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Breaking the Stalemate: An Analysis of Boom Town Mitigation Policies

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BREAKING THE STALEMATE: AN ANALYSIS OF BOOM
TOWN MITIGATION POLICIES

by

Andrew Ford

ABSTRACT

This paper poses a question of concern to boom town planners:

Should a town provide the public facilities required to serve the needs of the peak population if such facilities would not be fully used after the construction-related families leave town?

The question is answered by exercising simulation and evaluation models developed for boom town conditions. The simulation model shows the outcome resulting from a town's decision about building the extra public facilities. Output variables of the simulation model include population, property tax rate, adequacy of public facilities, outstanding debt, housing stocks, and adequacy of retail and service facilities. The outcomes of the simulation model are evaluated with value models developed for nine public and private viewpoints from Farmington, New Mexico.

The policy conclusion to be drawn from this analysis is that local viewpoints could arrive at a consensus to provide the full complement of public facilities needed at the peak of the boom as long as specific boom town policies are implemented. Most importantly, they require a dependable signal from the energy company about the size and timing of the construction work force. Further assistance in the form of a loan guarantee or a direct grant for public construction is needed to deal with the "front-end" financing problem. If such policies are not implemented, local viewpoints could be locked in a stalemate over the preferability of even attempting to provide the public facilities required for the peak population.

I. INTRODUCTION

A. Background on Energy Boom Towns

As the nation pursues the elusive goal of reducing its dependence on foreign oil, energy companies are turning to the vast energy resources of the Rocky Mountain West. With its huge fields of low-sulfur coal, with most of the nation's uranium, all of the prime-grade oil shales, and a large fraction of the potential geothermal sites, the region is aptly characterized as the energy breadbasket of the nation.

A serious problem associated with the development of Rocky Mountain energy resources is the adverse boom town conditions that can result from locating large energy facilities near small, isolated communities. Case studies of previous boom towns have described a wide range of problems arising from rapid, unmanaged growth. Schools become overcrowded and go to double sessions. Health services do not keep up with population growth, and families must drive hundreds of miles for medical care. Housing is inadequate; rents and land prices skyrocket out of the reach of local citizens. Newcomers are not integrated into the community; crime and mental illness increase; and the general quality of life is degraded. Construction turnover is high, causing a loss of productivity and cost overruns that may run as high as a \$100 million for a large energy facility.

In response to the need for extraordinary measures to deal with energy boom towns, officials from all levels of government and from private industry are taking action to try to prevent adverse boom town conditions in the future. In November 1976, President Ford signed into law the Coastal Zone Management Act, which provided a \$1.2 billion assistance program for communities and states affected by offshore energy development. Senator Hart of Colorado introduced a similar bill to the 95th Congress to provide assistance for inland communities. The "Inland Energy Development Impact Assistance Act of 1977" (S. 1493) authorizes \$1 billion for the creation of an Inland Energy Impact Fund.

The states have also acted to deal with adverse boom town conditions. Perhaps the most extensive action has taken place in Wyoming, which possesses vast fields of strippable coal and the two well-known boom towns of Rock Springs and Gillette. Wyoming has passed a "coal impact tax;" authorized \$40 million to the Farm Loan Board for loans to local governments; enacted a major industrial siting act; amended their joint powers act; organized the Wyoming Human Services Project; and formed the Wyoming Community Development Authority.

Notable examples of energy companies taking preventative action are the Missouri Basin Electric Cooperative, the Puget Sound Power and Light Company, and Montana Power Company. Missouri Basin is working extensively with local officials in Wheatland, Wyoming in preparation for the construction of the 1500-megawatt Laramie River plant.¹ Puget Sound Company has agreed to provide impact payments to schools and law enforcement agencies in Skagit County, Washington;² Montana Power has provided housing and recreational facilities in Colstrip, Montana.³

B. Purpose of the Report

Whether they be employed by the local, state, or federal government or by a private energy company, boom town planners face a myriad of difficult and

interrelated problems. This report focuses on just one of the many problems. Specifically, we focus on a difficult decision that must be made by planners working with small towns that will act as host to extremely capital intensive energy facilities. The type of population changes that such towns could experience is illustrated by the four graphs shown in Fig. 1. Although each of these projections was prepared by different analysts using different techniques and studying different towns, all projections show the same general shape. Population grows rapidly during the construction phase and then declines sharply as the construction of the energy facility is completed. The eventual population is higher than the initial population but much lower than the population at the peak of the construction boom.

