A SYSTEMS SIMULATION APPROACH TO PUBLIC POLICY PLANNING FOR AREA ECONOMIC DEVELOPMENT

by

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INTRODUCTION

"Overall Economic Development Programs" (plans) required by federal legislation for multicounty development districts have not in fact been comprehensive. Planners have failed to view distressed rural areas as a system for which a strategy or policy can be devised, comprised of the level and combination of public programs which meet development targets with efficient use of limited resources. Typical plans are especially deficient in socio-economic planning, failing to identify public programs required to alleviate poverty and underemployment. This study reports methodology and results for reaching such goals efficiently--using mainly federal programs to induce efficient use of private capital and labor. Results apply specifically to only one multicounty district, but suggest directions for other multicounty districts characterized by high underemployment and poverty.

Systems planning (cf. Tweeten, [6] for definition) of socio-economic development such as reported herein can improve both classroom instruction and public policy in rural development. Economic evaluation of the efficiencies of various programs viewed in the context of systems planning, can help public policy decision-makers decide which programs to expand and which to contract, and what total level of funds is required to reach development targets. In the classroom, the systems approach, organized as a rural

development game, allows students to gain "experience" in devising a development strategy. It serves as a method to make students aware of the complicated relationships among demographic factors and policy activities within economic areas. The development model used in this study has been used in the classroom to generate enthusiasm, experience and feedback that are important for effective learning [3].

Objectives

The purpose of this study is to develop and utilize a pilot exemplary model to simulate and evaluate the results of potential rural development policies. The formal objectives of the study are to:

1. Estimate technical efficiency coefficients for alternative area development activities.
2. Devise a computerized simulation model depicting the development process and how it is influenced over time by public programs.
3. Evaluate the effectiveness of past and potential rural area development policy packages in attaining selected targets.

The process of economic development is simulated for the seven-county Eastern Oklahoma Development District located in the Ozarks Region. Development targets are to alleviate, within a reasonable time frame, the high rates of poverty and underemployment that characterize the district.[1] Results show the public cost of efficient strategies to reach these targets.

THE MODEL[2]

We now turn to the content of the simulation model. Because the demographic, program-efficiency and other input data utilized in this study were not originally collected for use in systems planning, more than the usual

number of assumptions are necessary to formulate the simulation model. On the whole, however, coefficients appear to be sufficiently reliable to make possible preliminary conclusions concerning efficient rural development strategies from the model.

The planning model developed herein simulates the rural development process over time as it is influenced by combinations of development programs comprising policy. The population of the Eastern Oklahoma Development District is divided into socio-demographic categories based on income, work eligibility, age and levels of education and training. It is assumed that a decision-making authority has funds available on an annual basis which can be spent on various programs which in turn influence these subpopulations. Various combinations of programs comprising a development strategy are entered into the computerized simulation model. The model simulates adjustment of the population by births, deaths and ageing. It also simulates changes in the population (educational and training levels, migration, birth rates, income, number of poor, etc.) induced by special programs. The output of the computerized model describes, at the end of each simulated year, the simulated new situation of subpopulations and the simulated aggregate economic condition of the area.

Socio-Demographic Data

Impacts of public programs depend on the socio-demographic characteristics of the developing area. In this research, the area population is cross-classified into 21 socio-demographic categories based on income, age, ability to work and levels of education and training (Table 1).

The poor in the area are classified according to their ability to work.

TABLE 1

SOCIO-DEMOGRAPHIC DATA FOR THE EASTERN OKLAHOMA DEVELOPMENT DISTRICT--1970[a]

	Number of Persons	
Nonpoor	114,104	
Less than age 20		
School dropouts (low income)		1,376
Young children and students		38,609
Age 20-39		
High income[a]		2,931
Medium income[b]		12,016
Low income[c]		14,361
Age 65 and over		9,465
Poor[d]	77,090	
Unsalvageable		
Age 15-64		15,298
Age 65 and over		17,147
Young children and students		29,813
Salvageable		
Age 20-39		
With high school education and training		312
With high school education and no training		1,024
With training and no high school education		1,201
With neither high school education nor training		3,958
Age 40-64		
With high school education and training		362
With high school education and no training		1,205
With training and no high school education		1,407
With neither high school education nor training		4,633

TABLE 1 (Continued)

	Number of Persons
Poor (continued)	
Salvageable	
Age 15-19	
With neither high school education nor training (school dropouts)	730

Source of basic data: U.S. Bureau of Census [7, 8].

