure of its exports over the long term.

- The relationship between output and investment is such that current output depends on past investment, and therefore current investment will determine future output.

- Short-term changes do not have any significant influence on relative prices. In long-term models, however, one

can study the feedback between changes in the price structure and real economic variables. Current knowledge of transmission mechanisms, e.g., price elasticities, is limited.

At present, in Hungary, there is a need to construct detailed sectoral models that, in attempting to explore long-run changes in the social structure, go beyond a mere description of economic changes.

DISCUSSION

Arthur stressed the importance of taking into account social factors. The size of models should be large enough to encompass the set of issues being studied. He asked if simulations were done using different sets of constraints.

Augustinovics said that, contrary to current opinion, long-term models should, in some areas, be more detailed than short-term models. This can be accomplished by the use of various alternative models. In simulation, several sets of constraints are used to trace alternative feasible paths. Concerning specific projects, one should always have a comprehensive view, taking into account the development of the whole economy; this is a central idea in planning.

CHOICE OF OBJECTIVE FUNCTIONS IN ECONOMIC PLANNING

J.-C. Milleron

Social welfare functions have been used in planning processes for several reasons:

- They are convenient means of exploring and narrowing down the set of feasible solutions in an optimization process, the set of bounding hyperplanes being interpreted in this case as social indifference curves.

- They serve as tools for decentralization in mathematical programming; an overall solution can then be computed as a sum of various partial solutions.

- It is believed that they can correctly express the values of a society; this point is open to discussion.

- It is thought that in a democratic society social welfare functions are related to the tastes of the individuals in that society.

In order to deal with problems of social choice, it is necessary for the analyst to make explicit all the consequences of various alternative criteria. It is left to the politicians to decide which one is used.

Another point that deserves closer attention is the connection between the choice of a social welfare function and equity considerations (see below). It is possible in certain circumstances to proceed some way in an iterative planning exercise without having to introduce a social welfare function [1].

For the choice of social welfare functions in mathematical models, two cases can be isolated:

- Where one assumes that people have the same tastes but different endowments.

- Where one assumes that people have different tastes and different endowments.

Two approaches can be identified in economic literature [2,3]: the utilitarian approach and the Rawlsian approach.

In the case 1 above, two subcases can be considered. Let $u(x,\ell)$ be the social utility function where x refers to consumption, and ℓ to labor. In the first subcase, the probability

distribution of qualifications n in society is known; then the optimal situation may be obtained by maximizing the mathematical expectation of utility

$$\max \int_{n_1}^{n_2} u[x(n), \ell(n)] f(n) dn \quad .$$

In the second subcase, the probability distribution of qualifications in society is unknown; here, the best solution is the maximin solution:

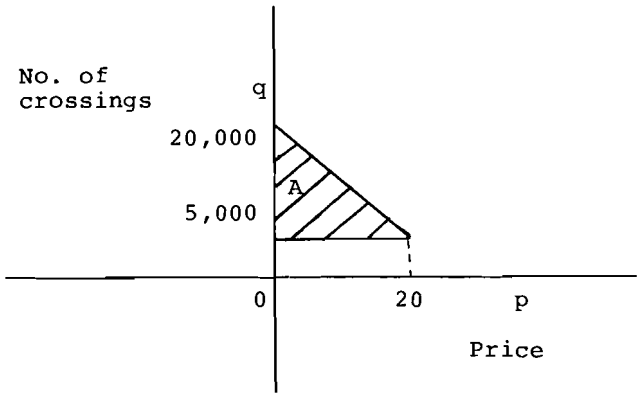
$$\max\{\min_{n} u[x(n), \ell(n)]\} \quad .$$

Case 2 is seldom considered in the literature because of the yet unsolved problems of aggregation [4]. A solution to this problem can perhaps be found along the following lines: by making explicit a required distribution of income over and above the choice of a social welfare function, the latter being more of an abstract concept than the former. A link between social welfare functions, that is, the aggregation of individual preferences, and a required distribution of income should be sought.

Standard cost-benefit analysis has been a widely used tool in planning. However, it has its shortcomings, as can be shown by the following example:

Consider the case of a river that can only be crossed by boat, at the price per crossing of 20 units of some currency. The profit per crossing to the boat company is 5 units, the number of crossings in a given period is 5000. The question under consideration is would it pay to build a bridge across the river? The cost of construction of the bridge is estimated at 3 million units, which can be financed (assuming a perfect capital market) at the rate of 10%, i.e., interest payment of 300,000 per period. The bridge is expected to increase the number of crossings to 20,000 crossings per period if the price of using the bridge is zero.

Applying the Marshall condition (consumer surplus), the answer to the question of whether the bridge should be built is negative:



Area A represents the net benefit to consumers.

Consumer benefit:	+ 150,000
Reduction in private profits:	- 25,000
Increase in taxes: (Interest on loan)	- 300,000
Net benefit to society:	- 175,000

The solution is derived by using separable preference functions. No consideration is given to the distributive aspects, i.e., who gains and who loses from the project.

One way of taking into account distributive goals is to attach weights to the social welfare function as such: if $\{\ell_i\}_{i=1}^{m}$ is the desired distribution of income, the social welfare function could plausibly be written as $W = W(\lambda_i U_i, \ldots, \lambda_m U_m)$, where the λs are different weights attached to the utilities of different groups or individuals. This raises the question of the relationship between the ρ and λ vectors.

There is in general no simple relationship between the weight of individual utilities in the social welfare function and the share of each agent in total income. There are two reasons for this. First, an equilibrium associated with a given distribution of income cannot be guaranteed to be unique. Secondly, it is not easy to define a social welfare function, since it is only meaningful for a given cardinal specification of individual utility functions. For a more formal treatment of these issues the reader is referred to [5].

REFERENCES

[1] Malinvaud E., Proceedings of the Conference on Activity, Analysis in the Theory of Growth and Planning, eds. Malinvaud E., and M.O. Bacharach, *International Economic Association*, St Martins, New York, 1967.

[2] Mirrlees, J.A., An Explanation in the Theory of Optimum Income Taxation, *Review of Economic Studies*, 38, 114 (1971).

[3] Atkinson, A.B., Maximum and Optimal Income Taxation, paper presented at the Budapest meeting of the Econometric Society, 1972.

[4] Arrow, A.J., *Social Choice and Individual Values*, Wiley, New York, 1951, 2nd ed. 1969.

[5] Milleron, J.-C., *Equilibrium as a Solution of an Optimal Control Problem*, Ecole Nationale de la Statisque et de l'Administration Economique, Paris, 1977.

DISCUSSION

Bell made two remarks, one concerning externalities and the other about the concept of basic needs. He thought that although it is analytically difficult, one should consider externalities in consumption (conspicuous consumption), especially in stratified societies. In developing economies the concept of basic needs is often used. This notion can be extended to studies of the planning process, where one has to take into consideration that no utility index for the society can be constructed if an individual is denied a basic bundle of goods. The standard neoclassical literature on utility ignores both externalities and basic needs.

Milleron agreed that the problem of needs is very important, and pointed to one technical difficulty that can arise in connection with the consumption set: there can be differential equations that contain discontinuities on the right hand side.

Porwit pointed out that there is a problem in deciding on the weights in the social welfare function, especially if one looks into the future. In the short term one is concerned with needs, but in the long term the issue of restructuring society is predominant, and might distort our view of present needs.

A second problem in the planning process is that one must be concerned with the relative benefits of alternative projects financed out of a specified fund.

MANAGEMENT AND CONTROL PROBLEMS IN DYNAMIC ECONOMIC PLANNING

K. Porwit

This contribution attempts to explore the role of long-term economic planning as a process of control over the economic system. Thus, one cannot rely on any general rules developed from experience, but must venture to formulate hypotheses on the possible future evolution of the control process.

The aim of long-term planning is to progressively narrow the discrepancy between social needs and social resources to fulfill these needs. The concept of planning is dynamic, since social needs are not constant over time but vary with changes in their perception and formulation.

The procedure for formulating and implementing plans is greatly influenced by the type of socioeconomic system under consideration. The discussion below is derived mainly from the author's experience of problems in socialist countries, but it is general enough to encompass problems of planning in other systems. Briefly, the basic features of a socialist system are (a) public ownership of the means of production, and (b) active participation of the population in decision making at all levels. The second feature is at least as important as the first for considerations of planning and control processes.

The issues that have to be resolved by long-term planning are considered in four consecutive stages. The first is the specification of certain social needs--e.g., in health, in education, in future consumption of certain commodities--and the identification of a "social utility function." The problems faced at this stage are complex; societal issues are by their very nature multidimensional. In addition to identifying social needs, one must be able to rank them in order of priority (or urgency) and to determine the prospective beneficiaries. The decision-making process involving multiple and heterogeneous needs is sociopolitical and not purely economic in nature, dealing as it does with trade-offs and relations between a range of objectives and scarce resources. No uniform methodology exists to deal with such problems. It is customary to use social indicators in this context.

The next stage is to translate these social needs into the language of final consumption demand. In central planning systems practicable plans have to be specified at the aggregate macrolevel, at the sectoral level, and at the microlevel of

individual enterprises. This involves using procedures that include branchwise, regional, and problem-solving-oriented approaches. An important feature of this stage is related to the internalization of social objectives into sectoral goals. In general, quantification is easier here than at the first stage, although in linking motivations to sectoral goals, numerous and not always easily quantifiable aspects have to be considered. At this level the feasibility of certain plans over a given time horizon is considered. To what extent is it economically and socially possible to narrow the gap between needs and constraints? Technological considerations, related to gestation lags (or implementation cycles), also play an important role in formulating plans.

In stages 1 and 2 the question of who is involved in the decision-making process is essential. It is necessary for members of the working population to participate in defining the social needs and the ultimate pattern of use and distribution of the fruits of planning. Here a distinction must be made between the concept of central planning, seen in a wide societal context of participation, and that of planning at the central level of an administrative hierarchy, whereby the latter is just one element of the former.

The third stage in the long-term planning process involves evaluation of the plans. Here the monetary unit, although the most common means of measurement, is most inadequate. This is most evident in the evaluation of social phenomena--such as social change--and of social services. Even at the level of economic processes per se, e.g., production, it is still far from ideal. In a socialist economic system the enterprises are socioeconomic entities. The motivation and attitudes of people working in them certainly have sociopolitical implications and affect the planning process and the success of implementation. These shortcomings in measurement and evaluation lead to problems of communication between planning experts (using their special terminology) and representatives of society (reflecting sociopolitical considerations) and the working people whose motivation and collaboration are essential to the economic success of the enterprise [1]. However, given the fact that, at present, no other feasible mechanism exists, monetary units of measurement (prices) and synthetic indicators of performance (such as profit or value added) are widely used.

The final stage is to apply a mixture of different control rules to development processes. The mixture depends upon many factors such as the duration of a plan or the linkages that exist within sectors. For example, in the case of investment processes one can make the following rough distinctions:

- Long-term programs, with far-reaching implementation cycles and many interbranch implications, which are best tackled directly within the central planning framework;

- Adaptive investments, with shorter gestation periods, but still having interbranch repercussions--here, it is necessary to enrich central planning procedures with an ex ante consideration of expected future conditions;

- Intrabranch adaptive processes that can be regulated at the microlevel by means of economic instruments of control.

REFERENCE

[1] Bager, G., and A. Hajnal, "Organizational Aspects of Social Planning." In *Progress in Cybernetics and Systems Research*, R. Trappl and F. de Hanika (eds.), Hemisphere, Washington, D.C., 1975.

DISCUSSION

Klein asked the following questions: In centrally planned economies are long-term plans considered as an intellectual luxury? How do planners communicate with the government? Do governments understand the limitations of technology, methodology, etc.?

Porwit answered that plans are a necessity for all nonroutine decisions and that the problems of communication between the microlevel and macrolevel cause difficulties within long-term planning. The problems of communication indicate the need to improve the common language not only between experts and society but also within the planning body.

Nagy discussed another aspect of long-term planning. In the future the degree of freedom in planning will increase, but if the models are too specific, this freedom will be lost. Also if one cannot change the parameters, the plan will be devalued. Therefore the planning process has to be democratized.

Bell agreed that money indicators would eliminate many alternative possibilities from discussion. This situation could be observed in lesser developed countries at the present time. He felt that cost-benefit analysts often do not take into account important structural and other changes in the economy.

Mitra referred to the recommendations of the two principal works on the subject (UNIDO and OECD manuals), which recommended that accounting prices be derived from an aggregated macroeconomic planning model that took into consideration expected structural changes. The planning model was used to calculate shadow wage rates (SWR), accounting rates of interest (ARI), and other summary statistics, which would then allow a project authority to develop a system of accounting prices. This was the decentralization scheme underlying the manuals. It fell short of a

general equilibrium system, because planning at the project level often was not fed back to modify the centrally derived estimates of the SWR and ARI. The reason was not that cost-benefit analysts were insufficiently aware of the need to develop a consistent general equilibrium system, but that the informational and communication difficulties of implementing a feedback system were considerable. The fact that the summary statistics central to project evaluation had to be derived from perspective long-term planning models belied the notion that cost-benefit analysis ignored structural economic changes. He agreed that it was important to consider the appropriate domain of cost-benefit analysis, and hence to resist the temptation of using accounting prices to evaluate every alternative.

Porwit remarked that the use of accounting prices is quite relevant for resources and technology choices, whereas it would not allow for finding alternatives in objective patterns, e.g., needs could hardly be described by prices.

Arthur pointed out the difficulties that arise when hierarchically organized plans have to deal with structural changes. He suggested increased dialogue between the different planning levels.

Sheshinski observed that the decision-making rules appearing in the recent literature on planning and "second best" welfare economics were complicated, and their implementation required much information about the economy. He suggested the use of approximation models and sensitivity analysis to derive simple rules for decision making.

Mitra stated that the temptation to derive simple rules from models could lead to the overimplementation of these rules, and so Sheshinski's suggestion should be approached cautiously. Furthermore, the models used by economic theorists were deliberately chosen for their simplicity in order to isolate those issues adjudged to be important in a specific context. He doubted that rules derived from a further simplification of such models would prove useful in policy making.

Weiss mentioned that in the United States, for example, it was necessary for planners to balance conflicting interests represented by lobbies. He thought it would be interesting to discover what particular difficulties would arise from an attempt to implement a Ramsey-type tax rule.

Tardos said that a concern with optimizing decisions was probably not appropriate. Lobbies often distort accounting prices in their own interests. He felt that shadow prices and other theoretical prices had a weak statistical and scientific base.

II. INCENTIVE COMPATIBILITY PROBLEMS

DISTRIBUTIONAL CONSEQUENCES OF LONG-TERM PLANNING INSTRUMENTS

J.E. Stiglitz

GENERAL TAXONOMY

The interaction between various distributional instruments and their consequences can be analyzed within the framework of the following matrix.

	Direct allocations	Taxes + subsidies	Regula- tions	Incentive schemes
Sectoral distribution				
Factor distribution				
Producers versus consumers				
Locational consequences				
Individual size distribution				
Intertemporal distribution				

There are, of course, many linkages between the above distributions. For example, a taxation policy that has the effect of increasing equality today might affect the growth of the capital stock, and thus exert some influence on intergenerational distribution, so that individual size distribution may affect intertemporal distribution.

POSSIBLE RESEARCH AREAS

Sectoral Distribution: Between the Urban and Rural Sectors in Less Developed Countries (LDCs)

Here one might be faced with a problem of possible trade-offs between distributional and efficiency targets. This

problem has a long history in the literature. At first it was thought that the development of the urban manufacturing sector would be the motor force for growth. Later, the opposite view, the importance of developing the rural sector, became dominant. Depending on the model under consideration, different conclusions can be reached about the effect of sectoral distribution policies. Using one particular model it is claimed that there is no trade-off between efficiency and growth. The argument is that the capital stock in the rural sector is smaller than in the urban sector; thus it can be assumed that the marginal product of capital, being greater in the rural sector, would lead to both more growth and a greater degree of equality, since a distortion caused by imperfections in the capital market is being countered.

On the other hand, some economists maintain that there is a trade-off between growth and efficiency targets. By increasing rural income one would simply encourage more migration to urban centers, assuming that migration is positively related to the possession of capital, or the means to support oneself before finding a job in the urban sector. This aid to the rural sector would not promote efficiency--rural output would not increase--and it would have minimal effects on inequality, mainly an increase in unemployment in the urban sector. This view reflects the nature of the limited control on labor allocation between rural and urban sectors in LDCs.

Human Capital versus the Screening Theory of Education

There are two views about the function that education performs in society: it either increases productivity, or it serves to identify abilities (or both). In the case where the market provides imperfect information about individual abilities, and when this information is itself endogenous, then a screening view of education (as opposed to the human capital view) concludes that an equilibrium position is no longer Pareto optimal. It can be shown, under some specific conditions, that the net national income (net of the costs of screening) is lower as a result of screening, and y-distribution is more depressed, i.e., there is no trade-off between distributional and efficiency targets. However, these conditions are not fully explored in the literature, and one cannot determine whether this would be a normal or an exceptional case.

There are two types of screening: hierarchical screening, which attempts to differentiate total abilities; and comparative advantage screening, which identifies different individuals' comparative advantages. The latter raises the productivity of the economy by increasing the efficiency of resource allocation, while the former leads to greater inequality, but no improvement in allocation efficiency by allowing individuals to get their ability rents.

At this point one should note that in the case of education, social returns can differ widely from private returns; this is evident in some LDCs. If education is the criterion for employment, skilled labor will be appointed to jobs for which unskilled labor would have qualified, in the case where the number of workers exceed the jobs offered. Thus, the private demand for education is high, and the private return to education is not only positive, but increases as more education is supplied. However, the social return (increase to social product) is nil.

Evaluation of Public Projects

The question to be considered here is whether there is any economic argument for applying a particular discount rate in social cost-benefit analysis. Since the need for cost-benefit analysis arises precisely under circumstances in which markets are imperfect, and in which the government can exercise only a limited degree of control, the answer depends on the way those particular features are modeled. This point can be illustrated by referring to a simple model. (A detailed description of the model, together with a complete statement of results and proofs are to be found in Stiglitz, J.E., The Social Rate of Time Preference and the Rate of Discount for Cost Benefit Analysis, Mimeo, 1977.) Individuals live for two periods, having a wage, w^j, in the first period, saving the remainder, receiving an interest return of r on their investment, and consuming their capital (including interest) in the second period. If there is wage and capital taxation, w^j and r are post-tax returns. Individual welfare is represented by an indirect utility function, $u^j(w^j,r,I^j)$, giving utility as a function of the wage, the rate of interest, and any lump sum income (or tax) received.

Social welfare is represented by a Benthamite social welfare function, $W = \Sigma_t(\Sigma_j u_t^j)\frac{1}{(1+\delta)^t}$, where the subscript t represents the date at which the individual is born, and δ (>0) is a guaranteed discount factor. For simplicity, there is no population growth.

There is an aggregate production function, $Q_t = F(K_t^p, K_t^g, L_t)$, where

$$Q_t = C_t + \Delta K_t^p + \Delta K_t^g,$$

Q = aggregate output = sum of consumption (c) and investment ($\Delta K^p + \Delta K^g$),

K^p = private capital,

K^g = public capital,

L = aggregate labor,

$$F_1 = \frac{\partial \phi}{\partial K^p} \ , \ F^2 = \frac{\partial \phi}{\partial K^g} \ , \ F_3 = \frac{\partial \phi}{\partial L} \ .$$

Private capital and labor supplied will depend on individual decisions, i.e., on consumer prices and incomes. The amount of public capital supplied is constrained by the tax revenues of the government. The objective of the government is to find a set of taxes (or interest and wages) at each date, and a program of investment in the public good that is feasible and that maximizes social welfare.

