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A Matrix Model of the Public Social Welfare System for the Aged in the U.S.: A Research Proposal

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The creation or adaptation of planning tools will in all probability be an integral feature of the future development of social planning practice. Social planning in this case means a social process involving institutionalized intervention into the social order, and in particular the political and economic systems, designed to positively affect the general welfare by modifying the distribution of burdens and benefits. This is generally perceived in the literature as a problem-solving process involving identification or definition of the problem, design and selection of alternative solutions, and implementation of choices. In this context, planning tools are defined as extensions of the observational and rational capabilities of the individual social planning involving any of three kinds of formal knowledge: 1) bodies of facts, including research findings, biographical or demographic data; 2) terms, concepts and theory; 3) methods and techniques for observation and analysis.

One tool that offers a great deal of potential utility if it can be adapted to the constraints of the social planning milieu is matrix analysis utilizing input-output matrices. Although professionals engaged in social planning have in recent years developed access to a number of important analytic and observational techniques, the advantages of matrix modeling have generally not been explored. According to Abraham Kaplan (1964, 263) models are isomorphs of one another in the sense that when a relationship holds between two elements of a system a corresponding relationship holds between corresponding elements of another system. In the usage here, these two systems will be referred to respectively as empirical reality and the model. Karl Deutsch (1963, 8) suggests that we may think of models as serving, more or less imperfectly, four distinct functions: the organizing, the heuristic, the predictive and measuring (or mensurative).

As an analytic technique, input-output analysis can be interpreted at a number of levels of complexity and sophistication. To economists and operations researchers the technology appears sufficiently developed that one need seldom venture far from standard operational procedures. The point of view of this proposal and the ensuing dissertation is at a considerably more elementary level. The methodology of input-output-analysis from this point of view can be said to rest upon a detailed analogy or partial isomorphism between a system of quantitative data presented in the columns and rows of a matrix and certain characteristics of an identifiable segment of the empirical social world, in the manner identified by Kaplan and Deutsch just above. Through the ordering and manipulation of this system of data the planner can draw inferences about the probable effects of change in the empirical world.

A basic input-output table of the U.S. economy developed by Wassily Leontief, for example, is composed of an 80-cell square matrix in which the economy is divided into industrial and final demand sectors, and dollar flow data is utilized to

reveal the relationships between the material inputs and finished good outputs (Leontief, 1966). On the basis of general equilibrium theory, it is assumed in input-output economics that changes in one sector of the economy, such as increases or decreases in production, have effects in other sectors of that economy that are demonstrated (organized, predicted and measured) in other cells of the matrix. Highly sophisticated prediction techniques have been developed through the use of linear programming methods. On the basis of operational definition of the economy as a system of linear equations, it is possible to predict future unknown present effects upon other sectors of that economy of a change in any given sector by solving the system of equations for given values subject to established constraints.

If we take the example of input-output economics, it would appear that matrix models have many advantages as isomorphs of certain empirical situations frequently encountered by social planners and which involve a large number of interacting social units. Thus, one of the apparent general advantages of matrix analysis in social planning would appear to be that it simultaneously presents both structural and process or interactional, characteristics of the reality being modeled. For example, the grouping of individual firms into industries on the basis of the production of similar products can be seen as a logico-structural classification based on the ends of economic activity. Likewise, the dollar flow data of the input-output stable provides a closed set of indicators of both the direction and the magnitude of the interactions that characterize the operation of the economy.

Another of the attractive characteristics of the matrix model would appear to be its parsimony, the relative economy with which it allows for expression of complex relationships and for incorporation of huge amounts of information into a relatively concise format.

Finally, one of the most interesting properties of the input-output matrix is the manner in which various indirect relationships (such as the impact of a change in the production of automobiles on the production of chemicals used in the production of synthetic rubber tires) can be established and predicted. Noneconomic matrix models developed in the field of sociometry also suggest their possible usefulness for dealing with similar indirect relationships and otherwise unanticipated consequences in the social world. For example, Leon Festinger converted sociometric data on positive and negative preferences in a small group into a matrix format through the use of + signs to indicate a favorable choice and – signs for negative responses. By squaring and then cubing the matrix he was then able to link together into chains those who chose and were chosen. This technique, he argued, uncovered an aspect of the sociometric structure of groups not readily available by any other technique.Although there are substantial differences between a model of the entire U.S. economy and the interactions of a small group of individuals, the similarities of these two models contribute to greater understanding of the potential usefulness of matrix methods to a broad range of problems in social planning.