[a]High income nonpoor classifications include all adults with annual family income equivalents greater than $15,000.

[b]Medium income nonpoor classifications include all adults with annual family income equivalents from $8,000 to $15,000.

[c]Low income nonpoor classifications include all adults with annual family income equivalents from $4,000 to $8,000.

[d]All persons with annual family income equivalent of less than $4,000 were classified as poor.

Those capable of supporting themselves by work are classified as salvageable. Those incapable of supporting themselves by working are classified as unsalvageable. The poor are further classified by age and levels of education and training. The nonpoor in the area are classified by age and income level.

Alternative Development Activities

It is assumed that development funds in the area can be allocated among the following activities:

1. Public assistance grants to unsalvageable poor over age 65.
2. Public assistance grants to unsalvageable poor, ages 15-64.
3. Education (school dropout prevention).
4. Technical training.
5. Family planning.
6. Industrialization.
7. Labor mobility subsidization.

These alternatives are special development activities which can be initiated over and above "conventional" public investments in an area. Roads, schools and other services and infrastructure appear to be adequate in the area, and spending of public funds on these items over and above the projected pattern would appear to have low economic payoff.[3] Of course the area is free to tax the additional economic base generated by economic development programs to provide additional services as residents see fit.

Unsalvageable poor are removed from poverty by continuous transfer payments. Upon reaching age 65, unemployed salvageable poor are reclassified as unsalvageable poor.

Funds allocated to education keep students from dropping out of school. Funds allocated to technical training train untrained poor.[4]

These activities do not provide direct earnings to the poor, but appreciably raise income when the individuals become employed.

Funds allocated to family planning reduce birth rates by making information and contraceptives available to the poor. Over time, this reduces the number of young children and students in poverty.

A portion of the jobs made available by industrialization and labor mobility subsidies go to the poor. Among the poor, jobs go first to the best educated, best trained and youngest. Local jobs made available by industrial development are filled first, then jobs outside the region made accessible by labor mobility grants are filled. Wages paid those taking new jobs vary according to the levels of education and training of the workers. Wages of outmigrants are included in aggregate income of the development district. Some of the new jobs generated locally are filled by local nonpoor and some are filled by nonpoor who migrate into the area. Jobs vacated by the local nonpoor are assumed to be filled by the poor.

While funds allocated to activities other than industrialization do not create permanent jobs in the area, such expenditures do create income for both nonpoor and poor. Administrative costs as well as transfer payments are examples of funds assumed not to directly generate jobs but to add income for the district.

Technical Coefficients

Technical coefficients specified for the rural development simulator determine the simulated economic and other changes which occur in the study area over the time period considered. Some of these changes are

affected by development activities while others are independent of such activities. The population constitutes a dynamic environment, changing over time whether or not development activities are initiated in the area. The technical coefficients required for this simulator are of four types: demographic coefficients, income coefficients, employment coefficients and development activity efficiency coefficients.[5]

Demographic coefficients in the model include birth rates, death rates and a population growth rate (including implicit net migration rates apart from those influenced by the programs) for the study area. The income coefficients specified for the simulator include poverty income thresholds for socio-demographic categories of the study area population, potential earnings for the area's poor who take jobs created by development activities, total income resulting in the area per dollar of public funds spent on development activities, and the percentage of the area's income which goes to the area's poor. The simulator requires the specification of three coefficients descriptive of the labor force of the area considered. These employment coefficients include the percentage of working age adults in the labor force, the percentage of poor in the labor force who have jobs but are underemployed, and the percent underemployment of the underemployed poor.

Estimates of effects of each development activity included in the simulator (activity efficiency coefficients) serve as a starting point for estimating total effects of strategies containing multiple development activities. Linkages become apparent as for example, skill training programs display low payoffs in the absence of programs to provide jobs locally or elsewhere. Development activity efficiency coefficients utilized in this study describe the impact in terms of cost effectiveness, of labor mobility programs,

industrialization programs, school dropout prevention programs, technical training programs and family planning programs.

RESULTS

The quantitative model developed in this research simulated the effects of alternative development strategies on the population of the eastern Oklahoma study area based on the coefficients mentioned above. In this section the simulated results of alternative strategies are discussed and the strategies are compared and evaluated in light of development goals--alleviation of poverty and underemployment in the study area. Because underemployment is concentrated among the salvageable poor, alleviation of poverty also alleviates underemployment.