This model can be used to argue that the relationships between the social rate of time discount, the rate of pure time preference, and the marginal product of capital in the private sector, depend on the distribution between workers and capitalists of the rents associated with the public capital good, and on the set of instruments available to the government. Thus, with lump sum taxation, it is clear that the social rate of discount (F_2) equals the marginal product of capital (F_1), i.e., productive efficiency is desirable. This conclusion no longer holds in the absence of lump sum taxation. Suppose that some of the public capital good augments the productivity of workers, while the rest is appropriated by capitalists. If the government has complete control over the set of indirect taxes imposed, it can be shown that in steady state the social rate of discount (F_2) equals the pure rate of social time preferences ($1 + \delta$). However, there will be indirect taxation on capital, and the marginal product of private capital (F_1) will not equal the social rate of discount (F_2), violating productive efficiency. If, however, we change the underlying distributional assumption, different conclusions follow. Suppose that capital and labor are paid their marginal products, but that, in addition there are rents accruing to the owner of firms. There is a market for the equity of firms, and the price of the equity must be adjusted so that the return from holding equity is just equal to the rent from owning capital. If the government cannot distinguish between pure equity (rents) and capital for tax purposes, then the social rate of discount (F_2) always lies between the pure rate of time discount ($1 + \delta$) and the private return to capital (F_i).

Uncertainty

The problem of uncertainty has been dealt with in the literature by means of two standard procedures:

- By applying a higher discount rate in the presence of uncertainty--the disadvantage of this method is that it confuses an intertemporal price with an uncertainty price;

- By using certainty equivalences, which would seem to be a correct approach--projects should be evaluated by using the certainty equivalent of a random pay-off tomorrow and then by discounting it at the social rate of discount.

Nature of Technological Change and Its Effect on the Structure of the Economy

The rate and direction of technical change show a number of characteristics that can be partly controlled by planning. Research can be viewed as an extreme value statistic; it is a search for better ways of doing things where, out of a large number of experiments, the only relevant one is the best. The mean rate of technical progress is related to the risk involved in the research: the higher the variance, i.e., risk, the faster the technical progress, but also the greater the variance of income, since individuals are richly rewarded for successful results. It can be argued that the market economy does not undertake research with a high level of risk, and therefore government policies should be devised to influence the situation and the resulting distribution of income.

Technical change may result in a greater minimum scale of output and a lower cost curve. This has implications for competition in the economy, for factor distribution, for further research and development (R&D) expenditure, and for the pace of innovation. The problem is to find an optimal degree of competition in the economy. With too much competition, profits would be low and too few resources could then be allocated to R&D. On the other hand, an economy characterized by a lack of competition generates no incentive for growth and consequently for expenditure on R&D. The degree of competition is itself an endogenous variable. The allocation of R&D resources requires a choice to be made between the market and the public sector, but the expediency of the choice can only be seen in retrospect. There is something to be said for a decentralization of research, despite the fact that competition may lead to a duplication of efforts. Given imperfect information, in order to be able to design an incentive scheme of payment, it is essential for more than one firm to undertake research. The payment scheme would then relate the rewards of a firm not only to its own success and costs, but also to the performance of competing firms.

DISCUSSION

Klein questioned the influence of education on the lifetime income stream. If one discounted future earnings to the present, it would become clear that to obtain a university education does not pay.

Stiglitz remarked that at present one could not observe a reduction in the number of university students, although he thought that a lagged response could be expected in this case, and one would have to wait and see if the number of applicants would fall in the future. On the other hand, he indicated that a university education could be viewed as a consumption good.

Dasgupta observed that in the early literature on cost-benefit analysis, one method of evaluating projects was to rank them according to their impact on different population groups.

Sheshinski added that different weights should be assigned separately to various income groups, after determining which population groups were benefiting from a specific project.

Turning to the issue of R&D as related to the degree of competition in an economy, Klein thought that the public authority could always provide funds to cover the difference between actual and optimal R&D, or alternatively firms could borrow the necessary funds on the capital market.

Dasgupta replied that not only the quantity but also the appropriateness of R&D expenditure must be taken into account. He added that only a monopoly position gives enough market power for R&D to be undertaken by the firm.

Sheshinski raised the subject of private versus public goods: on what grounds can a general theory be developed concerning goods that are best provided collectively? Economic analysis has so far provided no satisfactory answer to this problem.

Milleron asked about the kind of information required to advise a government on the choice of a discount rate for public investment. Mitra replied that in addition to knowledge of distributional weights, it was necessary to have an idea of the substitutability between private and government capital in production. He asked why formally the Diamond-Mirrlees production efficiency result was not valid. Stiglitz replied that in the Diamond-Mirrlees model all goods can be produced and "consumed" both by the private and public sectors. Here, the public capital good is only supplied by the public sector, the private capital good only by the private sector. There is no margin by which the government can, within its own sphere, trade off a unit of K^p directly for a unit of K^g.

INCENTIVE PROBLEMS IN ECONOMIC PLANNING: CASE STUDY OF A SOCIALIST COUNTRY--HUNGARY

M. Tardos

The purpose of this presentation is to summarize current discussions in Hungary about problems of long-term planning and its implementation. It will concentrate on the interaction between enterprises and the government in a socialist country.

Long-term planning is concerned with forecasting the future of a national economy. It is needed to deal with decisions whose effects have long gestation periods, e.g., investment decisions, and for the formulation of social objectives, e.g., income distribution. An important question in this context is the irreversibility of most investment decisions, e.g., infrastructure.

The basic characteristic pattern of a socialist economy is the lack of private capital. The means of production are owned by the state, complemented by cooperative ownership.

CENTRALIZED PLANNING

How are rational economic decisions made, given the hierarchical structure of the state and of the economy? In a strictly centralized economy, as was Hungary before 1968, the degree of centralization in decision making and the extent of detail in target setting for individual firms are important issues. The information flow between the central authorities and the enterprises is often far from optimal, leading to imperfect decision making. In a decentralized economy the government would restrict its activities to the setting of prices for central resources and to use of the taxation system. Shortcomings emerge in the two types of systems. Neither functions optimally, and it is difficult to decide which system is preferable. The differences between them emerge in the implementation of economic decisions.

INCENTIVE SYSTEM

In a centralized economy detailed targets are set for the enterprises, and all resources are allocated centrally. The enterprises are required to adapt to unexpected changes in the environment and to other difficulties relating to the fulfillment of targets.

To obtain satisfactory results two types of incentive systems are used: the bonus system for fulfillment of planning targets, and the bonus system for any decrease in wages and other factor inputs. The flaw in this system is that firms are tempted to understate their potential target figures to guarantee target fulfillment, and, in general, to avoid giving accurate information to the central planning body. To remedy this situation, it has been suggested that an incentive system rewarding increases in planning targets should be introduced.

Although the present incentive system is very detailed, it cannot hope to encompass all aspects of the enterprises' activities. In addition, the rigidity of these incentives does not lead to the efficient economic management of an enterprise, since little space remains for managers to manoeuvre and to adjust to environmental changes.

Economists have therefore proposed modifications to the present incentive system for target planning. The existing system is so complicated that no manager can take account of all its aspects, and decisions are usually based on simple rules, ignoring a large part of the incentive structure. Thus an even more comprehensive incentive system would not lead to better management practices.

DISADVANTAGES OF THE CENTRALIZED PLANNING SYSTEM

Although this type of system can often generate rapid growth, it has many drawbacks--the principal one being that efficiency is very low. Factor inputs are high, and adaptability to requirements on the demand side are suboptimal, for the following reasons:

- Environmental changes are very rapid.
- Forecasting of these changes is usually inaccurate.
- The static nature of target planning does not allow a smooth adaption to these changes.

POSSIBLE SOLUTIONS

Improvements in efficiency can be achieved by abolishing the system of centralized target planning, and by providing enterprises with more general targets. In the public services sector there is no need to dictate specific targets to the individual units, e.g., schools, hospitals, since their activities are well defined, and so each unit would be able to set its own targets.

In the competitive sector, on the other hand, general aims must be specified. The social goal would be to increase profit ability. It must not be ignored that profits do not give optimal guidance to decentralized units, but a better alternative system of success indicators does not exist. Adoption of the profitability aim, does not necessarily indicate that the government should not interfere in economic activities. Central guidance must be provided, but it must be of the same nature and to the same extent for all firms. Decentralized units should be given the prices, and they should then attempt to adapt their plans to maximize profits. State discrimination for or against enterprises, e.g., specific subsidies or exemptions, are to be avoided. If the government interferes to equalize profits, there exists the danger that firms will relax their efforts to improve performance, since lower than average profits make firms liable to government assistance.

The Hungarian experience shows that it is not sufficient to abolish target planning. An institutional reform is also necessary to abolish the hierarchical structure of decision making. A pluralistic system of decision making can be established without destroying the socialist economy. There would still be no private ownership of the means of production, but a system of "holding banks" would fulfill the function of capital ownership in the competitive sector.

Which activities should be carried out by the public sector and which by the competitive sector is not determined by economic factors alone but also by political and historic considerations. This question can be approached from an economic viewpoint in two ways:

- When changes in the environment are rapid, and forecasting is weak, the branches affected by these factors should be controlled by independent, autonomous units, e.g., industry, agricultural activities, and trade. In the public sector, on the other hand, the hierarchical system would not impede efficiency.

- Each social system can decide which basic products and services must be supplied to the public. These include goods and services whose provision and equal distribution is more important than efficiency, e.g., health, education. Furthermore, the government can always intervene in important areas of production, e.g., energy and raw materials production, where resources must be guaranteed for every consumer. In these activities, economies of scale are very important, thus it may be concluded that large, perhaps unique, organizations are optimal.

DISCUSSION

Sheshinski asked Tardos why he had included intermediate goods in the public sector, together with health and education. Only for education could one agree that, for equity reasons, the private sector might not be ideal. Tardos commented that equity considerations were not the only criteria; he then analyzed the public health system in Hungary, where the introduction of payments by patients to physicians may prove to be a better solution than the present illegal tipping. Dasgupta raised many points: First, he said in some cases the government may have to intervene to ensure the supply of certain commodities without actually producing them, production being left to the private sector. Secondly, he raised doubts about the use of "difficulty of forecasting" criteria for deciding on the allocation of goods to be produced either in the private or in the public sector. In agriculture one must ensure against excessive price fluctuations if the private system is to guarantee a desired output. Thirdly, he agreed with Tardos that investment in the infrastructure was better left to the public sector where capacity can best be expanded in certain discrete units, because of the importance of increasing returns to scale. In this case prices are not a very useful mechanism for the allocation of investment. Also, since substitution possibilities are limited, and perfect foresight is impossible to achieve, prices may not be the best means of solving structural uncertainty problems, and there is a bias towards the use of quantity controls. Fourthly, administrative rather than equity considerations may play a role in the provision of certain basic services by the public sector, e.g., inoculation. Lastly, Dasgupta mentioned two theoretical views about the irreversibility of investment decisions, leading to the centralization of decision making: if one relies on the price system when making planning decisions, there will be a tendency to overinvest if one tries to reach an optimum position; owing to uncertainty, and if the investor is risk neutral, the effects of price system might result in overinvestment, in the sense that one cannot reverse investment decisions, and thus, flexibility may be lost.

Bell raised the question of how coordination between the competitive and socialist sectors can be achieved, since some Keynesian unemployment of labor might result from such a system. He asked whether nominal prices are really fixed. If they are fixed, the government might resort either to giving quantity instructions, or to buying the output in order to insure sufficient effective demand.

Tardos responded to Dasgupta's questions by saying that the models of incentives do not deal with effort in a satisfactory manner; he agreed that in agriculture, where uncertainty of income may be very great, some equalization of income should be introduced. A system of minimum pricing in a market type of organization may prove to be a satisfactory solution. Tardos

agreed with Bell that some Keynesian type of regulation may be necessary. The government is better able to carry out anticyclical policies in a socialist than in a market economy.

Klein asked how prices were determined in a centrally planned economy, and how overall levels of growth, capital formulation, and other aggregate decisions were coordinated with planning at the microlevel. Tardos commented that there is a need for a freer system of pricing in Hungary, i.e., the use of market feedback, but that the prices of some commodities should still be centrally determined.

Klein then inquired whether the decision maker at the enterprise level had access to loans, to which Tardos replied positively: loans, based on profitability criteria, were provided by the national bank. In practice, however, state preference is a decisive factor in the allocation of funds, and profit does not always play the dominant role. Hungary, he added, is at present in a far from optimal situation with regard to capital and labor markets. An improvement could be made by establishing a labor market where wage increases are not determined by profits only, and also by reforming the capital market so that it is more responsive to the criterion of expected profits.

Mitra also referred to the criteria that can be used to determine whether goods should be produced in the private or public sectors. The analysis by Weitzman--to which Dasgupta had drawn attention in his presentation--showed the conditions for the relative superiority of price-guided decentralization and various quantity controls. These conditions applied when all members of a team had quadratic preferences. He wondered if better performance of price versus quantity signals could be made to correspond to the private versus public sector distinction. Dasgupta said that if the net-benefit schedule has a threshold, then prices are not very reliable. Mitra suggested that the equity objective, which is often used as an argument for governmental intervention, should be formally incorporated into an analysis of the efficacy of the price mechanism as against quantity rationing and other non-linear policies. Sheshinski thought that another criterion might be the heterogeneity of tastes or talents, e.g., musical talents, as opposed to minimum basic needs (in health, and partly in education). Augustinovics agreed that basic needs do exist, and that equity considerations do play a role in the noncompetitive sector.

Tardos added that economic rationality is not the only criterion but that different societies could decide on what they considered to be basic needs, which should be provided by the public sector. Ethical considerations play some role here, Sheshinski responded by saying that conceptions of what constitute basic needs do not vary among countries with differing political systems. He then asked if the distribution of income in socialist countries was moving towards more equality.

Tardos replied that there was no need to reduce the range of income distribution to improve the situation. With the given income distribution one could attain more efficiency by removing certain contradictions, e.g., between effort and income, and by increasing the number of small production and trade units, so that shortages in production, i.e., demand exceeding supply, could be overcome. "Black" markets could then be eliminated. He said that "black" and "grey" markets do affect income distribution, although the extent of their influence is statistically immeasurable. He added that, in his view, it would be incorrect to increase income differentials, but he thought that a decline in wage and salary differentials would not occur in the near future. At the moment, the issue of efficiency had higher priority, and social aims could be reached with the given income distribution.

Klein asked about the time perspective over which managers tried to maximize their profits. He also inquired about the criteria that a firm would use to decide whether they should introduce a new line of products, and whether they could afford to take risks. Finally, he asked how the mechanism was used to distribute capital gains.

Tardos answered that an enterprise making losses could now always count on more government subsidies and support. Firms that wanted to introduce new products would also have to ask for support from the central authorities. He then answered the question of reallocation of profits by saying that "holding banks of conglomerates" should be established to reallocate funds on the basis of expected profit.

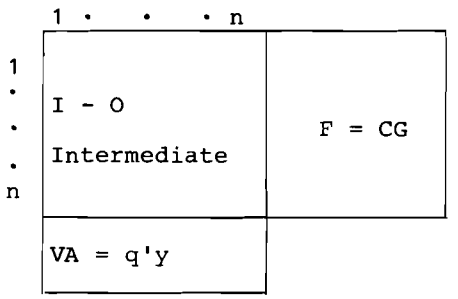
III. FORECASTING MODELS

DEMAND FORECASTING AND CAPACITY CREATION IN THE PRIVATE SECTOR I

L. Klein

This paper describes the Wharton Annual and Industry Forecasting Model, a long-term model for the United States that is also applicable to other industrialized Western countries, e.g., Canada and the UK. It is being used both by the public and private sectors in the United States and by multinational organizations. It is a large Keynes-Leontief-type model containing more than a thousand equations.

Its formal structure can be represented as follows:



$$(I-A)X = F$$

$$X = BY$$

$$F = CG$$

$$(I-A)BY = CG$$

$$Y = B^{-1}(I-A)^{-1}CG \qquad \text{output conversion}$$

$$q'Y = r'G$$

$$q'Y = q'BX$$

$$q'B^{-1}(I-A)^{-1}CG = r'G \qquad \text{price conversion (value added→final demand)}$$

$$q'B^{-1}X = p'(I-A')X \qquad \text{price conversion (gross output→value added)}$$

where

I = unit matrix

A = matrix of intermediate input-output coefficients

X = gross output

Y = real value added

B = diagonal transformation matrix transforming Y into X

F = final demand

G = vector of components of gross national product (GNP)

C = rectangular matrix relating G to F

r' = price of final demand goods

p' = gross output price, determined as a markup of unit factor costs

q' = value-added price

VA = value added = CG (given reconciling items)

In the U.S. model, the intermediate input-output is an $n \times n$ matrix, with about 25 manufacturing sectors (two-digit system) and about 25 nonmanufacturing sectors defined, e.g., energy is subdivided into electricity, gas, coal, etc. The GNP is then equal to the row sum of all the columns in F (or the column sum of rows in VA). Another alternative for the Keynes-Leontief model would be a general equilibrium model. The Keynes and Leontief models combined represent a production→income→expenditure circular flow system, where the macromodel cannot be without the Leontief intermediate flows, and the intermediate flows (or the industrial low position of output) cannot be solved without the final demand flows.

The market variables in the model are prices (which are market clearing), wages (which establish balance in the labor market), and interest rates (which clear the securities and money markets).

There are two problems in the model:

- the row problem--to convert from GNP accounts to X and Y;

- the column problem--to convert from p to q to r.

The system is dynamic, with the equations of final demand depending on distributed lags. To project the system to the year 2000, a forecast with continuing 10-year periods was first attempted. A feedback system was established by periodically inviting model users, representing different sectors, to comment on the performance of the model and to present their own projection. A 10-year period was seen to be too short for solving some problems, and a stretch of 25 years was estimated to be more appropriate for policy recommendations dealing with energy and related problems.

To determine inputs for the long-term system, many models have been used separately but simultaneously: models of different sectors, cities, states, and global models. A short-term business-cycle model was run on a detailed basis, taking into consideration government monetary and fiscal policies. Exogenous inputs were set for the first 3 years, on an annual basis, to reproduce short-run business-cycle results from a quarterly model.

In order to make long-term planning projections, two methods were used. The first was the "cut and try" technique, where projections are made on the basis of trends in government spending, tax systems, monetary policies, and world trade estimates. A von Neumann property is adhered to whereby the real growth rate should be equal to the real interest rate. One adjusts the exogenous inputs, on the basis of changing trade accounts and inflation rates until the desired composition of real growth and interest rates is reached. The second method was the optimal control technique where one optimizes over the solution horizon. Policy instruments are selected that bring the solution to a minimum deviation from desired targets. This selection of instruments determines the values of exogenous variables in some important cases.

The model is used as a basic, live scenario. At the request of users (public or private), alternative policies can be introduced into it, and the simulation can be performed again. Convenient computer programs that can be rapidly processed have been developed to make these projections.

In the public sector, the model is used, together with others, as an aid to policymaking, but the models are not automatically or solely relied upon in the process of policy formation. The private sector also makes use of this model.

Tables of the results of the forecasting model for the U.S. economy follow at the end of this paper. Table 1 (selected indicators) presents a quick overview of the U.S. economy up to the year 2001: GNP at current (1978) and 1972 dollars, population, labor force, GNP deflator, etc. Some basic ratios are expected to remain stable, e.g., the labor share in the national income remains at approximately 75%.

Table 2 gives the breakdown of GNP into personal consumption expenditures, gross private domestic investment, net exports of goods, services and government expenditures in current (1978) dollars and in 1972 dollars. A GNP growth rate, at constant prices, of around 3% is projected for the period 1977-2001 being slightly higher (~4%) in the first period until 1980. The average inflation rate over the period is estimated at 4.5%, the unemployment rate is projected to fall from its present level to about 4-5%.

Tables 3 and 4 present the growth rates of fixed investment and capital stock, respectively.