Fuller utilization of matrix modeling in planning, with the exception of straight-forward applications of input-output economics to relevant economic problems, appears dependent on the elaboration of solutions to four major problems:

1. The adaptation of social theories sufficient to determine the bounds or limits of the proposed model and its major characteristics.
2. Determination of a suitable basis for differentiating the major structural sub-units that form the rows and columns of the matrix.
3. Identification of the most important inter-relationships between structural units and development of suitable indicators for expression of those relationships in quantitative terms.
4. Identification of specific isomorphic relationships between the behavior of the empirical social world and the possible mathematical operations of matrix algebra involved.

As suggested by these four points, the present development of matrix modeling in social planning can be perceived as proceeding in four steps:

1. Identification and definition of the empirical system to be modeled.
2. Elaboration of the constituent units of that system at the desired level of generality, either constructively through what Leontief terms disaggregation or inductively through what he terms aggregation.
3. Isolation of the key or critical interactions that occur in empirical reality that are to be represented by the model.
4. Conversion of all of these relationships and interactions into structural equations.

For any given matrix model it would appear that these tasks could be approached roughly in the order listed since each is at least partly dependent on the preceding ones.

The purpose of the study proposed here is to set forth an empirical matrix model in a pre-operational manner – roughly the first three steps – through rational argument and presentation of existing, fragmentary evidence. The model to be built is an isomorph of an important sub-set of the American social welfare system; specifically the system of public social welfare for the aged.

Definitions

Definitions of the U.S. social welfare system are many and varied. Ida Merriam defines it as "those public programs that directly contribute to or are concerned with the well-being of individuals and families with respect to basic human needs in the areas of income maintenance, health, welfare, education and housing (Merriam, 1966, 11). According to Harold Wilensky and Charles Le Beaux there are two major conceptions in the literature: the *residual* view of social welfare as an interim stage

in social development and the *institutional* view of social welfare as a permanent feature of urban, industrial societies (Wilensky & Le Beaux, 130-140).

For purposes of this study, the social welfare system is defined as the set of organizations and institutions whose goal-oriented collective action is directed at the purposive manipulation of individual clients and social units toward the end of positive well-being. The major organizations involved in the social welfare system are generally presented as public bureaucracies and voluntary agencies, although private firms and corporations also taken on significance in the case of services for the aged. The majority of nursing homes in the U.S., for example, are under private, for-profit management (Department of Health, Education and Welfare, 1969).

The term institutions is used here in the sociological sense of "clusters of interrelated meanings and values" which form the basis and the environment of individual recurrent behavior (Rose, 1958). Goal-oriented collective behavior here is intended to convey the entire range of volitional and coordinated activity engaged in by social welfare organizations and institutions. It should be noted here that the term manipulation is used in the non-invidious sense of the Random House Dictionary of the English Language (1967), denoting the handling, managing or using with skill some process, treatment or performance. Finally, the idea of positive welfare or well-being is intended to denote what is a nearly universal paradigm of the American social welfare system; the idea that the ends of activities within that system are directed toward adding to or increasing the utility or well-being of particular individual, group or community targets: incremental increases in income, improved health, or the delivery of specific services or other forms of individual benefit.

The specific focus of the proposed study is on the public welfare system of the aged in the United States. This is conceived as a distinct and major sub-system of the total American social welfare system. It consists of those organizations and institutions under public auspices whose programs and services are directed at clients or recipients officially defined as aged, or with old age-related problems. Thus, the end toward which the study is directed can be termed in systems parlance, a "partial systems" model. The model is not purported to represent an entity whose theoretical unity is established, such as an economy or family unit, but rather to empirically establish the relationships existent between entities within a network of separate organizations and institutions essentially united in a logical manner by common purposes.

This unit of analysis was chosen for several reasons. First, there is the stubbornness of certain facts, in particular, the enormity of the task of developing a fully articulated model of the entire social welfare system along the lines suggested here. In addition, one of the real barriers to modeling the private sector activities on behalf of the aged is the general lack of available data at the form and level of specificity required. Another reason for choosing this approach is that in many actual planning episodes, those involved are only interested in a small segment of what is from a theoretical viewpoint an entire system. This discrepancy may, in

fact, be partially responsible for some of the current popularity of "the systems perspective" among social work and planning practitioners. References to "the aging system" or "the field of aging" are quite common, for example, despite the enormous problems of establishing the empirical validity of such a concept as a coherent whole. This kind of vagueness can best be handled at present by an analogy with the mathematical concept of overlapping sets within a larger set (See, Flament, 1963, 1-18). The system of social welfare services for the aged is, in effect, just such a sub-set of the entire social welfare system that overlaps conceptually with a number of other sub-sets including the health care delivery system, the income maintenance system, the housing system, personal care and others.