Simulated poverty amelioration in the study area was measured by the number of simulated years required for alternative strategies to eliminate poverty, and by the simulated person poverty years accumulated for alternative strategies over the time horizon considered. Of these two measures, person poverty years accumulated is the most complete. It is defined as the sum over all years simulated of the number of people remaining in poverty in the study area at the end of each simulated year. Thus, it is one measure of the relative effectiveness of alternative development strategies in removing people from poverty and keeping them out of poverty over time.

Simulated efficiencies of alternative strategies in generating income for the people of the study area were measured by two different efficiency ratios calculated within the simulator. These ratios included a ratio of present value of simulated total regional income generated by

each strategy to the present value of simulated total public costs of the strategy (including transfer payments) and a ratio of present value of simulated income generated for the study area's poor by each strategy (including transfer payments) to the present value of simulated public strategy costs.

Conceptually these efficiency ratios are similar to traditional benefit-cost ratios, but the two concepts are not equivalent. The ratios calculated in this study do not include private costs nor account for all future benefits, hence they are only indexes of income generation efficiency for the strategies considered. They were only calculated over the 15 year planning horizon of the study (until all of the strategies that had the potential to alleviate poverty had done so). Because benefits beyond this 15 year horizon were not simulated, none were included in the efficiency ratios calculated. Consequently, the reported efficiency ratios are biased downward for programs such as family planning and school dropout prevention which have long term effects.[6]

The number of strategies which could be simulated was almost unlimited. To counter this problem, those possible development strategies which appeared to be the most reasonable and feasible from the standpoint of social, economic and political practicality were simulated (Table 2).

Preliminary work with the simulator indicated that the input coefficient of the number of jobs directly created per public dollar spent on industrialization is of critical importance to results of many strategies. Consequently, some of the strategies simulated included the same development activities as other strategies, but were based on different assumptions about the cost effectiveness of industrialization programs.

TABLE 2

SUMMARY OF SIMULATED FINAL RESULTS OF STRATEGIES CONSIDERED[a]

Strategy	Programs Included	Assumed Industrialization Cost Effectiveness[b]	Years Required to Substantially Eliminate Poverty	Person Poverty Years Accumulated	Present Value of total Income Generated[c] ($ Mil.)	Efficiency Ratio 1[d]	Efficiency Ratio 2[e]
1	programs in effect--1970	M	poverty not eliminated	815,666	807	1.59	1.51
2	welfare, training, education, family planning, labor mobility, industrialization	M	12	182,988	1,169	1.46	1.38
3	welfare, training, education, family planning, industrialization	M	11	190,932	1,050	1.39	1.31
4	welfare, education, family planning, industrialization	M	9	142,786	1,085	1.45	1.38
5	welfare, education, industrialization	M	9	130,024	1,095	1.48	1.42

TABLE 2 (Continued)

Strategy	Programs Included	Assumed Industrialization Cost Effectiveness[b]	Years Required to Substantially Eliminate Poverty	Person Poverty Years Accumulated	Present Value of Total Income Generated[c] ($ Mil.)	Efficiency Ratio 1[d]	Efficiency Ratio 2[e]
6	welfare, family planning, industrialization	M	9	141,324	1,086	1.46	1.40
7	welfare, labor mobility, industrialization	M	9	98,756	1,142	1.55	1.48
8	welfare, industrialization	M	9	129,749	1,103	1.49	1.43
9	welfare, labor mobility, industrialization	U	7	69,654	1,186	1.64	1.57
10	welfare, industrialization	U	6	85,316	1,160	1.60	1.54
11	welfare, labor mobility, industrialization	L	15	190,474	1,140	1.39	1.33
12	welfare, industrialization	L	15	229,286	1,051	1.28	1.22

TABLE 2 (Continued)

Strategy	Programs Included	Assumed Industrialization Cost Effectiveness[b]	Years Required to Substantially Eliminate Poverty	Person Poverty Years Accumulated	Present Value of Total Income Generated[c] ($ Mil.)	Efficiency Ratio 1[d]	Efficiency Ratio 2[e]
13	welfare training, education, family planning, labor mobility	no industrialization allocations	poverty not eliminated	357,906	888	1.20	1.11

[a]Results are for year 15--the final year simulated.