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 1. SELECTED INDICATORS

LINE	VAR	LABEL		ITEM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	GNP$		I	GROSS NATIONAL PRODUCT (CUR $)--------	1887,1	2081,8	2286,8	2518,5	2770,2	3036,5	3330,0	3638,3	3954,5	4281,4
2	GNP$		I	% CHANGE---	10,6	10,3	9,8	10,2	10,0	9,6	9,7	9,3	8,7	8,3
3														
4	GNP		I	GROSS NATIONAL PRODUCT (72 $)---------	1335,9	1391,1	1445,5	1500,6	1552,2	1598,8	1655,8	1713,8	1765,1	1813,9
5	GNP		I	% CHANGE---	4,8	4,1	3,9	3,8	3,4	3,0	3,6	3,5	3,0	2,8
6														
7	PDGNP		I	GROSS NAT. PROD. DEFL. (1972=100.0)---	141,3	149,7	158,2	167,8	178,5	189,9	201,1	212,3	224,0	236,0
8	PDGNP		I	% CHANGE---	5,5	5,9	5,7	6,1	6,3	6,4	5,9	5,6	5,5	5,4
9														
10	NPT		E	POPULATION (MILLIONS)----------	216,60	217,99	219,33	220,73	222,28	223,93	225,61	227,26	228,88	230,46
11	NPT		E	% CHANGE---	0,7	0,6	0,6	0,6	0,7	0,7	0,7	0,7	0,7	0,7
12														
13	NLC		I	LABOR FORCE (MILLIONS)----------	97,25	99,38	101,33	103,38	104,95	106,48	108,04	109,54	111,03	112,56
14	NLC		I	% CHANGE---	2,6	2,2	2,0	2,0	1,5	1,5	1,5	1,4	1,4	1,4
15														
16	NLC/NPC16+			PARTICIPATION RATE----------	61,3	61,7	62,0	62,3	62,5	62,7	63,0	63,5	63,6	63,8
17	NLC/NPC16+			% CHANGE---	1,0	0,6	0,5	0,6	0,3	0,4	0,5	0,4	0,4	0,4
18														
19	NEHT#			EMPLOYMENT (MILLIONS)----------	90,37	92,66	94,92	96,97	98,98	100,70	102,46	104,22	105,86	107,35
20	NEHT#			% CHANGE---	3,3	2,5	2,4	2,2	2,1	1,7	1,7	1,7	1,6	1,4
21														
22	WRCS		I	WAGE RATE - ALL INDUSTRIES (PER WEEK)-	245,55	263,77	281,82	304,83	328,44	383,59	380,12	408,51	437,65	468,04
23	WRCS		I	% CHANGE---	7,8	7,4	6,8	8,1	7,9	7,7	7,5	7,5	7,1	6,9
24														
25	GNP/NEHT			PRODUCTIVTIY - ALL INDUSTRIES---------	14,783	15,013	15,228	15,475	15,682	15,876	16,160	16,443	16,674	16,896
26	GNP/NEHT			% CHANGE---	1,5	1,6	1,4	1,6	1,3	1,2	1,8	1,8	1,4	1,3
27														
28	XMF/NEETIMF			PRODUCTIVITY - MANUFACTURING----------	16,570	17,245	17,698	18,156	18,543	18,887	19,354	19,766	20,092	20,418
29	XMF/NEETIMF			% CHANGE---	3,0	4,1	2,6	2,6	2,1	1,9	2,5	2,1	1,6	1,6
30														
31	GNP/NPT			REAL PER CAPITA GNP (THOU 72 $)-------	6,167	6,382	6,590	6,798	6,983	7,140	7,339	7,541	7,712	7,871
32	GNP/NPT			% CHANGE---	4,1	3,5	3,3	3,2	2,7	2,2	2,8	2,7	2,3	2,1
33														
34	YPD/NPT			REAL PER CAPITA DISPOSABLE INCOME-----	4,281	4,440	4,598	4,733	4,810	4,901	5,021	5,158	5,265	5,365
35	YPD/NPT			% CHANGE---	3,4	3,7	3,6	2,9	1,6	1,9	2,4	2,7	2,1	2,3
36														
37	CPUBT$		I	CORPORATE PROFITS BEFORE TAXES (CUR $)	175,6	196,8	211,6	236,8	269,3	300,3	332,9	361,8	392,2	418,5
38	CPUBT$		I	% CHANGE---	12,0	12,1	7,5	11,9	13,8	11,5	10,8	8,7	8,4	6,7
39														
40	FRMCS		B	BOND RATE (%)----------	8,41	8,49	8,72	9,28	9,70	9,73	9,37	8,92	8,53	8,27
41	FRMCP4M		B	PRIME COMMERCIAL PAPER RATE (%)-------	5,65	7,17	7,87	7,73	7,92	7,56	6,94	6,97	6,98	7,05
42	FM4$		I	MONEY SUPPLY----------	874,6	962,2	1019,2	1129,3	1240,5	1359,1	1490,4	1629,0	1772,2	1920,7
43	FM4$		I	% CHANGE---	9,0	7,7	8,2	10,8	9,8	9,6	9,7	9,3	8,8	8,4
44														
45	NRUT		I	UNEMPLOYMENT RATE (%)----------	7,08	6,76	6,32	6,20	5,69	5,42	5,16	4,85	4,66	4,63
46	YPDSAVR		I	SAVINGS RATE (%)----------	5,19	5,73	6,21	6,84	6,24	5,65	5,54	5,51	5,39	5,40
47														
48	GVSURPF$		I	SURPLUS OR DEFICIT, FEDERAL (CUR $)---	-49,4	-56,1	-68,3	-56,6	-32,5	-22,8	-14,0	-7,6	8,6	15,1
49	GVSURPS$		I	SURPLUS OR DEF., STATE & LOC (CUR $)--	27,7	27,9	31,3	34,2	32,6	32,3	37,0	41,7	39,7	33,0
50														
51	WBC$/YN$			COMPEN. TO EMPLOYEES TO NAT. INCOME---	75,9	75,5	75,4	75,4	75,2	75,1	74,8	74,8	74,9	75,0
52	CPOBT$/YN$			PROFITS TO NATIONAL INCOME----------	11,5	11,7	11,5	11,6	12,0	12,2	12,3	12,2	12,2	12,0

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 1. SELECTED INDICATORS

LINE	VAR LABEL		ITEM	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	GNP$	I	GROSS NATIONAL PRODUCT (CUR $)--------	4641.5	5037.0	5474.9	5939.9	6463.3	7022.1	7614.5	8226.6	8916.3	9684.2
2	GNP$	I	% CHANGE---	8.4	8.5	8.7	8.5	8.8	8.6	8.4	8.0	8.4	8.6
3													
4	GNP	I	GROSS NATIONAL PRODUCT (72 $)---------	1864.7	1921.2	1983.7	2044.5	2115.5	2184.5	2250.8	2310.0	2378.6	2455.3
5	GNP	I	% CHANGE---	2.8	3.0	3.3	3.1	3.5	3.3	3.0	2.6	3.0	3.2
6													
7	PDGNP	I	GROSS NAT. PROD. DEFL. (1972=100.0)---	248.9	262.2	276.0	290.5	305.5	321.4	338.3	356.1	374.9	394.4
8	PDGNP	I	% CHANGE---	5.5	5.3	5.3	5.3	5.2	5.2	5.2	5.3	5.3	5.2
9													
10	NPT	E	POPULATION (MILLIONS)----------	232.00	233.48	234.90	236.27	237.56	238.77	239.92	240.98	241.97	242.89
11	NPT	E	% CHANGE---	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4
12													
13	NLC	I	LABOR FORCE (MILLIONS)----------	114.15	115.80	117.48	119.19	120.94	122.72	124.55	126.46	128.43	130.48
14	NLC	I	% CHANGE---	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.6	1.6
15													
16	NLC/NPC16+		PARTICIPATION RATE----------	64.1	64.3	64.6	64.8	65.0	65.2	65.4	65.6	65.9	66.1
17	NLC/NPC16+		% CHANGE---	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3
18													
19	NEMT@		EMPLOYMENT (MILLIONS)----------	108.93	110.45	112.11	113.76	115.55	117.36	119.14	120.88	122.66	124.52
20	NEMT@		% CHANGE---	1.5	1.4	1.5	1.5	1.6	1.6	1.5	1.4	1.5	1.5
21													
22	WRC$	I	WAGE RATE - ALL INDUSTRIES (PER WEEK)-	500.78	536.02	573.98	614.30	657.68	703.71	752.58	803.65	859.02	918.23
23	WRC$	I	% CHANGE---	7.0	7.0	7.1	7.0	7.1	7.0	6.9	6.8	6.9	6.9
24													
25	GNP/NEMT		PRODUCTIVITY - ALL INDUSTRIES---------	17.119	17.394	17.695	17.972	18.309	18.615	18.891	19.114	19.391	19.718
26	GNP/NEMT		% CHANGE---	1.3	1.6	1.7	1.6	1.9	1.7	1.5	1.2	1.4	1.7
27													
28	XMF/NEFTIMF		PRODUCTIVITY - MANUFACTURING----------	20.769	21.161	21.592	21.978	22.468	22.910	23.333	23.720	24.242	24.821
29	XMF/NEFTIMF		% CHANGE---	1.7	1.9	2.0	1.8	2.2	2.0	1.8	1.7	2.2	2.4
30													
31	GNP/NPT		REAL PER CAPITA GNP (THOU 72 $)-------	8.037	8.228	8.445	8.653	8.905	9.149	9.381	9.586	9.830	10.109
32	GNP/NPT		% CHANGE---	2.1	2.4	2.6	2.5	2.9	2.7	2.5	2.2	2.5	2.8
33													
34	YPD/NPT		REAL PER CAPITA DISPOSABLE INCOME-----	5.485	5.609	5.754	5.924	6.089	6.252	6.413	6.563	6.730	6.943
35	YPD/NPT		% CHANGE---	1.9	2.3	2.6	2.9	2.8	2.7	2.6	2.3	2.5	3.2
36													
37	CPUBT$	I	CORPORATE PROFITS BEFORE TAXES (CUR $)	449.7	490.4	538.7	579.5	640.7	702.1	756.6	795.6	862.3	958.7
38	CPUBT$	I	% CHANGE---	7.5	9.0	9.9	7.6	10.6	9.6	7.8	5.2	8.4	11.2
39													
40	FRMCS	B	BOND RATE (%)-------------------------	8.27	8.12	8.01	7.88	7.74	7.72	7.70	7.67	7.66	7.57
41	FRMCP4N	B	PRIME COMMERCIAL PAPER RATE (%)-------	7.05	7.05	7.04	6.98	6.88	6.78	6.68	6.67	6.67	6.67
42	FM4$	I	MONEY SUPPLY--------------------------	2085.5	2258.7	2451.2	2671.3	2913.0	3177.9	3461.5	3758.1	4061.5	4398.8
43	FM+$	I	% CHANGE---	8.6	8.3	8.5	9.0	9.0	9.1	8.9	8.6	8.1	8.3
44													
45	WRUT	I	UNEMPLOYMENT RATE (%)-----------------	4.58	4.62	4.57	4.56	4.46	4.37	4.38	4.43	4.49	4.57
46	YPDSAVR	I	SAVINGS RATE (%)----------------------	5.35	5.34	5.50	5.88	5.92	5.95	6.00	5.98	6.11	6.56
47													
48	GVSURPF$	I	SURPLUS OR DEFICIT, FEDERAL (CUR $)---	15.0	15.4	14.6	4.0	12.3	17.9	15.5	13.5	5.3	-1.2
49	GVSURPS$	I	SURPLUS OR DEF., STATE & LOC (CUR $)--	34.9	32.6	34.7	29.0	31.8	39.1	47.2	50.5	68.2	68.9
50													
51	WBC$/YN$		COMPEN. TO EMPLOYEES TO NAT. INCOME---	75.3	75.4	75.4	75.6	75.5	75.5	75.7	76.1	76.2	76.0
52	CPUBT$/YN$		PROFITS TO NATIONAL INCOME------------	11.9	12.0	12.1	12.0	12.2	12.4	12.3	12.0	12.0	12.1

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN, 1978

TABLE 1. SELECTED INDICATORS

LINE	VAR LABEL		I T E M	1997	1998	1999	2000	2001
1	GNP$	I	GROSS NATIONAL PRODUCT (CUR $)--------	10509,6	11388,9	12334,2	13360,3	14471,2
2	GNP$	I	% CHANGE---	8,5	8,4	8,3	8,3	8,3
3								
4	GNP	I	GROSS NATIONAL PRODUCT (72 $)---------	2532,3	2607,8	2684,9	2765,6	2850,0
5	GNP	I	% CHANGE---	3,1	3,0	3,0	3,0	3,1
6								
7	PDGNP	I	GROSS NAT. PROD. DEFL. (1972=100,0)---	415,0	436,7	459,8	483,1	507,8
8	PDGNP	I	% CHANGE---	5,2	5,2	5,2	5,2	5,1
9								
10	NPT	E	POPULATION (MILLIONS)----------	243,73	244,50	245,22	245,88	246,54
11	NPT	E	% CHANGE---	0,3	0,3	0,3	0,3	0,3
12								
13	NLC	I	LABOR FORCE (MILLIONS)----------	132,58	134,78	136,95	139,22	141,57
14	NLC	I	% CHANGE---	1,6	1,6	1,6	1,7	1,7
15								
16	NLC/NPC16+		PARTICIPATION RATE----------	66,3	66,5	66,6	66,8	67,0
17	NLC/NPC16+		% CHANGE---	0,3	0,3	0,3	0,3	0,3
18								
19	NEMT+		EMPLOYMENT (MILLIONS)----------	126,47	128,41	130,37	132,39	134,49
20	NEMT+		% CHANGE---	1,6	1,5	1,5	1,6	1,6
21								
22	WRC$	I	WAGE RATE - ALL INDUSTRIES (PER WEEK)-	980,76	1046,69	1116,30	1189,93	1267,58
23	WRC$	I	% CHANGE---	6,8	6,7	6,7	6,6	6,5
24								
25	GNP/NEMT		PRODUCTIVITY - ALL INDUSTRIES---------	20,023	20,308	20,595	20,890	21,191
26	GNP/NEMT		% CHANGE---	1,5	1,4	1,4	1,4	1,4
27								
28	XMF/NEETIMF		PRODUCTIVITY - MANUFACTURING----------	25,374	25,909	26,471	27,061	27,671
29	XMF/NEETIMF		% CHANGE---	2,2	2,1	2,2	2,2	2,3
30								
31	GNP/NPT		REAL PER CAPITA GNP (THOU 72 $)--------	10,390	10,666	10,949	11,248	11,560
32	GNP/NPT		% CHANGE---	2,8	2,7	2,7	2,7	2,8
33								
34	YPD/NPT		REAL PER CAPITA DISPOSABLE INCOME-----	7,143	7,339	7,549	7,774	8,004
35	YPD/NPT		% CHANGE---	2,9	2,7	2,9	3,0	3,0
36								
37	CPUBT$	I	CORPORATE PROFITS BEFORE TAXES (CUR $)	1068,1	1187,4	1309,1	1448,3	1601,2
38	CPUBT$	I	% CHANGE---	11,4	11,2	10,2	10,6	10,7
39								
40	FRMCS	B	BOND RATE (%)----------	7,56	7,56	7,55	7,55	7,54
41	FRMCP4M	B	PRIME COMMERCIAL PAPER RATE (%)--------	6,67	6,66	6,66	6,65	6,65
42	FM4$	I	MONEY SUPPLY----------	4776,2	5174,9	5602,8	6068,6	6568,0
43	FM4$	I	% CHANGE---	8,6	8,3	8,3	8,3	8,2
44								
45	NRUT	I	UNEMPLOYMENT RATE (%)----------	4,61	4,70	4,81	4,91	5,00
46	YPDSSVR	I	SAVINGS RATE (%)----------	6,78	6,87	7,06	7,31	7,52
47								
48	GVSURPF$	I	SURPLUS OR DEFICIT, FEDERAL (CUR $)---	6,2	9,9	11,0	9,1	5,7
49	GVSURPS$	I	SURPLUS OR DEF., STATE & LOC. (CUR $)--	64,0	60,4	58,2	50,9	56,2
50								
51	WBC$/YN$		COMPEN. TO EMPLOYEES TO NAT. INCOME---	75,8	75,7	75,4	75,4	75,2
52	CPUBT$/YN$		PROFITS TO NATIONAL INCOME----------	12,6	12,9	13,1	13,3	13,6

Source: Wharton EFA Inc., 4025 Chestnut St., Philadelphia, PA 19104, USA.

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 2. GROSS NATIONAL PRODUCT (CURRENT AND 72$)

LINE	VAR LABEL	ITEM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1													
2		----------CURRENT DOLLARS----------											
3													
4	GNP$	GROSS NATIONAL PRODUCT----------	1887,1	2081,8	2286,4	2518,5	2770,2	3036,5	3330,0	3638,3	3954,5	4281,4	4641,5
5	GNP$	% CHANGE-	10,6	10,3	9,8	10,2	10,0	9,6	9,7	9,3	8,7	8,3	8,4
6													
7	CE$	PERSONAL CONSUMPTION EXPENDITURES---	1207,6	1322,1	1443,4	1569,1	1712,6	1876,8	2048,7	2235,4	2425,8	2631,8	2846,0
8	CE$	% CHANGE-	10,4	9,5	9,2	8,7	9,1	9,6	9,2	9,1	8,5	8,5	8,1
9													
10	CED$	DURABLE GOODS----------	179,3	194,3	209,5	222,6	239,8	261,3	284,6	310,7	332,5	357,1	379,1
11	CED$	% CHANGE-	12,8	8,4	7,8	6,2	7,7	8,9	8,9	9,2	7,0	7,4	6,2
12													
13	CEN$	NONDURABLE GOODS----------	476,3	512,3	555,5	600,0	651,6	709,8	763,7	820,1	878,9	941,5	1008,1
14	CEN$	% CHANGE-	7,6	7,6	8,4	8,0	8,6	8,9	7,6	7,4	7,2	7,1	7,1
15													
16	CES$	SERVICES----------	552,0	615,5	678,3	746,5	821,1	906,1	1000,4	1104,6	1214,4	1333,2	1458,9
17	CES$	% CHANGE-	12,1	11,5	10,2	10,0	10,0	10,3	10,4	10,4	9,9	9,8	9,4
18													
19	IBT$	GROSS PRIVATE DOMESTIC INVESTMENT---	293,5	334,1	365,3	424,7	483,6	528,8	582,1	642,0	697,5	758,1	826,1
20	IBT$	% CHANGE-	20,6	13,8	9,4	16,3	13,8	8,5	10,9	10,3	8,6	8,1	9,5
21													
22	IBF$	FIXED INVESTMENT----------	276,5	316,5	346,7	405,5	462,9	503,2	554,9	611,3	665,4	721,2	792,1
23	IBF$	% CHANGE-	20,2	14,5	9,5	16,9	14,2	8,7	10,3	10,2	8,9	8,4	9,8
24													
25	IBFN$	NONRESIDENTIAL----------	186,0	219,4	255,7	284,6	319,1	354,7	392,0	431,6	473,8	517,9	569,8
26	IBFN$	% CHANGE-	14,9	17,9	16,6	11,3	12,1	11,1	10,5	10,1	9,8	9,3	10,0
27													
28	IBFR$	RESIDENTIAL STRUCTURES----------	90,5	97,1	91,0	120,9	143,8	148,5	162,9	179,7	191,6	203,3	222,3
29	IBFR$	% CHANGE-	33,0	7,3	-6,3	32,8	19,0	3,3	9,7	10,3	6,6	6,1	9,3
30													
31	IBIT$	CHANGE IN BUSINESS INVENTORIES-----	17,0	17,5	18,6	19,3	20,6	21,6	27,1	30,7	32,0	32,9	34,0
32													
33	IBB$	NET EXPORTS OF GOODS AND SERVICES---	-11,2	-16,1	-6,8	-5,5	-8,7	-5,5	-0,1	0,4	6,2	1,7	1,5
34													
35	IEB$	EXPORTS----------	175,3	194,1	227,8	256,0	288,7	323,5	362,3	402,8	451,9	494,4	545,5
36	IEB$	% CHANGE-	7,6	10,7	17,4	12,4	12,8	12,0	12,0	11,1	12,3	9,4	10,3
37													
38	IMB$	IMPORTS----------	186,5	210,1	234,6	261,5	297,4	328,9	362,4	402,1	445,7	492,7	544,0
39	IMB$	% CHANGE-	20,3	12,7	11,6	11,5	13,7	10,6	10,2	11,0	10,8	10,5	10,4
40													
41	GVPT$	GOV. PURCHASES OF GOODS AND SERVICES	397,1	441,7	484,5	530,2	582,8	640,3	699,2	760,5	825,1	893,8	967,8
42	GVPT$	% CHANGE-	9,9	11,2	9,7	9,4	9,9	9,9	9,2	8,8	8,5	8,3	8,3
43													
44	GVPF$	FEDERAL----------	187,3	166,6	188,3	199,8	218,8	238,3	258,3	278,5	299,8	322,1	345,6
45	GVPF$	% CHANGE-	13,2	13,1	10,0	8,6	9,6	9,3	8,4	7,8	7,6	7,5	7,3
46													
47	GVPS$	STATE AND LOCAL----------	249,8	275,2	301,2	331,2	364,8	402,0	440,9	482,0	525,3	571,7	622,2
48	GVPS$	% CHANGE-	8,1	10,1	9,5	9,9	10,1	10,2	9,7	9,3	9,0	8,8	8,8