The fundamental hypothesis of the proposed matrix model proposed here is that the general overall characteristic most representative of the system of public social welfare for the aged is the transmission of benefits between the two major structural elements of the system: service providers and recipients or beneficiaries. Benefits in this context refer to the outputs or products of a particular provider unit. The planners point of view is essential here because there is no universally valid way of establishing what constitute such outputs apart from the professional determinations of social planners. The term transmission is used here to suggest the analogy in communications theory of a structural relationship (the message) between senders and receivers (aka service providers and beneficiaries). The application of this basic idea to the field of social welfare was suggested a decade ago by Alfred De Grazia and Ted Gurr in their elaboration of the field as a system of givers and receivers of benefits (De Grazia and Gurr, 1961).

It is assumed at this point that all of the major characteristics of the proposed model can be derived from this basic model of benefits transmission or communication from providers to recipients. The interpretation of this relationship in input-output terms is that provider outputs become recipient inputs through the transmission of benefits through the delivery of professional services to clients.

Research Questions

The outlines of the model to be developed from this basic structure will represent, in effect the answers to three questions:

1. What are the major organizational units that make up the American public social welfare system for the aged?
2. How are these units related structurally?
3. What are the important patterns of transmission between those units?

A tentative presentation of the answers to these questions would be that the model building process must begin with breaking down into constituent units the two major organizational aspects of the model, providers and recipients, and the major interactional dynamic, transmission of benefits, as in Figure 1 below (Note: the Figures shown here were not part of the original 1971 research proposal.

However, they are consistent with and illustrate the original discussion and are included for that reason.):

Figure 1. A Basic Input-Output Table

Aging Service Providers – Outputs -→	Inputs → Aged Beneficiaries

The analogy with input-output economics suggests that further elaboration of this table might occur by the process of disaggregation. Disaggregation of the providers category might occur either by the elaboration of logical categories such as industries (Figure 2), levels of government (Figure 3), programs or other structural characteristics, or by presentation of evidence of actual, empirical interactions (Figure 4). Disaggregation of the recipient sector appears possible along several lines. Recipients might be classified along demographic lines by age (Figure 5) and/or sex (Figure 6) into population aggregates. Or they might be categorized by various problem groupings by such factors as epidemiological categories (Figure 7), income characteristics (Figure 8), or residential status (Figure 9). Or they might be sorted in specific situations by organizational or group memberships (Figure 10).

Figure 2. Aging Service Providers by Industry/Program Category

Income Maintenance Providers	Inputs to Aged Beneficiaries
Health Care Providers	Inputs to all other Beneficiaries
Welfare Service Providers	
Education Providers	
Housing Providers	

Figure 3. Aging Service Providers by Level of Government

Federal Service Providers	Inputs: Aged Beneficiaries
State Service Providers	
County Service Providers	
Municipal Service Providers	

Figure 4. Local, Public Aging Service Providers in Happy Valley

County Old Age Assistance Program	Inputs: Aged Beneficiaries
Happy Valley Senior Center	
Happy Valley Housing Authority	
Happy Valley School District	

Figure 5. Public Aging Service Recipients by Age

Aging Service Providers – Outputs -→	Under 60
	60-65
	65-70
	70-75
	Over 75

Figure 6. Public Aging Service Recipients by Sex & Age

Aging Service Providers – Outputs -→	Inputs →Men	Under 60
		60-65
		65-70
		70-75
		Over 75
	Inputs →Women	Under 60
		60-65
		65-70
		70-75
		Over 75

Figure 7. Public Aging Service Recipients by Disease

Aging Service Providers – Outputs -→	Heart-Related Diagnoses
	Cancer Diagnoses
	Pulmonary Diagnoses
	Dementia Diagnoses

Figure 8. Public Aging Service by Income

Aging Service Providers – Outputs -→	Lowest Income Quintile
	Lower Income Quintile
	Middle Income Quintile
	Higher Income Quintile
	Highest Income Quintile