[b]M--Middle estimate of cost effectiveness ($9,538 public funds required per direct job created).
U--Upper estimate of cost effectiveness ($5,582 public funds required per direct job created).
L--Lower estimate of cost effectiveness ($20,000 public funds required per direct job created).

[c]Present value, over the planning horizon simulated, of total area income generated development activities, including incomes of labor mobility relocatees living outside the study area.

[d]Ratio of the present value of total regional income generated by development programs to the present value of total public costs of the programs.

[e]Ratio of the present value of income to the poor generated by development programs to the present value of total public costs of the programs.

It was assumed that a first objective for development activities in the study area is to remove from poverty those poor who, for reasons of mental or physical incapabilities, cannot work to support themselves (unsalvageable poor). Almost $50 million were allocated to this purpose (public assistance) in the study area in 1970 [9]. Preliminary work with the simulator indicated that grants totaling almost $72 million per year in the early years of a development planning horizon are required to remove all of these unsalvageable poor from poverty. This preliminary work also indicated that, to appreciably reduce underemployment and poverty among salvageable poor in the area within a meaningful time horizon (less than 20 years), annual development allocations of from two to four million dollars in excess of allocations to unsalvageable poor are necessary.

To facilitate comparisons among programs by holding selected variables constant, a limit of annual funds available for development activities of $75 million was imposed for the strategies simulated. For one of the strategies considered (Strategy 1--continuing programs in effect in 1970) simulated annual allocations remained well under $75 million. For the other strategies considered, simulated annual allocations were at this limit in early years, then decreased as development program effects were felt. This annual development allocation limit spreads development strategy results over a longer, more realistic period. "Overnight" development would likely result in undesirable political, social and physical disruptions in an area even if it were technically and economically feasible.

The results of this research indicate that, given the assumptions of the model used, poverty could be eliminated in the study area in 15

or fewer years by annually allocating no more public funds to non-welfare development activities than were allocated in the area in 1970 (approximately $5 million) if sufficient funds were allocated to welfare grants to raise the incomes of the area's unsalvageable poor to the poverty threshold. Public assistance and job development programs were found to be necessary components of successful development strategies. However, alone, neither of these activities was found to be sufficient to alleviate poverty efficiently. Rather they must be utilized together, in possible conjunction with human resource development programs that supplement ongoing local and state education and training programs.

A development strategy containing all of the development activities considered in the study (Strategy 2) could alleviate poverty and underemployment in the study area over the 15 year planning horizon and could yield efficient income streams. Such a strategy provides program diversification, thus reducing risk and promoting complementarity among development activities. This strategy entails public assistance grants to provide minimum non-poverty incomes for the unsalvageable poor and job development activities (labor mobility and industrialization) to eliminate underemployment. Political considerations might reduce or eliminate labor mobility programs on grounds that they encourage out-migration of an area's youth, deplete a surplus labor pool or are inconsistent with programs to create jobs within the area.[7] The findings of this research indicate that a similar strategy to the one discussed above, but excluding labor mobility programs (Strategy 3) would be less effective but could still eliminate poverty and yield returns in excess of public costs.

Strategies containing post-high school technical training programs, school dropout prevention programs, and family planning programs were less effective (but not ineffective) in eliminating simulated poverty or generating simulated income than similar strategies with these activities excluded. However, the complementary effects of these programs on job development and public assistance activities may not be fully accounted for in the model. Also, the results of such programs are often considered highly socially desirable. So it does not appear that they should necessarily be avoided in planning for area economic development.

CONCLUSIONS AND LIMITATIONS

Regardless of what programs are included in rural area development program packages or strategies, if alleviation of poverty and underemployment are major goals, efficient strategies must include public assistance grants and job development. While much poverty can be eliminated among salvageable poor by job development, poverty can be eliminated among the unsalvageable poor only by welfare grants. For a development strategy to be effective in eliminating underemployment in a depressed area, job development activities are important and if continued for a sufficient period of time may generate a critical mass of self-sustaining economic activity. Other development activities (primarily human resource development) may be supportive of job development activities and have other results which are socially or politically desirable. But improvement of human, natural or public resources yields favorable returns only as these resources are gainfully employed.

One obvious limitation of this analysis is that the results specifically apply only to the study area. Some of the findings, such as the payoffs from various development activities, will be relevant

to plans for other depressed areas. But specific results of alternative development strategies are dependent on the particular income, employment and socio-demographic situations of areas to which such strategies are applied. Public funds and time required for development programs to attain a critical mass of self-sustaining economic activity vary among underdeveloped areas.