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 2. GROSS NATIONAL PRODUCT (CURRENT AND 72$)

LINE	VAR	LABEL	ITEM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1														
2			--------CONSTANT 72 DOLLARS--------											
3														
4	GNP$	I	GROSS NATIONAL PRODUCT----------	1335,9	1391,1	1445,5	1500,6	1552,2	1598,8	1655,8	1713,8	1765,1	1813,9	1864,7
5	GNP$	I	% CHANGE-	0,8	4,1	3,9	3,8	3,4	3,0	3,6	3,5	3,0	2,8	2,8
6														
7	CE$	I	PERSONAL CONSUMPTION EXPENDITURES---	857,6	889,3	922,0	948,7	977,6	1010,5	1044,7	1082,1	1114,6	1148,5	1178,9
8	CE$	I	% CHANGE-	4,4	3,7	3,7	2,9	3,0	3,4	3,4	3,6	3,0	3,0	2,6
9														
10	CED$	I	DURABLE GOODS----------	137,7	145,4	152,2	156,0	161,1	167,0	174,0	181,8	186,4	191,7	194,8
11	CED$	I	% CHANGE-	8,0	5,6	4,7	2,5	3,3	3,7	4,1	4,5	2,5	2,8	1,6
12														
13	CEN$	I	NONDURABLE GOODS----------	330,2	338,1	349,9	358,8	367,9	378,4	386,9	395,8	403,7	412,0	419,7
14	CEN$	I	% CHANGE-	2,7	2,4	3,5	2,5	2,6	2,9	2,2	2,3	2,0	2,1	1,9
15														
16	CES$	I	SERVICES----------	389,7	405,8	419,9	434,0	448,7	465,1	483,8	504,5	524,5	544,8	564,4
17	CES$	I	% CHANGE-	4,7	4,1	3,5	3,4	3,4	3,7	4,0	4,3	4,0	3,9	3,6
18														
19	IBT$	I	GROSS PRIVATE DOMESTIC INVESTMENT---	196,4	208,1	214,0	233,1	248,3	252,2	263,6	274,8	282,1	288,8	298,5
20	IBT$	I	% CHANGE-	13,6	5,9	2,8	9,0	6,5	1,6	4,5	4,2	2,7	2,2	3,5
21														
22	IBF$	I	FIXED INVESTMENT----------	184,3	196,2	202,1	221,5	236,6	240,6	249,8	260,0	267,8	274,0	284,4
23	IBF$	I	% CHANGE-	12,0	6,5	3,0	9,6	6,8	1,7	3,8	4,1	2,9	2,5	3,8
24														
25	IBFN$	I	NONRESIDENTIAL----------	127,5	140,5	153,5	161,0	169,1	175,2	182,5	190,1	197,4	204,1	212,5
26	IBFN$	I	% CHANGE-	9,2	10,2	9,2	4,9	5,0	3,6	4,1	4,2	3,8	3,4	4,1
27														
28	IBFR$	I	RESIDENTIAL STRUCTURES----------	56,8	55,7	48,6	60,5	67,5	65,4	67,4	69,8	70,0	69,9	71,9
29	IBFR$	I	% CHANGE-	19,0	-1,8	-12,8	24,4	11,6	-3,1	3,0	3,7	0,3	-0,2	2,8
30														
31	IBIT$	I	CHANGE IN BUSINESS INVENTORIES-----	12,1	11,9	11,9	11,6	11,7	11,6	13,8	14,8	14,7	14,4	14,1
32														
33	TB$	I	NET EXPORTS OF GOODS AND SERVICES---	9,5	8,7	14,8	14,5	16,1	18,0	21,1	21,9	24,7	24,3	25,2
34														
35	TE$	I	EXPORTS----------	97,4	102,0	113,2	119,7	127,0	133,8	141,7	149,3	159,0	165,9	174,2
36	TE$	I	% CHANGE-	1,6	4,7	11,0	5,7	6,1	5,4	5,9	5,3	6,6	4,3	5,0
37														
38	TM$	I	IMPORTS----------	87,9	93,3	98,3	103,2	110,9	115,8	120,6	127,3	134,3	141,5	149,0
39	TM$	I	% CHANGE-	10,1	6,1	5,4	4,9	7,4	4,5	4,1	5,6	5,5	5,4	5,3
40														
41	GVPT$	I	GOVERNMENT PURCHASES OF GOODS & SER,	272,4	285,0	294,7	302,3	310,1	318,1	326,4	334,9	343,7	352,7	362,1
42	GVPT$	I	% CHANGE-	3,0	4,6	3,4	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6
43														
44	GVPF$	I	FEDERAL----------	102,5	108,1	111,1	113,2	115,3	117,4	119,6	121,8	124,1	126,4	128,8
45	GVPF$	I	% CHANGE-	6,2	5,5	2,8	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9
46														
47	GVPS$	I	STATE AND LOCAL----------	169,9	176,9	183,6	189,1	194,8	200,7	206,8	213,1	219,6	226,3	233,3
48	GVPS$	I	% CHANGE-	1,2	4,1	3,8	3,0	3,0	3,0	3,0	3,0	3,1	3,1	3,1

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
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TABLE 2. GROSS NATIONAL PRODUCT (CURRENT AND 72$)

LINE	VAR LABEL	I T E M	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1													
2		----------CURRENT DOLLARS----------											
3													
4	GNP$	I GROSS NATIONAL PRODUCT----------	5037.0	5474.9	5939.9	6463.3	7022.1	7614.5	8226.6	8916.3	9684.2	10509.6	11388.9
5	GNP$	I % CHANGE=	8.5	8.7	8.5	8.8	8.6	8.4	8.0	8.4	8.6	8.5	8.4
6													
7	CE$	I PERSONAL CONSUMPTION EXPENDITURES---	3083.5	3341.8	3629.8	3938.0	4269.6	4626.3	5004.3	5410.5	5859.0	6341.1	6861.3
8	CE$	I % CHANGE=	8.3	8.4	8.6	8.5	8.4	8.4	8.2	8.1	8.3	8.2	8.2
9													
10	CED$	I DURABLE GOODS----------	408.9	440.7	476.2	517.1	558.9	602.4	647.8	696.8	751.9	810.0	871.2
11	CED$	I % CHANGE=	7.9	7.8	8.5	8.1	8.1	7.8	7.5	7.6	7.9	7.7	7.6
12													
13	CEN$	I NONDURABLE GOODS----------	1078.9	1156.4	1242.6	1332.6	1428.8	1534.4	1645.2	1766.0	1898.3	2038.1	2185.7
14	CEN$	I % CHANGE=	7.0	7.2	7.5	7.2	7.2	7.4	7.2	7.1	7.5	7.4	7.2
15													
16	CES$	I SERVICES----------	1595.7	1748.7	1908.9	2088.3	2281.8	2489.5	2711.3	2947.7	3208.8	3493.1	3804.5
17	CES$	I % CHANGE=	9.4	9.3	9.4	9.4	9.3	9.1	8.9	8.7	8.9	8.9	8.9
18													
19	IBT$	I GROSS PRIVATE DOMESTIC INVESTMENT---	902.3	991.9	1071.6	1183.7	1297.5	1410.3	1512.8	1652.0	1819.8	1994.9	2175.6
20	IBT$	I % CHANGE=	9.2	9.9	8.0	10.5	9.6	8.7	7.2	9.3	10.2	9.6	9.0
21													
22	IBF$	I FIXED INVESTMENT----------	865.0	948.9	1024.1	1129.0	1237.3	1346.6	1447.6	1583.5	1742.6	1909.4	2081.5
23	IBF$	I % CHANGE=	9.2	9.7	7.9	10.2	9.6	8.8	7.5	9.4	10.0	9.6	9.0
24													
25	IBFN$	I NONRESIDENTIAL----------	623.2	677.7	742.0	807.4	884.2	968.5	1061.5	1157.0	1253.2	1363.3	1485.0
26	IBFN$	I % CHANGE=	9.4	8.7	9.5	8.8	9.5	9.5	9.6	9.0	8.3	8.8	8.9
27													
28	IBFR$	I RESIDENTIAL STRUCTURES----------	241.8	271.2	282.1	321.6	353.2	378.1	386.2	426.5	489.4	546.1	596.5
29	IBFR$	I % CHANGE=	8.8	12.2	4.0	14.0	9.8	7.1	2.1	10.4	14.7	11.6	9.2
30													
31	IBIT$	I CHANGE IN BUSINESS INVENTORIES-----	37.3	43.0	47.5	54.7	60.2	63.7	64.4	68.5	77.3	85.5	92.1
32													
33	IBM$	I NET EXPORTS OF GOODS AND SERVICES---	3.2	6.6	10.2	12.5	16.0	19.8	22.9	26.8	32.4	40.2	49.0
34													
35	TEB$	I EXPORTS----------	605.0	668.2	737.2	811.8	892.6	980.7	1075.9	1179.8	1293.3	1416.9	1551.5
36	TEB$	I % CHANGE=	10.9	10.4	10.3	10.1	9.9	9.9	9.7	9.7	9.6	9.6	9.5
37													
38	TMB$	I IMPORTS----------	601.8	661.5	727.0	799.3	876.5	960.9	1053.0	1153.0	1260.9	1376.8	1502.5
39	TMB$	I % CHANGE=	10.6	9.9	9.9	9.9	9.7	9.6	9.6	9.5	9.4	9.2	9.1
40													
41	GVPT$	I GOV. PURCHASES OF GOODS AND SERVICES	1088.0	1134.5	1228.3	1329.1	1439.0	1558.1	1687.5	1827.1	1972.9	2133.4	2305.0
42	GVPT$	I % CHANGE=	8.3	8.3	8.3	8.2	8.3	8.3	8.3	8.3	8.0	8.1	8.0
43													
44	GVPF$	I FEDERAL----------	371.2	398.7	428.2	460.0	494.1	530.8	570.3	612.7	658.3	707.3	760.0
45	GVPF$	I % CHANGE=	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
46													
47	GVPS$	I STATE AND LOCAL----------	676.8	735.8	800.1	869.1	944.8	1027.2	1117.1	1214.3	1314.6	1426.1	1545.0
48	GVPS$	I % CHANGE=	8.8	8.7	8.7	8.6	8.7	8.7	8.8	8.7	8.3	8.5	8.3

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 2. GROSS NATIONAL PRODUCT (CURRENT AND 72$)

LINE	VAR LABEL	ITEM	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1													
2		--------CONSTANT 72 DOLLARS--------											
3													
4	GNP$	GROSS NATIONAL PRODUCT----------	1921,2	1983,7	2044,5	2115,5	2184,5	2250,8	2310,0	2378,6	2455,3	2532,3	2607,8
5	GNP$	% CHANGE-	3,0	3,3	3,1	3,5	3,3	3,0	2,6	3,0	3,2	3,1	3,0
6													
7	CE$	PERSONAL CONSUMPTION EXPENDITURES---	1218,3	1252,0	1293,3	1336,0	1379,2	1422,0	1462,9	1505,1	1552,3	1600,0	1648,5
8	CE$	% CHANGE-	3,0	3,1	3,3	3,3	3,2	3,1	2,9	2,9	3,1	3,1	3,0
9													
10	CED$	DURABLE GOODS----------	201,2	207,9	216,1	224,4	232,5	240,2	247,3	254,9	263,6	272,1	280,4
11	CED$	% CHANGE-	3,3	3,3	3,9	3,8	3,6	3,3	3,0	3,1	3,4	3,2	3,0
12													
13	CEN$	NONDURABLE GOODS----------	427,9	437,3	447,7	458,2	468,7	479,2	488,9	499,2	511,8	524,0	536,1
14	CEN$	% CHANGE-	2,0	2,2	2,4	2,3	2,3	2,2	2,0	2,1	2,5	2,4	2,3
15													
16	CES$	SERVICES----------	585,1	606,7	629,5	653,5	677,9	702,5	726,7	751,0	776,9	803,8	832,0
17	CES$	% CHANGE-	3,7	3,7	3,7	3,8	3,7	3,6	3,4	3,3	3,5	3,5	3,5
18													
19	IBT$	GROSS PRIVATE DOMESTIC INVESTMENT---	308,6	321,6	329,2	345,7	359,4	370,4	376,3	389,8	407,4	421,7	437,9
20	IBT$	% CHANGE-	3,4	4,2	2,4	5,0	4,0	3,1	1,6	3,6	4,5	4,0	3,3
21													
22	IBF$	FIXED INVESTMENT----------	293,8	305,4	312,1	326,8	339,4	350,1	356,6	369,7	385,5	400,4	413,6
23	IBF$	% CHANGE-	3,3	3,9	2,2	4,7	3,9	3,2	1,9	3,7	4,3	3,8	3,3
24													
25	IBFN$	NONRESIDENTIAL----------	220,3	227,8	236,2	245,6	255,6	265,9	275,9	286,2	295,8	306,7	318,0
26	IBFN$	% CHANGE-	3,7	3,4	3,7	4,0	4,1	4,0	3,8	3,7	3,4	3,7	3,7
27													
28	IBFR$	RESIDENTIAL STRUCTURES----------	73,6	77,6	75,8	81,2	83,8	84,2	80,7	83,5	89,7	93,6	95,6
29	IBFR$	% CHANGE-	2,3	5,4	-2,2	7,1	3,1	0,5	-4,1	3,5	7,4	4,4	2,1
30													
31	IBIT$	CHANGE IN BUSINESS INVENTORIES-----	14,7	16,2	17,2	18,9	20,0	20,3	19,7	20,1	21,9	23,4	24,3
32													
33	IBB$	NET EXPORTS OF GOODS AND SERVICES---	26,7	28,5	30,2	31,4	32,8	34,0	34,9	35,9	37,0	38,4	39,7
34													
35	IEB$	EXPORTS----------	183,9	193,2	202,7	212,2	221,8	231,7	241,5	251,6	262,0	272,7	283,6
36	IEB$	% CHANGE-	5,5	5,1	4,9	4,7	4,5	4,4	4,2	4,2	4,1	4,1	4,0
37													
38	IMB$	IMPORTS----------	157,2	164,7	172,5	180,8	189,0	197,6	206,6	215,7	225,0	234,3	243,9
39	IMB$	% CHANGE-	5,5	4,8	4,8	4,8	4,6	4,5	4,5	4,4	4,3	4,1	4,1
40													
41	GVPT$	GOVERNMENT PURCHASES OF GOODS & SER.	371,7	381,6	391,8	402,3	413,2	424,4	435,9	447,8	458,5	470,2	481,7
42	GVPT$	% CHANGE-	2,7	2,7	2,7	2,7	2,7	2,7	2,7	2,7	2,4	2,5	2,5
43													
44	GVPF$	FEDERAL----------	131,2	133,6	136,1	138,6	141,2	143,9	146,5	149,3	152,1	154,9	157,8
45	GVPF$	% CHANGE-	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9
46													
47	GVPS$	STATE AND LOCAL----------	240,5	248,0	255,7	263,7	271,9	280,5	289,3	298,5	306,5	315,3	323,9
48	GVPS$	% CHANGE-	3,1	3,1	3,1	3,1	3,1	3,1	3,2	3,2	2,7	2,9	2,7

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 2, GROSS NATIONAL PRODUCT (CURRENT AND 72$)

LINE	VAR	LABEL	I T E M	1999	2000	2001
1						
2			----------CURRENT DOLLARS----------			
3						
4	GNP$	4	GROSS NATIONAL PRODUCT----------	12334.2	13360.3	14471.2
5	GNP$	I	% CHANGE-	8.3	8.3	8.3
6						
7	CE$	I	PERSONAL CONSUMPTION EXPENDITURES---	7418.1	8020.8	8666.1
8	CE$	I	% CHANGE-	8.1	8.1	8.0
9						
10	CED$	I	DURABLE GOODS----------	936.5	1006.7	1080.0
11	CED$	I	% CHANGE-	7.5	7.5	7.3
12						
13	CEN$	I	NONDURABLE GOODS----------	2342.3	2511.2	2688.0
14	CEN$	I	% CHANGE-	7.2	7.2	7.0
15						
16	CES$	I	SERVICES----------	4139.3	4502.9	4898.1
17	CES$	I	% CHANGE-	8.8	8.8	8.8
18						
19	IBT$	I	GROSS PRIVATE DOMESTIC INVESTMENT---	2370.1	2586.5	2829.9
20	IBT$	I	% CHANGE-	9.0	9.1	9.4
21						
22	IBF$	I	FIXED INVESTMENT----------	2272.0	2481.3	2716.2
23	IBF$	I	% CHANGE-	9.2	9.2	9.5
24						
25	IBFN$	I	NONRESIDENTIAL----------	1617.5	1761.2	1915.8
26	IBFN$	I	% CHANGE-	8.9	8.9	8.8
27						
28	IBFR$	I	RESIDENTIAL STRUCTURES----------	654.5	720.1	800.4
29	IBFR$	I	% CHANGE-	9.7	10.0	11.1
30						
31	IBIT$	I	CHANGE IN BUSINESS INVENTORIES-----	98.1	105.2	113.7
32						
33	TBB$	I	NET EXPORTS OF GOODS AND SERVICES---	57.7	66.0	73.1
34						
35	TEB$	I	EXPORTS----------	1697.9	1857.2	2030.5
36	TEB$	I	% CHANGE-	9.4	9.4	9.3
37						
38	TMB$	I	IMPORTS----------	1640.2	1791.2	1957.4
39	TMB$	I	% CHANGE-	9.2	9.2	9.3
40						
41	GVPT$	I	GOV. PURCHASES OF GOODS AND SERVICES	2488.4	2687.0	2902.1
42	GVPT$	I	% CHANGE-	8.0	8.0	8.0
43						
44	GVPF$	I	FEDERAL----------	816.5	877.1	942.2
45	GVPF$	I	% CHANGE-	7.4	7.4	7.4
46						
47	GVPS$	I	STATE AND LOCAL----------	1671.9	1809.9	1959.9
48	GVPS$	I	% CHANGE-	8.2	8.3	8.3

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 2. GROSS NATIONAL PRODUCT (CURRENT AND 72$)

LINE	VAR	LABEL	I T E M	1999	2000	2001
1						
2			--------CONSTANT 72 DOLLARS--------			
3						
4	GNP$	1	GROSS NATIONAL PRODUCT----------	2684.9	2765.6	2850.0
5	GNP1	1	% CHANGE-	3.0	3.0	3.1
6						
7	CE $	1	PERSONAL CONSUMPTION EXPENDITURES---	1698.0	1749.9	1803.4
8	CE 1	1	% CHANGE-	3.0	3.1	3.1
9						
10	CED $	1	DURABLE GOODS----------	288.8	297.5	306.0
11	CED 1	1	% CHANGE-	3.0	3.0	2.9
12						
13	CEN $	1	NONDURABLE GOODS----------	548.8	562.5	576.8
14	CEN 1	1	% CHANGE-	2.4	2.5	2.5
15						
16	CES $	1	SERVICES----------	860.4	889.9	920.6
17	CES 1	1	% CHANGE-	3.4	3.4	3.5
18						
19	IHT $	1	GROSS PRIVATE DOMESTIC INVESTMENT---	452.9	469.0	487.1
20	IHT 1	1	% CHANGE-	3.4	3.5	3.9
21						
22	IBF $	1	FIXED INVESTMENT----------	427.9	443.1	459.9
23	IBF 1	1	% CHANGE-	3.5	3.5	3.8
24						
25	IBFN $	1	NONRESIDENTIAL----------	329.9	342.3	355.4
26	IBFN 1	1	% CHANGE-	3.7	3.8	3.8
27						
28	IBFR $	1	RESIDENTIAL STRUCTURES----------	98.1	100.7	104.5
29	IBFR 1	1	% CHANGE-	2.5	2.7	3.7
30						
31	IBIT $	1	CHANGE IN BUSINESS INVENTORIES-----	25.0	25.9	27.1
32						
33	TBB $	1	NET EXPORTS OF GOODS AND SERVICES---	40.8	41.7	42.2
34						
35	TEB $	1	EXPORTS----------	298.9	306.4	318.4
36	TEB 1	1	% CHANGE-	4.0	3.9	3.9
37						
38	TMB $	1	IMPORTS----------	258.1	264.8	276.2
39	TMB 1	1	% CHANGE-	4.2	4.2	4.3
40						
41	GVPT $	1	GOVERNMENT PURCHASES OF GOODS & SER.	493.2	505.0	517.3
42	GVPT 1	1	% CHANGE-	2.4	2.4	2.4
43						
44	GVPF $	1	FEDERAL----------	160.8	163.8	166.8
45	GVPF 1	1	% CHANGE-	1.9	1.9	1.9
46						
47	GVPS $	1	STATE AND LOCAL----------	332.4	341.3	350.5
48	GVPS 1	1	% CHANGE-	2.6	2.7	2.7

Source: Wharton EFA Inc., 4025 Chestnut St., Philadelphia, PA 19104, USA.