Figure 9. Public Aging Service Recipients by Residence

Aging Service Providers – Outputs -→	Living Independently
	Independent Living w/Supportive Services
	Housing for the Elderly
	Living in Personal Care Home
	Living in Nursing Home

Figure 10. Public Aging Service Recipients by Group Membership

Aging Service Providers – Outputs -→	District 1 Senior Citizens Club
	District 2 Senior Citizens Club
	District 3 Senior Citizens Club
	District 4 Senior Citizens Club
	District 5 Senior Citizens Club

Through aggregation and disaggregation, any of these combinations could be transformed into many possible square matrices, depending on the particular problems of greatest interest to the planner at the moment. For example, the provider sector can be divided into three subsectors by ownership: public, or governmental, private (including both voluntary and for-profit) and mixed. The focus will be only on the public or governmental sector in this study for reasons discussed below.

(Note: *The development and widespread dissemination of electronic spreadsheets, and in particular Excel, more than a decade after this proposal made this entire process notably simpler and more straightforward).*

In its final form, the model to be built in this study will be presented as a square data matrix displaying dollar flow date for FY 1970. The suitability of dollar flows is critical. Characteristics of input-output modeling require indicators of interaction or exchange but in the case of social welfare services these can be hard to come by. Conversely use of dollar flows cannot fully come to terms with Sharkansky's criticisms of expenditure performance models Although the question of indicators of interaction is a critically important one in matrix modeling, only a partially adequate formulation is anticipated here, in line with the pre-operational stance of this study. The reasons for this are two. First, dollar flow represents one of the few available approaches to a system of interacting indicators of the type required, because of the lack of non-economic models in this area. Secondly, there are important questions that require detailed investigation regarding the appropriateness of dollar flow as an indicator of the transmission of benefits.

It seems likely that the major barriers to full-scale operationalization of the model proposed here will be related to the relationships that can be established between expenditure-outputs of organizations and the flow of benefits. In a number of instances, for example, utilization of data available in terms of the categories of line-item budgets would result in outputs in which benefits are transmitted to recipients but shown in the model only as an interaction within the provider sector (as in the case of purchase of service agreements). It is anticipated that the organization and presentation of data in program terms will partially overcome this problem. Program budgeting in social welfare organizations is still in its infancy, but much is to be learned from presentations like those of Novick (1969), and Lyden & Miller (1968). Alfred Kahn approaches the subject directly from a social planning perspective (Kahn, 1969, 240-262).

Methods and Data

The major challenge of this study will be the collection of available data and examination of available knowledge about the existing system of public social welfare for the aged, to determine whether the proposed model as it is developed is

consistent with or misrepresents in any fundamental manner the empirical realities that it purports to model.

The major structural units and interrelationships of the system will be identified through examination of existing scholarly literature on aging as well as general social welfare literature and public documents such as federal agency reports and state government blue books. Quantitative data to be used in developing the matrix model once it is defined will be derived from four sources for Fiscal Year 1970: expenditure reports from the Department of Health Education and Welfare and other public sources; reputable non-governmental information sources such as the Council of State Governments; recently released estimates by the Administration on Aging of total federal expenditures for the aged; and data on special state legislative appropriations contained in interview transcripts of the state planning systems research project at the Heller School. (Note: Dr. Robert Binstock is the Principal Investigator of the study.)

Format

The end product of this investigation and model building exercise will be a monograph tentatively organized into five chapters. In the introductory chapter, the role of tools in planning and the potential value of matrix analysis as a tool of social planning will be introduced and discussed with special attention to public social welfare benefits for the aged.

The second chapter will focus on elaboration of the major characteristics of a matrix model appropriate for analysis of the social welfare delivery system for the aged, along the lines set forth in this proposal.

The third chapter will focus specifically on the input-output idea as it is manifested in the relationships between major sectors of the model. Through the use of the concept of a "super matrix" or a matrix whose cells are themselves matrices, the idea of certain characteristics that apply only to limited zones of the model will be developed.

In the fourth chapter the presentation will address the step-by-step introduction of the data into the empty data matrix previously defined. At the end of this chapter, the fully articulated model will be displayed along with a discussion of its major features and how the data are to be interpreted.

The fifth and final chapter will involve an assessment of this model constructed around three primary questions:

1. What is (and is not) shown or modeled by the matrix model as it was devised?
2. What aspects of empirical reality (if any) are misrepresented or not adequately represented by the model?
3. What are the likely fruitful areas of application of the model in social planning?

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