This study also was limited by lack of data describing the effects of alternative development activities. For some types of activities no information was available, so the activities were not included. For activities for which information was available precision fell much short of that desired.

Data are, for the most part, unavailable for estimating economic payoffs from state or federal subsidies to develop area infrastructure such as transportation, water and sewer systems. No studies were available showing the distribution of benefits from such infrastructure among income groups nor the effectiveness of such investments in generating jobs. Also, no information was available on the effects of public processes (e.g. by the extension service) to initiate and maintain local planning and development organizations in underdeveloped areas. Cost effectiveness data would make it possible to include these activities in a systems model.

Although the most complete and current information was used insofar as possible, data describing the effects of education (school dropout prevention) programs and family planning programs were much less comprehensive than desired. However, both activities affect only a small part of the population. Further research could provide information useful in more definitively assessing the potential contributions of these and other

area development programs to area subpopulations, and also could provide data on chance or random elements to include in a stochastic model of development.

Price decreases for the output of newly developed industries or increases in public costs of programs to generate jobs could result in diminishing returns to industrial development activities. Such diminishing returns are not directly accounted for in the model presented herein. However, aggregate effects should not be a problem if development programs are focused on only a few depressed areas with potential for eventual self-sustaining progress given a critical mass of assistance. The study area appears to have such potential. Other areas lacking transportation facilities, natural resources, adequate population or a growth center may not have such development possibilities. It was assumed that the types of development activities considered would, at most, only be initiated in a few underdeveloped areas dispersed throughout the nation. As a critical mass of self-generating development is reached in economic districts, priority for funds then would be shifted to other districts characterized by underemployed resources. It was further assumed that there is a sufficient number of expanding local firms or mobile outside industries willing, if subsidized, to locate in such areas so that cost effectiveness coefficients would not change appreciably as more jobs are brought into the area.

Conventional evaluations of development activities examine only one level of cost (input) and returns (output). Typical studies also give little attention to the distribution of costs and benefits among economic and socio-demographic groups. These traditions will need to change if systems planning for area development is widely applied.

List of Footnotes

*Nelson is Extension Economist, Department of Agricultural Economics, University of Idaho, Moscow. A.E. Series 159: Paper presented at the North American Meetings of the Regional Science Association, Chicago, November, 1974.

[1]By county, the underemployment rates in 1960 and poverty incidence rates in 1969 [8] were the following respective percentages: Adair 26, 42; Cherokee 26, 28; McIntosh 30, 27; Muskogee 17, 21; Okmulgee 5, 23; Sequoyah 20, 28; and Wagoner 18, 18.

[2]The computer program for the simulator utilized in this research is listed in Nelson [2].

[3]In general, studies show that adequate infrastructure is necessary but not sufficient condition for economic growth [1]. Findings of White and Tweeten [10] showed differences in socio-economic background of students rather than differences in quality of education accounted for low schooling achievement in underdeveloped areas of Oklahoma. No studies were available showing the portion of public investments in infrastructure such as roads and water and sewer systems going to the poor in underdeveloped areas.

[4]Vocational-technical schools currently operating in the multicounty study area have adequate existing capacity to train "conventional" students in skills required. Major expansion would not be profitable [5].

[5]For a full discussion of the technical coefficients in the simulator see Nelson [4].

[6]The ratios consider only public costs and associated incomes generated thereby, and hence do not reveal whether strategies are consistent with overall economic efficiency. Except for public assistance, each

of the activities in the various strategies have been evaluated for overall economic efficiency in the studies reported earlier from which the coefficients were derived. In each instance, social (public and private) benefits exceeded social costs.

[7]Arguments by an area's nonpoor (especially employers) that labor mobility programs encourage outmigration of an area's youth and deplete an area's surplus labor pool may be valid. However, the argument that such programs are inconsistent with programs to create jobs within the area seems less well founded. Labor mobility programs can have much more rapid effects in removing salvageable poor from poverty than can industrialization programs. However, labor mobility programs typically have high attrition rates. Consequently, short run labor mobility programs may be consistent with long run area industrialization activities. Mobility programs generate income while industrial development is getting started, and provide a source of labor for local industry as workers return home. It is far more efficient from an economic, though not necessarily from a social standpoint, to hold the reserve labor supply awaiting local jobs in distant employment than in local underemployment.

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