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
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TABLE 3. GROWTH RATES, FIXED INVESTMENT (72 $)

LINE	VAR LABEL		ITEM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	IBF	I	FIXED INVESTMENT----------	12,0	6,5	3,0	9,6	6,8	1,7	3,8	4,1	2,9	2,5	3,8
2														
3	IBFN	I	NONRESIDENTIAL INVESTMENT----------	9,2	10,2	9,2	4,9	5,0	3,6	4,1	4,2	3,8	3,4	4,1
4														
5	IAAG	B	FARM----------	5,4	-2,5	3,1	11,8	10,4	5,7	2,4	-2,4	1,7	3,7	4,2
6														
7	IAMG	B	MINING----------	6,1	4,9	11,5	10,1	9,1	5,7	5,7	7,8	8,6	7,1	6,0
8														
9	IAMFD		DURABLE GOODS----------	12,5	11,5	8,9	8,8	4,8	1,8	2,2	3,4	4,3	3,5	3,3
10														
11	IAMFD33	B	PRIMARY METALS ----------	11,9	9,4	7,9	8,7	2,7	2,6	2,7	3,5	3,7	2,0	2,6
12	IAMFD36	B	ELECTRICAL MACHINERY----------	11,3	6,1	13,4	8,5	11,2	6,1	3,7	2,8	3,2	4,1	4,0
13	IAMFD35	B	NONELECTRICAL MACHINERY----------	10,9	13,4	9,7	7,3	5,7	1,8	1,6	2,3	2,9	2,8	2,1
14	IAMFD371	B	MOTOR VEHICLES----------	20,4	17,8	16,3	15,1	4,3	-12,5	-13,6	-4,1	8,8	5,7	4,1
15	IAMFD378P2	B	NONAUTO TRANS EQUIP, ORD,, + MISC	9,7	12,9	6,6	7,4	6,0	2,5	2,8	4,6	6,2	6,5	5,8
16	IAMFD32	B	STONE, CLAY, AND GLASS----------	12,9	10,4	2,9	11,9	-3,0	9,7	15,3	6,9	2,8	1,0	2,1
17	IAMFD34	B	FABRICATED METAL PRODUCTS---------	9,6	10,9	5,6	4,0	4,1	3,6	4,7	5,6	4,4	2,5	1,3
18	IAMFD24	B	LUMBER----------	11,9	12,3	7,3	4,3	4,2	9,4	10,8	7,0	6,1	7,3	7,7
19	IAMFD25	B	FURNITURE----------	8,1	10,1	4,3	9,4	3,8	0,9	3,2	4,1	4,7	4,1	4,5
20	IAMFD38	B	INSTRUMENTS----------	10,4	11,0	3,0	9,5	9,1	5,1	5,0	6,8	6,2	4,6	4,7
21														
22	IAMFN		NONDURABLE GOODS----------	7,2	5,9	7,5	3,5	5,1	3,7	3,4	4,9	5,8	4,9	5,1
23														
24	IAMFN20	B	FOOD AND BEVERAGES----------	7,8	7,7	5,3	4,6	7,5	6,3	5,9	5,2	5,5	3,6	5,0
25	IAMFN22	B	TEXTILES----------	5,2	6,7	7,5	4,3	1,1	1,0	4,1	4,4	1,9	0,9	0,9
26	IAMFN26	B	PAPER----------	7,8	9,1	16,5	5,6	3,3	0,7	1,4	3,8	3,8	3,5	3,3
27	IAMFN28	B	CHEMICALS----------	8,2	4,4	8,3	6,6	5,6	1,3	1,1	3,6	5,7	3,9	4,5
28	IAMFN29	B	PETROLEUM----------	6,5	5,0	4,8	-0,5	3,5	4,9	3,7	5,3	6,2	6,0	6,0
29	IAMFN30	B	RUBBER----------	5,9	8,6	12,3	7,8	15,4	6,4	6,0	6,7	7,8	6,8	5,4
30	IAMFN21	E	TOBACCO----------	4,0	6,7	6,2	5,9	5,6	5,3	5,0	4,8	4,5	4,3	4,2
31	IAMFN23	B	APPAREL----------	4,3	6,2	5,3	6,0	6,9	7,1	9,4	9,8	8,5	8,2	6,9
32	IAMFN31	B	LEATHER----------	6,7	3,8	7,3	6,7	9,0	7,1	8,4	9,0	9,8	9,8	9,4
33	IAMFN27	B	PRINTING AND PUBLISHING----------	8,6	5,2	5,4	7,8	5,7	4,2	4,4	7,3	9,3	9,9	8,5
34														
35	IARGT	B	TRANSPORTATION----------	-9,3	18,0	26,4	5,4	2,4	-0,8	0,5	5,0	8,5	9,6	15,6
36	IARGU49	B	UTILITIES----------	11,7	12,1	8,3	5,5	9,5	7,0	4,3	3,2	2,2	1,9	3,0
37	IARGC48	B	COMMUNICATIONS----------	11,4	23,1	15,4	1,1	2,5	6,3	7,5	6,1	4,6	4,6	5,1
38	IACO	B	COMMERCIAL AND OTHER----------	11,2	10,1	7,8	2,9	2,7	1,9	5,3	5,3	2,3	1,4	2,0
39														
40	IBFR	I	RESIDENTIAL STRUCTURES----------	19,0	-1,8	-12,8	24,4	11,6	-3,1	3,0	1,7	0,3	-0,2	2,8
41	IBFRN	I	NONFARM ----------	19,5	-2,2	-13,5	25,3	11,8	-3,4	3,0	3,7	0,2	-0,3	2,8
42	IBFRF	E	FARM----------	0,0	14,3	6,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
43	IBFRE	E	RESIDENTIAL DURABLE EQUIP,---------	10,0	9,1	8,3	7,7	7,1	6,7	6,2	5,9	5,6	5,3	5,0
44	IBFRMXNO-MH	B	ADDITIONS AND ALTERATIONS---------	2,5	-0,0	0,0	14,2	-1,6	-6,1	2,3	0,6	+1,4	-0,4	1,5
45														
46	HSPR	I	PRIVATE HOUSING STARTS----------	26,1	-5,2	-13,7	12,5	12,0	-6,8	0,4	2,2	-4,8	-5,6	0,4
47	HSPRSI	H	SINGLE UNIT----------	20,9	-8,8	-16,3	14,6	15,2	-8,8	0,2	5,1	-10,0	-2,9	4,7
48	HSPRSM	B	MULTIPLE UNIT----------	42,4	4,2	-7,8	8,1	5,0	-2,0	0,8	-4,2	7,9	-11,1	-9,2
49	HSPRN	I	PRIV NONFARM HOUSING STARTS--------	26,8	-5,3	-13,9	12,7	12,2	-6,9	0,4	2,3	-4,9	-5,7	0,4
50	HSPRF	E	PRIV FARM HOUSING STARTS----------	-14,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
51	HSPRMH	B	MOBILE HOMES----------	9,8	-7,5	-5,6	62,0	5,1	16,1	-6,7	-24,1	44,8	2,7	-10,6

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
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TABLE 3. GROWTH RATES, FIXED INVESTMENT (72 $)

LINE	VAR	LABEL	ITEM	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	IBF	I	FIXED INVESTMENT----------	3.5	3.9	2.2	4.7	3.9	3.2	1.9	3.7	4.3	3.8	3.3
2														
3	IBFN	I	NONRESIDENTIAL INVESTMENT----------	3.7	3.4	3.7	4.0	4.1	4.0	3.8	3.7	3.4	3.7	3.7
4														
5	IAAG	B	FARM----------	4.1	4.0	3.9	3.8	3.8	3.8	3.8	3.9	3.6	3.7	3.7
6														
7	IAMG	B	MINING----------	4.7	3.5	3.5	7.9	7.6	6.7	5.3	4.4	3.9	3.9	3.9
8														
9	IAMFD		DURABLE GOODS----------	3.5	3.6	4.3	5.5	5.7	5.2	4.5	4.8	4.1	5.9	5.7
10														
11	IAMFD33	B	PRIMARY METALS ----------	2.1	3.5	6.2	5.9	4.7	3.7	3.5	4.2	2.8	5.6	5.4
12	IAMFD36	B	ELECTRICAL MACHINERY----------	3.5	3.0	3.1	3.9	4.6	4.7	4.3	3.9	3.9	3.9	4.2
13	IAMFD35	B	NONELECTRICAL MACHINERY----------	2.5	2.8	1.8	5.4	6.7	6.2	5.5	6.5	3.1	7.4	6.6
14	IAMFD371	B	MOTOR VEHICLES----------	4.1	1.1	2.3	4.6	5.9	5.1	1.9	1.2	1.0	5.1	5.9
15	IAMFD37SP2	B	NONAUTO TRANS EQUIP, ORD., + MISC	4.8	5.1	5.7	6.5	6.5	5.8	4.7	4.5	5.3	6.2	6.4
16	IAMFD32	B	STONE, CLAY, AND GLASS----------	1.6	2.7	4.1	4.3	4.7	5.2	5.7	5.9	5.6	5.7	5.8
17	IAMFD34	B	FABRICATED METAL PRODUCTS---------	5.9	6.2	5.9	7.1	7.2	6.7	6.2	6.3	7.1	6.8	6.3
18	IAMFD24	B	LUMBER----------	6.5	5.8	5.9	5.9	5.6	5.5	5.6	5.5	5.2	4.9	4.9
19	IAMFD25	B	FURNITURE----------	4.2	3.7	3.6	3.9	4.0	3.9	3.8	3.6	4.0	3.7	3.9
20	IAMFD38	B	INSTRUMENTS----------	5.6	6.2	5.5	5.9	6.0	5.5	4.6	5.1	6.3	6.2	5.5
21														
22	IAMFN		NONDURABLE GOODS----------	4.8	4.7	4.8	4.8	5.1	5.2	4.9	4.5	4.3	4.5	4.7
23														
24	IAMFN20	B	FOOD AND BEVERAGES----------	5.2	4.1	3.6	3.5	3.6	3.5	3.4	3.3	3.0	3.0	3.2
25	IAMFN22	B	TEXTILES----------	3.1	6.1	6.8	7.6	6.4	4.6	2.8	4.0	6.5	6.8	6.1
26	IAMFN26	B	PAPER----------	3.2	3.6	4.3	3.8	4.8	4.3	3.8	3.0	4.2	5.1	5.1
27	IAMFN28	B	CHEMICALS----------	3.7	5.1	5.8	5.8	5.4	5.2	4.4	3.5	5.2	4.6	5.5
28	IAMFN29	B	PETROLEUM----------	5.5	4.7	3.9	3.8	4.5	5.2	5.5	5.4	4.5	3.9	4.0
29	IAMFN30	B	RUBBER----------	4.7	4.7	5.0	5.9	6.2	6.0	5.1	4.9	5.3	5.5	5.5
30	IAMFN21	E	TOBACCO----------	4.0	3.8	3.7	3.6	3.4	3.3	3.2	3.1	3.0	2.9	2.9
31	IAMFN23	B	APPAREL----------	7.1	7.3	7.2	7.2	6.7	6.2	5.6	5.8	6.4	6.1	6.0
32	IAMFN31	B	LEATHER----------	9.6	9.8	10.0	10.1	10.1	9.9	9.7	9.7	9.7	9.5	9.3
33	IAMFN27	B	PRINTING AND PUBLISHING----------	7.3	6.7	11.9	11.7	10.9	9.7	8.4	7.4	7.1	6.8	6.4
34														
35	IARGT	B	TRANSPORTATION----------	10.9	8.7	7.5	7.6	7.8	7.7	7.1	6.5	5.4	5.5	5.7
36	IARGU49	B	UTILITIES----------	3.2	3.2	3.2	3.2	3.1	3.1	3.1	2.8	2.6	2.3	2.1
37	IARGC48	B	COMMUNICATIONS----------	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
38	IACO	B	COMMERCIAL AND OTHER----------	1.4	0.9	1.6	1.4	1.5	1.5	1.3	1.5	1.3	1.2	1.0
39														
40	IBFR	I	RESIDENTIAL STRUCTURES----------	2.1	5.4	-2.2	7.1	3.1	0.5	-4.1	3.5	7.4	4.4	2.1
41	IBFRN	I	NONFARM ----------	2.2	5.5	-2.4	7.1	3.1	0.4	-4.4	3.5	7.6	4.5	2.1
42	IBFRF	E	FARM----------	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	IBFRE	E	RESIDENTIAL DURABLE EQUIP,---------	4.8	4.5	4.3	4.2	4.0	3.8	3.7	3.6	3.4	3.3	3.2
44	IBFRNXND-MH	B	ADDITIONS AND ALTERATIONS----------	-0.0	1.7	-3.7	4.7	-1.3	-1.5	-2.9	4.2	2.8	-1.0	-1.3
45														
46	HSPR	I	PRIVATE HOUSING STARTS----------	-1.1	1.6	-7.8	3.8	1.1	-3.4	-9.4	-2.8	3.1	0.9	-2.7
47	HSPRS1	B	SINGLE UNIT----------	-0.8	1.4	-7.5	2.5	0.4	-3.7	-11.2	-6.4	2.6	1.0	-4.0
48	HSPRSM	B	MULTIPLE UNIT----------	-2.1	2.1	-8.5	7.5	-7.2	-2.5	-4.5	6.5	4.1	0.7	0.4
49	HSPRN	I	PRIV NONFARM HOUSING STARTS--------	-1.2	1.6	-7.8	3.9	1.1	-3.4	-9.5	-2.8	3.1	0.9	-2.7
50	HSPRF	E	PRIV FARM HOUSING STARTS----------	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	HSPRMH	B	MOBILE HOMES----------	1.4	9.1	5.4	3.6	-6.5	3.7	5.1	16.1	7.3	4.0	5.5

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 3. GROWTH RATES, FIXED INVESTMENT (72 $)

LINE	VAR LABEL		ITEM	1999	2000	2001
1	IBF	I	FIXED INVESTMENT----------	3.5	3.5	3.8
2						
3	IBFN	I	NONRESIDENTIAL INVESTMENT----------	3.7	3.8	3.8
4						
5	IAAG	B	FARM----------	3.8	3.8	3.8
6						
7	IAMG	B	MINING----------	3.8	4.0	4.3
8						
9	IAMFD		DURABLE GOODS----------	5.4	5.2	5.3
10						
11	IAMFD33	B	PRIMARY METALS ----------	4.8	4.3	4.1
12	IAMFD36	B	ELECTRICAL MACHINERY----------	4.4	4.4	4.3
13	IAMFD35	B	NONELECTRICAL MACHINERY----------	6.3	6.5	6.8
14	IAMFD371	B	MOTOR VEHICLES----------	4.9	4.1	3.6
15	IAMFD37SP2	B	NONAUTO TRANS EQUIP, ORD,, + MISC	5.9	5.1	4.9
16	IAMFD32	B	STONE, CLAY, AND GLASS----------	5.9	6.5	7.1
17	IAMFD34	B	FABRICATED METAL PRODUCTS--------	6.2	6.2	6.1
18	IAMFD24	B	LUMBER----------	4.7	4.6	4.6
19	IAMFD25	B	FURNITURE----------	3.8	3.8	3.9
20	IAMFD38	B	INSTRUMENTS----------	5.3	5.5	5.7
21						
22	IAMFN		NONDURABLE GOODS----------	4.8	5.0	5.2
23						
24	IAMFN20	B	FOOD AND BEVERAGES----------	3.7	4.0	3.9
25	IAMFN22	B	TEXTILES----------	5.8	5.9	5.9
26	IAMFN26	B	PAPER----------	4.9	4.9	5.2
27	IAMFN28	B	CHEMICALS----------	5.0	4.6	4.8
28	IAMFN29	B	PETROLEUM----------	4.5	5.1	5.5
29	IAMFN30	B	RUBBER----------	5.5	5.7	5.4
30	IAMFN21	E	TOBACCO----------	2.8	2.7	2.6
31	IAMFN23	B	APPAREL----------	6.1	6.3	6.2
32	IAMFN31	B	LEATHER----------	9.2	9.1	8.8
33	IAMFN27	B	PRINTING AND PUBLISHING----------	6.0	5.7	5.5
34						
35	IARGT	B	TRANSPORTATION----------	5.7	5.6	5.5
36	IARGU49	B	UTILITIES----------	1.8	1.6	1.3
37	IARGC48	B	COMMUNICATIONS----------	4.7	4.7	4.7
38	IACO	B	COMMERCIAL AND OTHER----------	1.6	1.6	1.8
39						
40	IBFR	I	RESIDENTIAL STRUCTURES----------	2.5	2.7	3.7
41	IBFRN	I	NONFARM ----------	2.5	2.8	3.8
42	IBFRF	E	FARM----------	0.0	0.0	0.0
43	IBFRE	E	RESIDENTIAL DURABLE EQUIP,--------	3.1	3.0	2.9
44	IBFRNXNU-MH	B	ADDITIONS AND ALTERATIONS----------	0.2	0.3	0.9
45						
46	HSPR	I	PRIVATE HOUSING STARTS----------	-2.0	-2.3	-0.3
47	HSPRSE	B	SINGLE UNIT----------	-1.2	-2.5	-0.7
48	HSPRSM	B	MULTIPLE UNIT----------	-3.7	-1.7	0.7
49	HSPRN	I	PRIV NONFARM HOUSING STARTS-------	-2.0	-2.1	-0.3
50	HSPRF	E	PRIV FARM HOUSING STARTS----------	0.0	0.0	0.0
51	HSPRMH	B	MOBILE HOMES----------	2.5	4.3	4.0

Source: Wharton EFA Inc., 4025 Chestnut St., Philadelphia, PA 19104, USA.

MHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 4. GROWTH RATES, CAPITAL STOCK (72 $)

LINE	VAR LABEL		ITEM	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	KIAAG	I	FARM----------	4,0	2,8	2,9	4,4	5,5	5,6	4,9	3,5	3,2	3,3	3,5
2														
3	KIAMG	I	MINING----------	3,6	3,8	4,8	5,5	6,1	6,0	6,8	6,2	6,6	6,7	6,6
4														
5			DURABLE GOODS											
6														
7	KIAMFD33	I	PRIMARY METALS----------	4,6	5,1	5,5	5,9	5,5	5,1	4,8	4,7	4,5	4,2	4,0
8	KIAMFD36	I	ELECTRICAL MACHINERY----------	2,7	3,0	3,8	4,2	4,8	4,9	4,8	4,6	4,5	4,5	4,4
9	KIAMFD35	I	NONELECTRICAL MACHINERY----------	4,4	5,2	5,6	5,8	5,8	5,8	5,0	4,7	4,6	4,4	4,2
10	KIAMFD371	I	MOTOR VEHICLES----------	2,6	4,3	5,8	7,1	6,7	3,9	1,7	1,1	1,9	2,3	2,5
11	KIAMFD37SP2	I	NONAUTO TRANS EQUIP + ORD + MISC MFG	1,4	2,9	3,5	4,1	4,4	4,1	3,9	4,0	4,3	4,7	4,8
12	KIAMFD32	I	STONE, CLAY, AND GLASS----------	3,0	3,6	3,5	4,2	3,6	4,1	5,1	5,8	5,2	4,8	4,5
13	KIAMFD34	I	FABRICATED METAL PRODUCTS----------	3,1	3,7	3,9	3,9	3,9	3,9	3,9	4,1	4,1	4,0	3,7
14	KIAMFD24	I	LUMBER----------	2,7	3,5	3,8	3,8	3,9	4,3	4,9	5,1	5,2	5,4	5,6
15	KIAMFD25	I	FURNITURE----------	-0,8	-0,0	0,3	1,1	1,3	1,3	1,5	1,7	2,0	2,4	2,6
16	KIAMFD38	I	INSTRUMENTS----------	4,8	5,0	4,8	5,2	5,6	5,6	5,5	5,6	5,7	5,6	5,5
17														
18			NONDURABLE GOODS											
19														
20	KIAMFN20	I	FOOD AND BEVERAGES----------	2,1	2,6	2,9	3,1	3,5	3,9	4,1	4,2	4,4	4,3	4,4
21	KIAMFN22	I	TEXTILES----------	-0,3	0,2	0,8	1,1	1,1	1,1	1,4	1,7	1,7	1,6	1,6
22	KIAMFN26	I	PAPER----------	5,7	6,0	7,1	6,9	6,5	5,9	5,4	5,3	5,1	5,0	4,8
23	KIAMFN28	I	CHEMICALS----------	4,7	4,6	5,1	5,3	5,3	4,8	4,3	4,3	4,4	4,4	4,4
24	KIAMFN29	I	PETROLEUM----------	4,7	4,7	4,7	4,2	4,2	4,2	4,2	4,3	4,5	4,6	4,7
25	KIAMFN30	I	RUBBER----------	2,2	2,6	3,2	3,5	3,4	3,6	3,7	3,9	5,1	5,3	5,3
26	KIAMFN21	I	TOBACCO----------	2,0	2,4	2,8	3,2	3,4	3,6	3,8	3,9	4,0	4,0	4,0
27	KIAMFN23	I	APPAREL----------	1,4	2,0	2,3	2,8	3,3	3,8	4,5	5,3	5,7	6,1	6,2
28	KIAMFN31	I	LEATHER----------	3,2	3,2	3,6	3,8	4,3	4,5	4,9	5,2	5,7	6,1	6,4
29	KIAMFN27	I	PRINTING AND PUBLISHING----------	0,1	0,7	1,1	1,7	2,1	2,3	2,5	3,0	3,7	4,4	4,9
30														
31	KIARGT	I	TRANSPORTATION----------	-0,6	0,8	3,0	3,3	3,2	2,7	2,5	2,8	3,8	4,1	5,4
32														
33	KIARGU49	I	UTILITIES----------	5,0	5,6	5,9	5,9	6,2	6,3	6,1	5,8	5,5	5,2	5,0
34														
35	KIARGL48	I	COMMUNICATIONS----------	3,5	5,3	6,4	5,8	5,4	5,5	5,7	5,7	5,6	5,5	5,5
36														
37	KIACO	I	COMMERCIAL AND OTHER----------	2,7	3,4	3,9	3,8	3,7	3,5	3,7	3,8	3,7	3,4	3,3
38														
39	KMGNP	I	STOCK OF REAL WEALTH----------	2,8	3,5	3,7	4,0	4,1	3,8	3,4	3,4	3,5	3,2	3,0
40														
41	KCEDA	I	STOCK OF AUTOS----------	7,3	6,2	5,5	3,7	3,5	3,8	4,0	4,2	3,3	3,1	2,2
42														
43	KIBFRN	I	STOCK OF NONFARM RESID. STRUCTURES---	3,2	2,7	1,5	3,0	3,7	3,1	3,1	3,2	2,9	2,7	2,7
44														
45	KIBIN	I	TOTAL NONFARM INVENTORIES----------	4,7	4,6	4,2	3,9	3,8	3,6	4,1	4,2	4,0	3,7	3,5
46	KIBIIDAV	B	STOCK OF AUTO DEALER INVENTORIES-----	12,3	8,6	5,9	4,8	2,9	3,1	2,6	4,3	3,7	3,6	2,3
47	KIBIMMF	B	STOCK OF MANUFACTURES INVENTORIES----	3,1	3,7	4,3	4,1	4,0	3,8	4,6	4,4	4,2	3,9	3,7
48	KIBINMM	I	STOCK OF NONMFG, NON-AUTO DEALER INV-	5,8	5,3	4,1	3,7	3,7	3,4	3,7	4,0	3,7	3,5	3,4

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN;1978

TABLE 4. GROWTH RATES, CAPITAL STOCK (72 $)

LINE	VAR LABEL		ITEM	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	KIAAG	I	FARM	3.6	3.6	3.7	3.7	3.7	3.7	3.8	3.8	3.7	3.7	3.7
2														
3	KIAMG	I	MINING	6.3	5.8	5.5	5.8	6.1	6.2	6.1	5.8	5.5	5.3	5.1
4														
5			DURABLE GOODS											
6														
7	KIAMFD33	I	PRIMARY METALS	3.8	3.8	4.1	4.3	4.3	4.2	4.2	4.2	4.0	4.2	4.3
8	KIAMFD36	I	ELECTRICAL MACHINERY	4.3	4.2	4.1	4.1	4.2	4.2	4.2	4.2	4.1	4.1	4.1
9	KIAMFD35	I	NONELECTRICAL MACHINERY	4.0	3.9	3.8	3.9	4.1	4.3	4.4	4.6	4.5	4.7	4.9
10	KIAMFD371	I	MOTOR VEHICLES	2.7	2.5	2.5	2.7	3.1	3.3	3.2	2.9	2.9	3.2	3.5
11	KIAMFD37SP2	I	NONAUTO TRANS EQUIP + ORD + MISC MFG	4.8	4.9	5.0	5.3	5.5	5.5	5.4	5.2	5.2	5.4	5.6
12	KIAMFD32	I	STONE, CLAY, AND GLASS	4.3	4.1	4.1	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8
13	KIAMFD34	I	FABRICATED METAL PRODUCTS	3.9	4.1	4.3	4.5	4.8	4.9	5.1	5.2	5.4	5.5	5.6
14	KIAMFD24	I	LUMBER	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.6	5.6	5.5
15	KIAMFD25	I	FURNITURE	2.8	2.9	2.9	3.0	3.1	3.2	3.3	3.3	3.4	3.4	3.5
16	KIAMFD38	I	INSTRUMENTS	5.5	5.6	5.6	5.6	5.6	5.6	5.5	5.5	5.6	5.6	5.6
17														
18			NONDURABLE GOODS											
19														
20	KIAMFN20	I	FOOD AND BEVERAGES	4.5	4.4	4.3	4.2	4.1	4.1	4.0	3.9	3.8	3.7	3.7
21	KIAMFN22	I	TEXTILES	1.7	2.1	2.6	3.1	3.5	3.6	3.5	3.5	3.9	4.2	4.4
22	KIAMFN26	I	PAPER	4.7	4.6	4.5	4.5	4.5	4.5	4.4	4.3	4.3	4.4	4.4
23	KIAMFN28	I	CHEMICALS	4.3	4.4	4.6	4.7	4.8	4.8	4.8	4.6	4.6	4.5	4.6
24	KIAMFN29	I	PETROLEUM	4.8	4.8	4.7	4.6	4.6	4.7	4.7	4.8	4.8	4.7	4.6
25	KIAMFN30	I	RUBBER	5.2	5.2	5.2	5.2	5.3	5.4	5.3	5.3	5.3	5.3	5.3
26	KIAMFN21	I	TOBACCO	4.0	4.0	4.0	3.9	3.9	3.8	3.7	3.7	3.6	3.5	3.5
27	KIAMFN23	I	APPAREL	6.4	6.5	6.6	6.7	6.7	6.6	6.5	6.3	6.4	6.3	6.3
28	KIAMFN31	I	LEATHER	6.8	7.1	7.4	7.7	8.0	8.2	8.4	8.6	8.7	8.8	8.9
29	KIAMFN27	I	PRINTING AND PUBLISHING	5.2	5.4	6.2	6.9	7.5	7.8	7.9	7.8	7.7	7.6	7.4
30														
31	KIAGT	I	TRANSPORTATION	6.1	6.4	6.6	6.7	6.9	7.0	7.0	6.9	6.7	6.6	6.4
32														
33	KIAGU69	I	UTILITIES	4.8	4.7	4.6	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.7
34														
35	KIAGC68	I	COMMUNICATIONS	5.4	5.3	5.2	5.2	5.1	5.1	5.0	5.0	5.0	4.9	4.9
36														
37	KIACO	I	COMMERCIAL AND OTHER	3.1	2.9	2.8	2.6	2.5	2.4	2.3	2.2	2.2	2.1	2.0
38														
39	KWGNP	I	STOCK OF REAL WEALTH	2.9	3.0	3.1	3.1	3.2	3.3	3.2	2.9	3.0	3.0	3.1
40														
41	KCED4	I	STOCK OF AUTOS	2.4	2.5	2.8	2.9	3.0	2.9	2.8	2.8	3.0	3.0	2.9
42														
43	KIBFRN	I	STOCK OF NONFARM RESID. STRUCTURES	2.7	2.9	2.5	2.8	2.8	2.7	2.1	2.2	2.6	2.7	2.7
44														
45	KIBIN	I	TOTAL NONFARM INVENTORIES	3.6	3.8	3.9	4.1	4.2	4.1	3.8	3.7	3.9	4.0	4.0
46	KIBITDAV	B	STOCK OF AUTO DEALER INVENTORIES	1.9	2.2	2.3	3.5	3.3	3.4	3.0	3.0	3.0	3.0	3.1
47	KIBIMMF	B	STOCK OF MANUFACTURES INVENTORIES	3.7	3.9	4.0	4.2	4.3	4.3	4.1	4.0	4.1	4.3	4.4
48	KIBINNM	I	STOCK OF NONMFG, NON AUTO DEALER INV	3.6	3.8	3.9	4.1	4.1	3.9	3.6	3.6	3.8	3.8	3.9

WHARTON ANNUAL AND INDUSTRY FORECASTING MODEL
POST-MEETING CONTROL SOLUTION EXTENDED TO YEAR 2001-JAN,1978

TABLE 4. GROWTH RATES, CAPITAL STOCK (72 $)

LINE	VAR LABEL		ITEM	1999	2000	2001
1	KIAAG	I	FARM----------	3.7	3.8	3.8
2						
3	KIAMG	I	MINING----------	4.9	4.8	4.7
4						
5			DURABLE GOODS			
6						
7	KIAMFD33	I	PRIMARY METALS----------	4.0	4.4	4.3
8	KIAMFD36	I	ELECTRICAL MACHINERY----------	4.1	4.2	4.2
9	KIAMFD35	I	NONELECTRICAL MACHINERY----------	5.0	5.2	5.3
10	KIAMFD371	I	MOTOR VEHICLES----------	3.7	3.7	3.7
11	KIAMFD37SP2	I	NONAUTO TRANS EQUIP + ORD + MISC MFG	5.6	5.5	5.4
12	KIAMFD32	I	STONE, CLAY AND GLASS----------	4.9	5.1	5.3
13	KIAMFD34	I	FABRICATED METAL PRODUCTS----------	5.7	5.7	5.7
14	KIAMFD24	I	LUMBER----------	5.4	5.3	5.3
15	KIAMFD25	I	FURNITURE----------	3.5	3.5	3.6
16	KIAMFD38	I	INSTRUMENTS----------	5.6	5.6	5.6
17						
18			NONDURABLE GOODS			
19						
20	KIAMFN20	I	FOOD AND BEVERAGES----------	3.7	3.7	3.7
21	KIAMFN22	I	TEXTILES----------	4.6	4.8	4.9
22	KIAMFN26	I	PAPER----------	4.5	4.5	4.6
23	KIAMFN28	I	CHEMICALS----------	4.6	4.6	4.7
24	KIAMFN29	I	PETROLEUM----------	4.6	4.7	4.7
25	KIAMFN30	I	RUBBER----------	5.3	5.4	5.4
26	KIAMFN21	I	TOBACCO----------	3.4	3.3	3.2
27	KIAMFN23	I	APPAREL----------	6.2	6.2	6.2
28	KIAMFN31	I	LEATHER----------	8.9	8.9	8.9
29	KIAMFN27	I	PRINTING AND PUBLISHING----------	7.2	7.0	6.8
30						
31	KIARGT	I	TRANSPORTATION----------	6.3	6.2	6.1
32						
33	KIARGUM9	I	UTILITIES----------	3.5	3.4	3.2
34						
35	KIARGC48	I	COMMUNICATIONS----------	4.9	4.9	4.8
36						
37	KIACO	I	COMMERCIAL AND OTHER----------	1.9	1.9	1.9
38						
39	KWGNP	I	STOCK OF REAL WEALTH----------	3.0	3.0	3.0
40						
41	KCEDA	I	STOCK OF AUTOS----------	2.9	2.9	2.8
42						
43	KI8FRN	I	STOCK OF NONFARM RESID. STRUCTURES---	2.7	2.7	2.8
44						
45	KIBIN	I	TOTAL NONFARM INVENTORIES----------	4.0	4.0	4.0
46	KIBIDAV	B	STOCK OF AUTO DEALER INVENTORIES-----	3.1	3.0	2.8
47	KIBIMMF	B	STOCK OF MANUFACTURES INVENTORIES----	4.4	4.4	4.5
48	KIBINMM	I	STOCK OF NONMFG, NON-AUTO DEALER INV-	3.6	3.6	3.6

Source: Wharton EFA Inc., 4025 Chestnut St., Philadelphia, PA 19104, USA.

DEMAND FORECASTING AND CAPACITY CREATION IN THE PRIVATE SECTOR II

R. Witcomb

This paper briefly describes the basic characteristics of the multisectoral dynamic model of the UK economy, constructed in Cambridge under Professor Sir Richard Stone. Two particular problems of demand forecasting are discussed: the ratio of manufactured imports to gross domestic product (GDP), and the ratio of personal savings to real income.

The basic commodity balance equation of the multisectoral dynamic model (57 commodities) is

$$q + m = q_c + q_i + q_g + q_x + Z$$

domestic supply	imports	consumption	investment	public exp.	exports	intermediate demand

$$q_c = Q_c\, c \quad (42),$$

$$q_i = Q_i\, i \quad (40 \times 5),$$

$$q_g = Q_g\, g \quad (5),$$

$$q_x = Q_x\, x \quad (16 \times 10),$$

$$Z = Ay \quad (40),$$

$$y = Mq\ ,$$

where Q_c, Q_i, Q_g, Q_x, A, M are the classification converters.

Unfortunately there are no data on the various components of demand on the same disaggregation scheme. So demand functions are estimated for the categories for which data are available, i.e., the right-hand variables in the matrix equation above use classification converters, which are usually assumed constant from year to year. This is generally a correct assumption, since many of the cells of the converters are zeros or ones. Intermediate demand comes from an input-output matrix that varies over time, but that, owing to lack of data, is insensitive to relative price changes in a particular year.

The model is Keynesian in the following sense: producers set prices on a mark-up basis, while final demands are determined either exogenously (government expenditure) or by income-output

and relative prices. Producers then meet the demand. Commodity markets will therefore clear, but there is no guarantee that factor markets will also clear.

One important feature of the UK model, which occurs because the UK has such an open economy, is that the prices of imports, of exports, and of domestically produced output of a particular commodity are allowed to diverge. This is a reflection of the fact that each "commodity" is an aggregated measure, and the relative prices of different components can and do vary. This aggregation assumption will not be incorrect as long as the different price indices do not vary too much; this will occur if price elasticities of imports and exports are sufficiently high.

The income side is modeled in a very detailed fashion. There are many tax rates, and more than 20 categories of income and expenditure for 8 sectors. The econometric approach of demand forecasting then becomes that of estimating the components of final demand and of imports for the categories for which data are available: 57 for imports, 42 for customers' expenditure, 40 industries × 5 categories for investment, 16 goods × 10 areas for exports. Traditionally, investment and exports have been regarded as "difficult" areas of forecasting, but in the UK the other two categories have had problems of their own:

1. $\left(\frac{\text{Imports of manufactures}}{\text{G D P}} \right)$

1966	7.0%
1976	14.5%

2. Personal savings ratio

1966	1967	1968	1969	1970	1971
9.1	8.5	7.9	8.1	8.9	8.5

1972	1973	1974	1975	1976
10.5	11.7	14.1	15.3	14.6

The first estimate of the import functions had the following form:

$$\log \frac{m}{q} = \alpha_1 + \alpha_2 h + \alpha_3 \log \frac{d}{\bar{d}} + \alpha_4 t + \alpha_5 \log \frac{P_m}{P_q} \quad ,$$

where

h = total domestic demand,

$\frac{d}{\bar{d}}$ = deviation from trend of total demand for commodity,

t = trend,

$\{ \log \frac{p_m}{p_q} \}$ = distributed lag on relative prices.

This was reached after much testing of alternative specifications. The term in total domestic demand reflects the variety hypothesis in international trade: as incomes rise, demand diversifies to a greater range of goods, most of which may come from abroad. However, this particular specification implies marginal propensities to import that are greater than one, i.e., that domestic production is inferior.

Although this may be true for one or two industries, it does not seem plausible for the economy as a whole. Accordingly (log h) was substituted for (h) in the import functions, and α_1 and α_2 were adjusted so that the level and slope of the import equations were the same as before for the final year of the estimation period. The effects over the forecast period are shown in Table 1.

It should be stressed that the comparisons in Table 1 are not true forecasts; one reason for this is that there is a trade surplus in both runs, a large one in the new run, but many other features need clarification. The figures are presented only to give an idea of the large effects of a small change in the model structure. Of course, the equations should be reestimated. This report is based on work in progress, and it illustrates the problems facing the economic forecaster where there is no obvious way of modeling a changing structure. It also indicates that he must be attentive to the economics of his hypothesis, because, in the long term, inconsistencies may become apparent.

The same general remarks can be made about modeling the savings ratio in the light of its recent sharp variations. The

Table 1. Effects of a change in the import functions: Projected average annual growth rates 1977-1985(%)

	Old	New
GDP	1.7	2.0
Consumption	2.1	2.4
Investment	1.7	2.2
Exports	5.5	5.6
Imports	6.5	6.2
Employment	-0.3	0.0
Unemployment in 1985	14.0	10.0

popular explanations of such variations are (a) the rate of inflation and (b) the real value of liquid assets, but the economic theory behind these explanations is rather weak. Economists have instead looked into a model in which the explanation lies in misjudgments about real income. The latter explanation is acceptable at the moment, but one can never feel totally confident that it will be in the future when what was previously regarded as a stable relationship can diverge so far from its "norm."

DISCUSSIONS OF KLEIN'S AND WITCOMB'S PAPERS

Weiss asked Witcomb how inflation was introduced into the model. Witcomb answered that inflation is exogenously determined. There is no wage-price relation. It can originate from imports, or from the cost-push, but not from the demand-pull side.

Weiss then questioned the validity of this approach for the long term, to which Witcomb responded that, in the long run, mark-ups were fairly constant.

Young asked Klein for the cause of inflation in the model. Klein said it originated from many factors: agricultural product prices, the United States being a large agricultural products producer; energy prices; the degree of capacity use; and monetary and fiscal policies.

Bell asked Witcomb if in the UK model allowance was made for the possible migration of part of the UK unemployed labor force to other EEC countries. He also asked if demand coefficients were price sensitive.

Witcomb answered that the fuel elements of matrix A are price sensitive, and vary with relative prices. He said the model does not consider possible labor migration to other EEC countries.

Sheshinski wondered about the high levels of unemployment resulting from the UK model; although output was assumed to grow in the projection period, employment remained static. Witcomb answered that this came from productivity growth, but added that the actual results of the model were not as important as the degree of sensitivity of the results to, for example, imports.

Augustinovics asked Klein how, if the coefficients in matrix A are fixed, one takes care of the problem of technical change in a long-term projection (up to year 2000). Klein replied that a neutral type of technical progress could be introduced into the model by variations on the Cobb-Douglas theory. An alternative method would be to resort to the use of engineering signals (and not price signals) in areas where specific technical progress could be projected. This applies to the energy sector, where projections of coal or electric power, by a technique of separate submodeling, could be introduced into the total model.

Augustinovics then asked Witcomb where he thought the dynamic element in his model lay. Witcomb said that solutions to the

model were computed on a yearly basis and that lags were introduced in the demand functions; there was also a feedback from investment to productivity. Klein then pointed out that in the U.S. model trend dynamics or exogenous dynamics were needed. Mitra asked Klein about the sensitivity analysis in the model. Klein replied that estimation of errors and confidence intervals were handled in two ways:

1. Formal calculation of sampling errors (stochastic simulation) performed on the short-term model only. In the long term, errors of $\pm 5\%$ were tolerable, but in the business-cycle prediction, errors of $\pm 0.5\%$ were desirable.

2. By comparing the whole range of forecasts, i.e., by using corroborative evidence. For example, the GNP growth rates in the United States, Europe, and Japan were all shifting downwards in comparison with the period between World War II and the early 1970s. While in the period after the war growth rates of 3% would have meant high unemployment rates, demographic evidence shows that in the 1980s the work force will grow at a lesser rate, so that the lower GNP growth is tolerable.

Nagy asked Klein if the consumers of the model also checked their results with those of the model.

Klein said that for the last 10 years basically the same models have been used, and the panel of users has not changed. The enterprises make their own projections, and these are in line with the results of the model. There is a system of feedback, and the actual model is a type of distilled result.

INTERNATIONAL ASPECTS OF LONG-TERM ECONOMIC PLANNING

A. Nagy

Among the many aspects of international economic relations, international trade is perhaps one of those better understood and studied. Sectoral global issues however, are, easier to analyze than macroissues, since, in the former case, it is simpler to satisfy the consistency requirements, while, in the latter, the interrelations are more difficult to trace. Here a distinction must be made between foreign and international trade. In considerations of foreign trade, the outside world is taken as given or simply ignored by national plans; however, in analyses of international trade, the world economy is viewed as a globally consistent system into which national plans and models have to be fitted. In socialist countries, even medium-term plans cannot be successfully developed without coordination between trade partners, in order to avoid contradictory estimates of future actions. The classical example of insufficient coordination between an integrated group of countries is the one where all want to import the same good, e.g., raw materials, in exchange for exporting one good, e.g., machinery.

Consider a three-dimensional matrix-block of trade flows where the x_{ijk}'s are the values of exports from country i to country j of commodity k in a given year; the purpose of planning would be to avoid double entries into the cell of the matrices, i.e., to eliminate the difference between aspired or planned amounts of exports and imports between trade partners (ignoring transportation costs).

A model that takes into account the exports and imports of different countries can have several applications:

- It can try to account for the state of affairs in world trade flows, i.e., an analytical approach.
- The model can be used for forecasting purposes, in order to determine the most probable outcomes of trade.
- It can be used for planning purposes, to achieve desired levels of imports and/or exports.

The distinction between forecasting and planning is an important one. Although both attempt to look at the future in a logical way, the first is probability oriented while the latter is target oriented. Forecasting attempts to find the most probable result given certain assumptions, while planning defines

means to achieve certain given targets. There is at present insufficient global collaboration to allow common trade targets to be set for the whole world.

Trade-flow forecasting (or planning) carried out by national economies must satisfy two conditions. The first involves internal consistency; the sum of exports and imports must be equal to the difference between production and consumption in all branches of the economy. This is an accounting identity used in traditional planning methods and in macromodels. The second condition is one of international consistency; this requires that national export and import estimates (or plans) fit into a consistent system of world trade, so that the projected exports from country i to country j in commodity k would be equal to the projected imports of j from i in commodity k.

STRUCTURAL ANALYSIS OF INTERNATIONAL TRADE

The δ structural coefficient system assumes that there are three factors that influence trade flows between two countries: the export-push effect, the import-pull effect, and the intensity-of-trade effect (this characterizes the special trade relationship between two countries for a certain commodity, and will be defined presently).

The push and pull effects, called the volume factors, are defined by "normal" trade flows in commodities as follows:

$$\bar{z}_{ijk} = z_{i.k}\, z_{.jk} \quad ,$$

where

$$z_{i.k} = \frac{x_{i.k}}{x_{..k}}$$

the share of exports of commodity k from country i to total world trade in commodity k,

and

$$z_{.jk} = \frac{x_{.jk}}{x_{..k}}$$

the share of imports of commodity k by country i to total world trade in commodity k.

The intensity coefficient (δ) of the individual trade flows by commodities shows the relation of the actual trade flow to the "normal" flow, and is defined as follows:

$$\delta_{ijk} = \frac{z_{ijk}}{\bar{z}_{ijk}}$$

where

$$z_{ijk} = \frac{x_{ijk}}{X_{..k}}$$ the share of export of commodity k from country i to country j to total world trade in commodity k.

The above measure of intensity is clearly commodity-specific. More generally, the δ coefficients between two countries i and j can be taken to equal

$$\delta_{ij.} = \frac{z_{ij.}}{\bar{z}_{ij.}} = \frac{z_{ij.}}{z_{i..}\, z_{.j.}} \quad .$$

The δ coefficient system has one degree of freedom:

$$\sum_j \delta_{ij.}\, z_{.j.} = 1 \quad \text{and} \quad \sum_i \delta_{ij.}\, z_{i..} = 1,$$

$$z_{.j.} = \Delta^{-1}\, \underline{1} \quad \text{and} \quad z_{i.} = \underline{1}\, \Delta^{-1}$$

where $\underline{1}$ is a vector with all entries unity.

Investigating the historical development of this intensity factor, one can observe two trends. First, the normalization of international trade implies that the intensity coefficients tend towards the value one from above and from below, i.e., actual flows are approaching over time the value of "normal" flows (see the empirical findings in [1]). This is obviously the result of the opening up of economies, the dismantling of protective barriers, and the liberation of former colonies. Furthermore, it was observed that the rate of change in the δ coefficients are inversely proportionate to the distance away from one, which indicates that the time-curves of the δ coefficients are flattening out as they approach one from above and from below. Secondly, there is an integration effect for integrated regions or markets, e.g., EEC, CMEA, United States-Canada. Here the δ coefficients are observed to reach a significantly higher level than one in the cases of trade flows between participants of the integrated region; consequently, the coefficients of the flows with the "outside" are significantly below one. At the same time, disintegration effects are observed where previously there was forced integration, e.g., colonial ties, resulting in a substantial decrease of the intensity coefficients.

Very few studies have attempted to study the effects on trade of price rises in some commodities taking place as recently as in the early 1970s. It would be interesting to analyze volume and structural changes in world trade as a response to the changing terms of trade.

The sudden increases in world market prices may have been caused by the extreme rigidity in prices and exchange rates that had reigned for about two decades. The average world market price increase was less than 1% annually before 1969. Although it is difficult to explain the reasons for this rigidity, the fact that it existed might have generated sufficient tension to cause the violent release in both price and exchange rate changes in the early 1970s.

Nevertheless, it is difficult to predict future trends in prices and exchange rates, but one will probably continue to observe increasing flexibility in both factors.

To conclude, the author believes that, difficult as it may be, to find consistent solutions for world trade and price estimates is not a hopeless task. Research in this field is possible, provided that international cooperation can be established.

REFERENCE

[1] Nagy, A., *A Vila'gkereskedelem Struktura'ja E's Jövöse (The Structure and future of international trade)*, KJK, Budapest, 1977.

DISCUSSION

Klein asked how the domestic forces that shape international trade should be built into the model. Nagy answered that either one can assume that national economic models exist, or one has to determine total exports and imports between countries.

Klein stressed the importance of incorporating feedback effects; he also emphasized that changes in prices and exchange rates are the equilibrating mechanisms.

Mitra drew attention to the research activities at IIASA concerned with food problems, which link various national models.

Nagy answered that a model of one particular commodity does not ensure consistency; therefore, one should use comprehensive models. Klein asked how many countries or regions are encompassed by Nagy's model. Nagy said that he had analyzed the trade flows between six regions and six commodity groups.

De Janosi asked what would be the consequences if the forecasts are mutually inconsistent. Nagy replied that it would be

possible to revise the plan or to increase the competitiveness of exports.

Mitra mentioned that inconsistent forecasts can serve a useful role by being self-destructive. Milleron said that noncooperative solutions are not efficient if the agents follow a Nash-strategy. Nagy replied that his model does not provide any information on the efficient use of resources.

VI. APPLICATIONS OF PLANNING MODELS

SOCIAL SECURITY SYSTEMS

E. Sheshinski

INTRODUCTION

The major goal of social security systems is to supplement incomes during retirement. Thus, individuals are taxed during their working life and receive benefits upon retirement (after the age of 62 in the United States). The system in the United States (and in other countries, including Israel) is based on a pay-as-you-go principle, i.e., benefits to recipients are paid out of annual taxes. An alternative would be to establish an investment fund and to pay benefits from interest income.

Recently, the U.S. social security system has encountered severe solvency problems, the present value of benefits to future recipients exceeding present value of incoming taxes. This is largely due to demographic changes, i.e., the decrease in birth rates, increased life expectancy, and earlier retirement.

Economists should view social security as part of a general income-guarantee system, which includes standard (positive and negative) income taxation, but allows tax schedules to be age dependent.

Ultimately, the introduction of a social security system, which is a method of compulsory saving, can be justified because it counteracts the effects of imperfect foresight on behalf of economic agents, of capital market imperfections (savings availability), and, not least, distributional goals (the formulas for benefits, as a whole, are progressive, although social security taxes become regressive above a certain level of income, because of the ceiling limit for payments).

Diamond has made some simple calculations concerning individuals who expect to live in retirement for a certain period of time (say, 20 years), in terms of the wealth-income ratio at the time of retirement required to keep consumption at its pre-retirement level [1]. These calculations show (depending on the rate of interest) that accumulated wealth should be between 5-7 times annual income. In fact, low-income groups (in the lower two deciles) had wealth-income ratios of 1-2. This suggests that some kind of social security is warranted.

MAJOR ECONOMIC ASPECTS

Savings Effects

It has been argued by Feldstein and others that the pay-as-you-go principle, upon which the social security system is based, tends to reduce national savings and investment considerably. The reasoning is as follows. In the absence of social security, individuals would save towards retirement during their working life. This saving would be reflected in or backed by real investment. Under a social security system individuals regard future benefits from this system as their own savings. However, social security only provides for transfer payments from the young to the old that have no counterpart in real investment. Therefore, Barro has argued that if individuals take into account their descendants' (or parents') welfare, then social security tax payments by future generations are fully capitalized by the recipients of social security benefits at the time of the introduction of the system, and this concern will be reflected in increased bequests exactly offsetting the social security payments [2]. Thus, he concludes, there will be no real effects in the economy. Clearly, the debate cannot be settled by a priori reasoning but by an examination of the effects that social security has had (if any) on real savings. Such studies are currently being undertaken in several countries.

Feldstein, loyal to his theoretical conclusions, suggested that the social security system should be based on the Funding principle, i.e., benefits would be paid out of investment interest-income. Obviously, the accumulation of such a fund would impose great sacrifices on the current generation in favor of future generations. Clearly, this intergenerational justice problem cannot be settled by a priori reasoning.

There is another reason why we should not expect private savings to compensate for increases in social security benefits and taxes on a one-to-one basis. I refer to situations of uncertainty (with regard to, say, life horizon) in which individuals are risk-averse, but the social security system, because of an argument of large numbers is risk-neutral.

Example

c_0 = present consumption;
c_1 = future (retirement) consumption;
B = bequests;
w = wage income;
a = social security tax;
S = private savings;
R = $(1 + r)$ = rate of return in the capital market
θ = life horizon ($0 \leq \theta \leq 1$), a random variable, with expected value $\bar{\theta}$ ($= E(\theta)$).

Suppose the social security system is based on a fund, and that it promises benefits at a level x to an individual so long as he lives. Then, if the individual pays a in the first (working) period, this accumulates to $R\alpha$, at the beginning of the retirement period. Since benefits are paid only throughout life, in expected-value terms the social security's budget constraint is

$$R\alpha = \bar{\theta}x \quad \text{or} \quad x = \frac{R\alpha}{\bar{\theta}} \quad .$$

The individual maximizes

$$u(C_o) + E[\upsilon(c_1, B, \theta)]$$

with respect to c_0 and S, subject to

$$c_0 = w - a - S,$$
$$B = RS + \frac{R\alpha}{\bar{\theta}}\theta - c_1\theta \quad ,$$

and for a given a. It can be shown that at the optimum $-1 < \frac{ds}{da} < 0$. That is, an increase in social security will be only partially offset by a decrease in private savings. The reason for this result is discussed in a paper by E. Sheshinski and Y. Weiss [3].

Retirement Effects

It has been claimed that the social security system induces individuals to retire earlier. A theoretical discussion of this problem is contained in a paper by E. Sheshinski [4].

Insurance Aspects

We should distinguish here between personal risks (unemployment, health, etc.) and macrorisks (price level changes, state of the economy, etc.). In a decentralized economy insurance against one type of risk sometimes increases the other type; therefore, one should look for an optimal combination of insurance against the effects of personal and macrorisks.

REFERENCES

[1] Diamond, P.A., A Framework for Social Security Analysis, *Journal of Public Economy*, 8, 3 (1977).

[2] Barro, R.J., Reply to Feldstein and Buchanan, *Journal of Political Economy*, 84, 2 (1976).

[3] Sheshinski, E., and Y. Weiss, *Uncertainty and Optimal Social Security Systems*, Hebrew University, Jerusalem, mimeo, 1978.

[4] Sheshinski, E., *A Model of Social Security and Retirement Decisions*, Technical Report No. 30, Harvard University, Cambridge, Mass., Dec. 1976.

DISCUSSION

Klein mentioned that when comparing savings ratios between countries, one should add the contributions of the social security system to private savings. When this is done, the total savings ratios between the United States and Japan appear to be very different. Sheshinski said that taking lifespan uncertainty into account creates the incentive for private saving, in addition to compulsory saving by means of the social security system. Neither type of savings is a substitute for the other. Augustinovics pointed out that the working generation produces the benefits for the retired population; one should also remember that present productivity is probably higher than that of the previous generations. Furthermore, in considering the distribution of income in multigenerational families, one should not overlook redistribution processes within one family.

Sheshinski mentioned two alternative criteria for the distribution of social security benefits: either to maintain the same standard of living to which individuals have been accustomed during their working period or to relate benefits to the average level of wages in the economy. The selection will be influenced by the economic norms of society.

In opposition to the view that saving in the social security system is in fact investment (accumulation) leading to increased productivity, Sheshinski again stressed the redistributive aspect of this system. Stiglitz said that one should clearly separate the question "What is the optimal redistribution among the retired population?" from the question "Is there too much or too little private capital?" He also pointed out that the social security system is based on redistribution and not on a security principle in the strict sense.

Finally, Sheshinski mentioned two other aspects:

- Does the introduction of a social security system have strong distortive effects on the age of retirement?

- Should such a system aim to provide protection against personal risks or macrorisks?

NOTES ON EDUCATION AND INEQUALITY IN LONG-RANGE PLANNING

A. Weiss

INTRODUCTION

Education, whether conducted as schooling or "on-the-job" training, is often linked with examinations. The testing in schools is conducted explicitly and results in course grading and the passing (or failing) of accreditation exams, such as those for lawyers, doctors, and pharmacists.

The on-the-job process of examination can be observed from effects; some workers are given larger pay increases or promotions than their fellow workers, while others may be induced to quit or are dismissed. Differential pay policy is often explained by the link between wages and productivity. However, measures of productivity, or expected productivity, have the same imperfections, costs, and incentive problems as those found in school-administered examinations.

The examination component of education has social costs that are not internalized by the participants. In discussing the social costs of an examination, we will assume that education does not affect the productivity of individuals and that individuals do not have comparative advantages in performing different jobs.

SOCIAL COSTS

Increasing Inequality

If productivity could not be measured, each worker would receive a wage equal to the expected marginal product of an individual chosen randomly. Examinations cause wages to be linked to individual productivity and thus increase the variance of earnings.

Intergenerational Wealth Transfers

Education has many of the characteristics of a lottery. Therefore, if all members of society are risk-averse, the expected return from participating in this lottery will exceed the return from a safe investment. If the children of wealthy parents are less risk-averse than the average, they will take the more costly examinations, i.e., forms of education and jobs

in which the forgone earnings during education are substantial and in which entry-level salaries are low. These costly tests will have higher expected returns than less costly tests. The intergenerational transfers of costly education will be exacerbated by imperfections in the capital market, which further discourage the children of poor parents from taking long low-wage apprenticeships or from pursuing many years of education.

Signaling Properties

If people have some knowledge about their probability of passing an examination, then there may be excessive investment in examinations, even by those receiving the education. The return from being tested is the ex ante return that the individual expects minus the wage received by an untested worker. Once a testing procedure is introduced, it may attract the most able individuals, lowering the wage of the untested workers, and increasing the expected return from being tested.

If testing is especially costly, these most able workers might have their highest income in a world in which no one was tested and all received a wage equal to the productivity of the mean worker (by ability). However, in a state of equilibrium, rather than receive a wage equal to the productivity of the low-ability untested workers those most able choose to be tested.

Sitglitz has also noted that, if the workers with a high probability of passing tests are less productive in the untested jobs than the workers who normally do those jobs, the latter may wish to promote testing as a means of removing the former workers and of raising the mean productivity of the untested workers. Thus a state of equilibrium might entail too little testing.

Incorrect Incentives

If examination results are an imperfect measure of several attributes, some of which are correlated with ability, then individuals may expend a good deal of effort improving those attributes affecting examination scores, even if attributes are not well correlated with productivity.

CONCLUSION

Our assumptions of "no comparative advantage" and "no increase in productivity" from education have obscured two of the major benefits from testing: incentives for effort by students and workers in entry-level jobs; matching individuals to the jobs for which they are best suited. On the other hand, examinations may increase income inequality and lead to an overinvestment both in education and in the attributes tested by the examinations.

If the inequalities generated by the examination system are later to be alleviated by income redistribution programs, then the total loss of the associated taxes must be included in computations of the net return to investment in education.

Measures that lower the cost of higher education may decrease the inequality associated with wealth differences, if those transfers go from relatively wealthy to relatively poor members of society. At the same time, since individuals receiving higher education are likely to have greater lifetime earnings, aid to higher education will increase the inequality associated with ability differences.

DISCUSSION

Porwit asked how the topics mentioned in Weiss's paper were related to the planning problems faced by governments. Weiss replied that the decision to invest in schooling or in on-the-job training, depending on the rate of return, has long-range macroimplications for the distribution of income and wealth within and between generations. Klein mentioned a problem that is frequently discussed throughout the United States. It concerns an alternative to the use of a macropolicy aimed at reducing the rate of unemployment to the target level of 4%; for approximately 1 million workers, jobs should be provided either by the public sector directly or by the private sector subsidized by the government. Three questions should be considered here:

- At what level should the wage rate be fixed for these workers? How far should it exceed the minimum wage rate? To what extent should the difference be subsidized by the government?

- For how long should they be trained on the job?

- Should the government become an employer of last resort?

Weiss argued that such a subsidy program will face "matching problems" and probably lead to efficiency losses. Sheshinski asked why in many models it is assumed, contrary to facts demonstrated by empirical studies, that there is a connection between income and abilities? He posed three further questions related to the educational arrangements in socialist countries:

- Are there any studies on the rate of return to education?

- Which criteria do socialist countries use in examinations? Do they use efficiency criteria related to abilities, or is there favorable discrimination for certain groups?

- Are there any studies of social mobility matrices?

PLANNING FOR EQUITABLE GROWTH IN LESSER DEVELOPED COUNTRIES

C. Bell

This paper does not intend either to discuss the problems of less developed countries (LDC) in general or to deal with economy-wide planning methods, for two reasons. First, LDCs show great heterogeneity as a group, whichever measure of development one uses (per capita gross national product (GNP), social formation, history, structure of production, etc.), so that it is difficult to form general rules that would apply to all of them. On the other hand, LDCs display some common factors--mainly a desire to change the status quo, which is seen to be unsatisfactory--and many feel the need for some fundamental change in economic structure.

Secondly, the author, having worked on the development of an irrigation project in a backward region in Northwest Malaysia, the Muda River Valley, wishes to use this case study to illustrate some important issues concerning social cost-benefit analysis and its relationship to long-term planning. The basic features of paddy production in Malaysia are the following:

- It is an atypically small sector by Southeast Asian standards, constituting merely 2% of GNP; only 8% of the total population obtain their principal source of income from paddy production.

- It is highly localized in three or four areas, which are invariably poor regions. Average per capita income in the most affluent area is only 60% of the national average. The population of paddy farm households is racially homogeneous - mainly Malays, who support the ruling coalition.

To plan project appraisal in a wider context, it is necessary to have some idea of how the economy as a whole will develop in the following 10 to 15 years. In the last 10 years the Malaysian economy has grown rapidly (8%), and it will probably continue to grow at a slightly slower rate (7%) until 1990-1995, providing that civil strife does not occur. The Malays, who are mainly employed in government or agriculture, form 50% of the total population; the Chinese, mainly occupied in business and commerce, account for 35%. Annual per capita GNP is at present U.S. $750, and is expected to rise to $1500 by 1990. Annual population growth is estimated at 2.6-2.7% until the year 2000, at which time Malaysia is expected to be a fairly developed country, comparable in structure to present-day Italy. The agrarian problem will then cease to be of central importance.

The question is whether the present economic and social organization of paddy production will survive--and if it does, at what cost--or whether there will be large-scale destruction of the present system of paddy production.

The future growth of paddy production in the Muda River Valley is expected to be approximately 3-3.5% annually, allowing for double cropping, a result of the implementation of new irrigation schemes; for water control in presently irrigated areas; and for an improvement in varieties.

Given that relative prices are fixed, what would be the necessary general expansion in demand for rice that would absorb future supply? Domestic demand is expected to increase in proportion to the population increase--about 3% annually; the elasticity of demand for rice is very low--about 0.1%. At present, 85% of the rice needed is produced domestically, so the goal of achieving complete self-sufficiency leaves some margin for domestic supply to expand a little faster than domestic demand, without putting a downward pressure on prices. If, however, supply should exceed demand, it might be necessary to dump the excess supply on foreign markets, i.e., subsidize the farmer, since Malaysian rice prices are higher than world prices and Malaysia will remain a high-cost producer. This raises the question of who would pay for the subsidy.

The methodology used in the project involves the construction of a social accounts matrix for the region. The aim is to capture explicitly the changes in income distribution resulting from the project.

Households are categorized according to socioeconomic characteristics into four classes, three of which belong to the case-study region. The latter are:

- "landless" households, i.e., those deriving most of their income from employment on the paddy farms of others;
- "labor-abundant" farm households, i.e., those possessing a high ratio of family labor to area operated;
- "land-abundant" households, which hire nonfamily labor in substantial numbers.

Farm households outside the case-study region are heavily engaged in "other agriculture." They also supply labor to households in the region, when it is needed at times of peak activity. Nonfarm households account for 35% of the region's population; the majority of these households are Chinese.

To estimate the "downstream" effects of the project, a variant of the closed Leontief model is used. The variant chosen is usually characterized by fixed exogenous demand and perfectly

elastic supply. But these conditions do not apply to a small open economy, where output capacity is constrained, while demand is not fixed, exports acting as a buffer. Three types of goods are identified in the model: tradeable goods--output being determined by capacity; nontradeables--output proportional to level of economic activity; and noncompetitive imports.

The following scheme is greatly simplified for pedagogic purposes. The output of exportable goods is fixed, and the region is in balance-of-payments equilibrium, with zero net savings and investment. Consider a project, e.g., an irrigation system, that increases the gross output of tradeable goods by one unit. The following notation is used:

good 1: the tradeable good,

good 2: the nontradeable good;

and

X_1 : amount of tradeable goods produced,

X_2 : amount of nontradeable goods produced,

ΔC_m : change in consumption of noncompetitive imports,

ΔC_1 : change in consumption of good 1,

ΔC_2 : change in consumption of good 2,

ΔE_1 : change in exports of good 1,

ΔY : change in income,

v_1 : change in income as a result of producing one more unit of X_1,

v_2 : change in income as a result of producing one more unit of X_2.

Choosing units such that all goods prices are unity, the change in the material balances for domestic goods may be written as:

$$1 = a_{11} + a_{12}\,\Delta X_2 + \Delta C_1 + \Delta E_1 \quad , \tag{1}$$

$$\Delta X_2 = a_{21} + a_{22}\,\Delta X_2 + \Delta C_2 \quad . \tag{2}$$

There is a balance of payments equilibrium:

$$\Delta E_1 = m_1 + m_2\,\Delta X_2 + \Delta C_m \quad . \tag{3}$$

All extra income is spent:

$$\Delta Y = \Delta C_1 + \Delta C_2 + \Delta C_m \quad , \tag{4}$$

where

$$\Delta Y = v_1 + v_2 \, \Delta X_2 \quad , \tag{5}$$

and, because prices are equal to costs, $a_{ij} + a_{2j} + m_j + v_j = 1$ $(j=1,2)$.

A constant proportion of marginal income is spent on each good:

$$\Delta C_i = b_i \, \Delta Y \quad , \qquad i = 1,2,m, \tag{6}$$

with $b_1 + b_2 + b_m = 1$.

This linear system has six independent equations in six unknowns: ΔX_2, ΔE_1, ΔY, ΔC_1, ΔC_2, ΔC_m. By adding equations (1), (2), (3), and (5), using the restrictions $a_{ij} + a_{2j} + m_j + v_j = 1$, we obtain equation (4), and only two of the three equations comprising (6) are independent. After some simple substitution, we obtain:

$$\begin{bmatrix} -a_{12} & -b_1 & -1 \\ 1 - a_{22} & -b_2 & 0 \\ -v_2 & 1 & 0 \end{bmatrix} \begin{bmatrix} \Delta X_2 \\ \Delta Y \\ \Delta E_1 \end{bmatrix} = \begin{bmatrix} -1 + a_{11} \\ a_{21} \\ v_1 \end{bmatrix} . \tag{7}$$

Now the vector $\pi = [-1 + a_{11}, a_{12}, v_1]$ summarizes the direct effects of the project. After allowing for input use, the project makes available $(1 - a_{11})$ units of good 1 for use in the other sectors, in exports, and in household consumption. Also, the output of nontradeable goods must rise by a_{21} to support the additional unit of gross output in sector 1. Finally, the project results in a direct increase in household income of v_1.

Solving for X_2, Y, and E_1 explicitly,

$$\Delta X_2 = \frac{a_{21} + b_2 v_1}{1 - a_{22} - b_2 v_2} \quad , \tag{8}$$

$$\Delta Y = v_1 + \frac{v_2 (a_{21} + b_2 v_1)}{1 - a_{22} - b_2 v_2} \quad , \tag{9}$$

$$\Delta E_1 = (1 - a_{11} - b_1 v_1) - (a_{12} + b_1 v_2) \Delta X_2 \quad . \tag{10}$$

As the output of tradeables is fixed, all multiplier effects stem from the expansion of output and incomes in the nontradeable sector. The own input-output coefficient for the latter is a_{22}, and a fraction, b_2, of the income accruing to households from an extra unit of nontradeable output, v_2, is spent on that very good. Hence the multiplier for the system is $1/(1 - a_{22} - b_2 v_2)$. The direct impact of the project on the demand for nontradeables is the sum of the project's intermediate demand, a_{21}, and additional demand by households due to their direct gain in income from the project, $b_2 v_1$. After the multiplier process has petered out, we obtain the total change in the output of nontradeables given in equation (8).

The downstream effect of most concern to us is the increase in income accruing to households over and above that which is derived from the project. This would be the increase in value added in the nontradeable sector after all adjustments are complete.

The next step is to incorporate the downstream effects within a social cost-benefit analysis of the project. The methods used, those of Little and Mirrlees, are solely for purposes of illustration [1].

The change in social welfare resulting from the project can be written as follows:

$$\Delta U = \Delta F + \frac{1}{s} \Delta Y \quad , \tag{11}$$

where ΔU = the change in social welfare, ΔF = the resulting change in foreign exchange available to the economy (measured at border prices), which is the numeraire, and where $1/s$ = value of an additional unit of private consumption (measured at market prices) in terms of the numeraire. Notice that equation (11) sets the change in private consumption equal to the total change in income within the region, which reflects the assumption that household income is spent, and also implies that

incomes (and production) elsewhere in the economy do not change as a result of the project.

Suppose, for simplicity, that the social cost of creating the extra unit of capacity in the sector producing the tradeable good only consists of the foreign exchange content, K, of the plant and equipment, no labor or nontradeables from the national economy being needed. The change in foreign exchange holdings is the addition to the gross output of tradeables less the change in total demand for tradeables in intermediate and final uses, all valued at border prices.

$$\Delta F = (1 - a_{11} - a_{12}\,\Delta X_2)P_1 - (m_1 + m_2\,\Delta X_2)P_m$$

$$- (P_1\,\Delta C_1 + P_m\,\Delta C_m) - K \quad . \tag{12}$$

As $C_i = b_i \Delta Y$, we obtain the following expression for the social profit earned by the project:

$$\Delta U = (1 - a_{11} - a_{12}\,\Delta X_2)P_1 - (m_1 + m_2\,\Delta X_2)P_m$$

$$- (P_1 b_1 + P_m b_m - \tfrac{1}{s})\Delta Y - K \tag{13}$$

where ΔX_2 and ΔY are given by equations (8) and (9), respectively.

It is immediately apparent that the regional multiplier, $(1 - a_{22} - b_2 u_2)$, has an important influence on the determination of social profitability. However, it is less clear that a strong multiplier will make the project more socially attractive; for although the extra income is valuable, it may be associated with a heavy absorption of tradeables, and hence with a smaller change in foreign exchange holdings. Using equations (8) and (9), the term of interest in equation (13) may be written as:

$$- \left[a_{12}P_1 + m_2P_m + (P_1b_1 + P_mb_m - \tfrac{1}{s})v_2\right] \left[\frac{a_{21} + b_2v_1}{1 - a_{22} - b_2v_2}\right] \quad .$$

Hence, ceteris paribus, a rise in one or more of a_{22}, b_2, and v_2 will make the project more socially profitable if, and only if,[2]

$$\frac{1}{s} > (P_1b_1 + P_mb_m) + \frac{1}{v_2}(a_{12}P_1 + m_2P_m) \quad . \tag{14}$$

The first term on the right-hand side of equation (14) is the expenditure on tradeables (valued at world prices) out of an extra unit of regional income (equals consumption) at market prices. The second term is the tradeable content of intermediate inputs necessary to produce one unit of value added in the non-tradeable sector, the output response of which is the source of all multiplier effects. Thus, equation (14) has a natural economic interpretation: downstream income effects make the project more attractive if the social value of a unit of downstream income exceeds the direct and indirect foreign exchange costs associated with it.

The political assumption is that the utility of foreign exchange held by the government is higher than that in the householders' possession. But does the government actually utilize its foreign exchange to improve the social and economic welfare of the peasants, or for other purposes where the people do not benefit? In such a case, one could argue that extra purchasing power in the hands of householders is preferable to foreign exchange held by the government.

This also highlights the political role of the economic analyst working in government.

Income distribution is not the only issue that should be considered. The implications of structural changes induced by the project must also be examined, and the formation of an overall view of the expected changes in the economy and in its social organization is necessary.

REFERENCE

[1] Little, I.M.D., and J.A. Mirrlees, *Project Appraisal and Planning for Developing Countries*, Heinemann, London, 1974.

DISCUSSION

Tretyakov asked what assumptions concerning the interrelations between the rural and other sectors of the economy underlay the model. Augustinovics wished to know how the socioeconomic structure of households was affected by this project. Bell answered that for pedagogic reasons, he had simplified his model. In evaluating the project one can use different valuations of the income accruing to different households. His model is static, and does not pretend to provide a general equilibrium framework. In the long term one has to allow for structural changes. For example, in Malaysia Chinese households are not allowed to own land at present. If this regulation were to be removed, the Chinese entrepreneurs would probably buy a large part of the cultivated land, forcing the status of an urban or rural proletariat upon the Malays. An economic model cannot predict such changes and their repercussions on the economy.

Porwit wanted to know whether Bell had considered various social alternatives.

Bell replied that this model describes things ex post, as the project was under way at the time of the study.

Dasgupta mentioned the danger of assuming, given the present state of knowledge of project evaluation, that it could be useful at a strategic level. The evaluation procedure usually involves a detailed description of the project as a whole, and an expression of the outcome in one number. An alternative would be to give a description in terms of first-order conditions, showing the contributions of a project to diverse goals.

Klein asked how Bell's model fits into the planning process. What are the different results that market allocation alone would produce? Is the modeling of one region only a great limitation?

Nagy wanted to know how different valuations of the social profitability of foreign exchange reserves could be handled.

Bell pointed out that planning in Malaysia is still at a primitive level. The Malaysian government uses a closed Leontief-type planning model. There is concern that demand will not expand at a sufficiently rapid rate, and that the government will have to subsidize the excess supply. If a free market mechanism were allowed to operate, it would "expropriate" the Malaysians and change the distribution of income and wealth in favor of the Chinese entrepreneurs.

Arthur felt uneasy about the view of development underlying this model, which chooses foreign exchange generation as a main criterion. Changes in the structure of families, of attitudes, roles, social values, etc. were not mentioned. One could not evaluate a project with one number. Bell answered that he would like to emphasize again that in evaluating a project one has to use alternative welfare criteria. Then he raised the question of the degree of independence of an analyst, who sometimes has to produce the figures that an authority expects.

Young commented on the political role of a planner. Depending on the weight given to different variables, different solutions result, leaving a wide range of options for the politicians.

VII. CONCLUDING SESSION

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In an attempt to define future research directions for the Task Force, or for IIASA, or for a combination of both, Mitra summarized five themes that recurred frequently during the conference:

1. In the long-term planning process what are the respective functions of macroeconomic planning models and more disaggregated project evaluation exercises? How much aggregation is appropriate depends in part on how complete a description of a project it is worth assembling; this raises the question of how much information a planning model should contain. Is it possible to devise a methodology to assess the suitability of using summary statistics (e.g., a social rate of discount) and rule of thumb methods (e.g., the inverse elasticity rule in optimum taxation), when information is incomplete?

2. What are the criteria that should underlie the design of new and the improvement of existing planning units? This requires an analysis of multilevel organizations, including the relationship between different elements in the hierarchy. It calls for an examination of the implementability of plans in general and of the incentive compatibility of different instruments to which a planning authority might have access. A related issue is the effect of such instruments on the distribution of income. Whether or not such instruments are satisfactory on grounds of equity is clearly an important matter, as recent work in redistributive public economics illustrates.

3. How do long-term planning models illuminate the effects of technological uncertainty on investment decisions in key sectors of the economy? This question is related to the calculation of option values: is it always possible for a planning authority to postpone an irreversible investment decision if it expects to acquire more information about technological possibilities in the future?

4. The problem of how to define the appropriate scope of activity for the public sector arose repeatedly during the conference. Is it possible to develop methods to help determine the areas in which public intervention might be necessary, and the forms that such action

should take. No satisfactory theoretical answers were found: perhaps more specific questions had to be posed.

5. Some discussion centered around the development of large-scale versus small-scale models. A general solution to this problem was not found; Mitra wanted to stress the desirability of formulating models for specific applications.

Porwit thought that IIASA should not attempt to study a large number of problems at a general or superficial level, but rather concentrate on narrower, more significant issues. These would involve assessing the relevance of linking project evaluation to macromodels and to other aspects of planning--a problem related to the formulation of plans--and linking this to other projects currently undertaken by IIASA, attempting to relate future to current research.

Milleron thought that it was important to emphasize implementation problems; this implies the need to study the structure and operation of existing organizations involved in planning. As a starting point he suggested that specific practical problems faced in planning should be defined. It was necessary to decide on the areas in which future trends can be determined not only by extrapolating from present trends, but also by using other methods, which would have to be specified. He considered it was important to study feedback mechanisms from national-international and sectoral-national factors.

Arthur defined three styles of research that could be carried on at IIASA within the System and Decision Sciences Area:

- A theoretical approach to issues faced by planners, e.g., social security, social discount rate, that would lead to an output of theoretical academic papers. Such work is presently being done by Dasgupta, Sheshinski, Stiglitz, and Milleron, as well as by the System and Decision Sciences group. Arthur drew attention to a certain impatience with such work within IIASA, since the pay-offs in practical planning, although important, lie 10 to 15 years ahead.

- An attempt to improve existing planning tools, e.g., input-output analysis or macroplanning, as seen in the work of Witcomb, Bell, and Klein. This, however, would require a much larger team of researchers than could be assembled by IIASA.

- The use of IIASA's program results aa an aid to practical planning, e.g., all research in the energy, food and agriculture, population and settlement areas.

Witcomb pointed to the gap existing between model builders and planning theorists, and questioned the reasons for its

existence. He thought that intermediate research was needed to translate theoretical ideas into practical plans. Besides the need to improve the economics used in models, which can be done given the state of the art of economics, there is an onus on model builders to be operational.

Tretyakov found three categories of models useful in planning and forecasting:

- Development models (similar to those presented by Klein, Bell, and Witcomb), which are dynamic mathematical programing models valid in long-term planning, and which are currently being used successfully.

- Aggregated information that is presented to the planner, e.g., Nagy's model, which help him in decision making.

- Global models, which provide the long-term planner with general information about the possible repercussions of his decisions on the environment.

Bell mentioned that economists working on development issues do not really understand the process determining income distribution. It was believed that by introducing endogenous prices into a closed Leontief system one would generate an income distribution. Bell said that it had been shown by Taylor that if all prices are market clearing, then income distribution is determined by elasticity of substitution, whereas if nominal quantities, e.g., government outlays, were fixed, then income distribution would be determined by the differences in saving propensities. One should humbly admit that, at present, economists are ignorant of the speed at which the markets clear, assuming they do function in that way.

It is important to examine the change in the structure of institutions that occurs as development proceeds. There has been very little theoretical work on the modeling of both competitive and oligopolistic sectors at a level beyond simple generalization.

Another important issue is to determine the supply price of labor in less developed countries. Changes in agricultural organization and population growth rates (fertility rates being influenced by such factors as woman's role in the work force and the rate of mortality) should be considered.

Augustinovics expressed her satisfaction with the stimulating exchange of ideas that had occurred at the conference, and thought that it was not necessary to develop more models than those already existing. IIASA should use its unique role as an international and interdisciplinary institute to act as a clearinghouse of information on long-term planning experience. This includes listing current projects or methodological issues of interest, and analyzing the methods and results of all work in process that can provide insights into economics in the future.

Nagy said that research into long-term planning issues is a relatively new subject, but that common interests do exist among countries with different social and political systems, and at different levels of development; therefore, the collecting and storing of information and knowledge is a fruitful activity. In that sense he agreed with Augustinovics that IIASA should function as a clearinghouse of information; in addition, it would be useful to link the research of various countries, and to combine theoretical research with implementation. He shared the opinion of those conference participants who stressed the importance of studying societal structural changes, and of defining the circumstances under which it would be feasible to extrapolate future from present trends. He emphasized that he did not share the widespread skepticism about global models; one should attempt to direct research towards those areas in which global models are still weak. Finally, he thought that not enough research into desirable future patterns of life was being done.

Young highlighted an issue that had been considered only briefly at the conference: the political role of the planner. One should distinguish between the planner, whose role is to present models to the policymakers, and the planning process itself. The policymakers, or the critical decision makers who carry out planning, are politicians. The planner provides the policymaker with a greater understanding of the system and with a range of options that enable the policymaker to have power over society.

One should also emphasize the importance of the style in which the model is presented. The results must be put in terms of simple policy options, in order to insure that they may be easily and quickly understood by the policymaker; simple interrelationships need to be highlighted. This raises the question of whether politicians will use the information to manipulate the system for their own benefit.

The Director of IIASA, Dr. Roger Levien, closed the meeting by thanking the participants and inviting them to become part of IIASA's network.

IIASA TASK FORCE MEETING ON LONG-TERM ECONOMIC PLANNING, APRIL 3-7, 1978

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