The population declines shown in these projections are caused by the large ratio of the construction work force to the operating work force. A coal-fired power plant, for example, may require 10 times as many construction workers at the peak of construction as operating workers.⁴ For a gasification plant, four times as many construction workers may be required.⁵

Providing public facilities to serve the needs of the large population at the peak of the booms shown in Fig. 1 would require huge investments by the local communities. Yet because of the decline in population after the

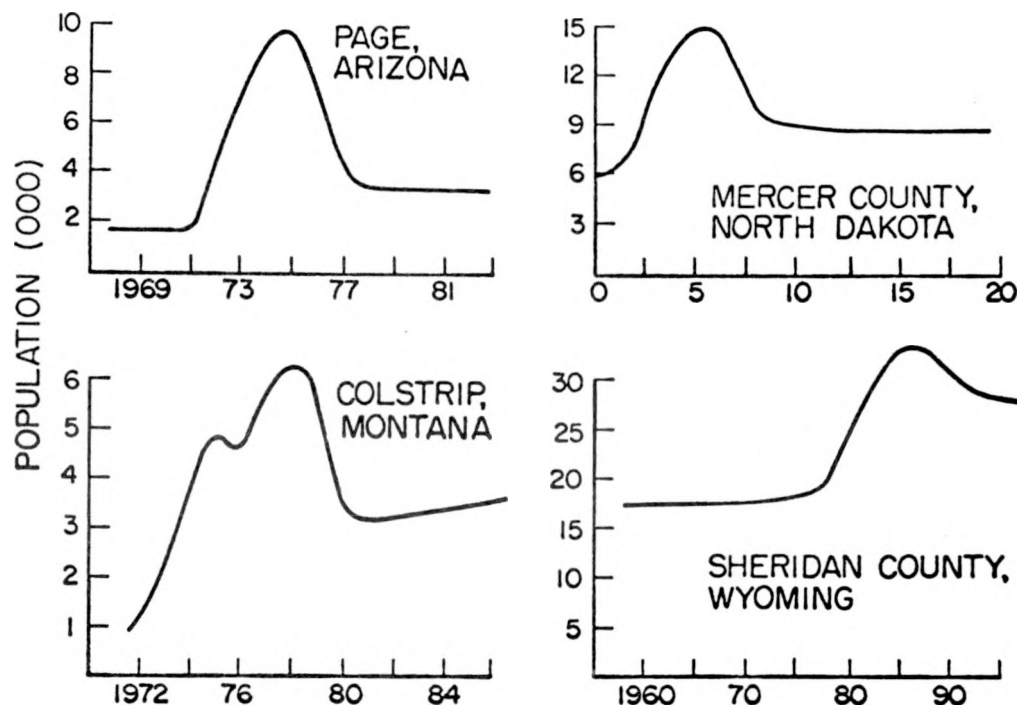


Fig. 1. Four projections of population growth in the West. Energy development responsible for population change:

Page - power plant⁶

Mercer County - coal gasification⁷

Colstrip - coal mining and power plant⁸

Sheridan County - coal mining, coal liquefaction, power plant⁹

completion of construction, such facilities would go unused for the remainder of their lifetime. In a study of the requirements for new public facilities in Mercer County, North Dakota, for example, analysts from the Argonne National Laboratory estimate that 47 elementary classrooms would be required at the peak of the construction boom; one year later the analysts project that 31 of these classrooms would be empty.¹⁰ Should these classrooms be constructed? Should new water treatment facilities, new roads, new hospitals, and other public facilities be constructed if they would lay idle after the population declines?

Clearly, these questions are of most immediate interest to local officials who actually face the prospects of a population growth and decline pattern like those shown in Fig. 1. It is mainly for these officials that this report is written. The report is also intended to help state and federal officials who may face these same questions during the course of their administration of community assistance programs. Should the administrator of an "Inland Energy Impact Fund," for example, provide assistance to help a small community build facilities that may not be fully used after the construction families leave town?

C. Statement of the Problem

To state the problem more precisely, we repeat the question with an accompanying set of assumptions:

Question: Should a town provide the public facilities required to fully serve the needs of the peak population if such facilities would not be fully used after the construction-related families leave town?

Assumption 1. The town is host to a single, highly capital intensive energy facility.

Assumption 2. The town can not expect any additional basic industry after the energy facility is constructed.

Assumption 3. The town does not have a significant option of building lower cost, temporary facilities.*

These assumptions constitute a worst case situation in which the hypothetical town is forced to face the difficult tradeoff between possible shortages of public facilities during the construction phase versus surpluses of facilities during the operation phase. That is, a town that chooses to invest in massive amounts of public facilities to serve the peak population must face surpluses of facilities after the peak; the surpluses cannot be erased by a promotional campaign to attract new basic industry or by removal of temporary, modular, public facilities.

* A study of the opportunities of use, and reuse, of temporary facilities concludes that "the state of the art regarding temporary/mobile facilities is not the most promising.... No utility systems currently manufactured are designed for efficient reuse."¹¹

After answering this question under the worst case assumptions, we will consider less difficult situations in which towns do have the option of attracting additional basic industry or of investing in temporary, modular facilities.

II. METHOD OF ANALYSIS

A general two-stage approach to aid in boom town decision analysis is diagrammed in Fig. 2 below. In the first stage, a simulation model is used to project future boom town conditions under alternative assumptions about the town, the energy project, and assistance policies. In the second stage, an explicit calculation of values scores is performed for each set of future boom town outcomes to be evaluated. To perform this calculation, the second model requires quantitative statements of the values and preferences of the viewpoints to be used in the evaluation.

A variety of techniques and models could be employed to accomplish the calculations indicated in Fig. 2; we make use of existing simulation and evaluation models for this analysis. For the simulation component, we use the BOOM1 simulation model developed at the Los Alamos Scientific Laboratory (LASL); for the evaluation component, we use Multi-Attribute Utility Measurement (MAUM) models developed for public and private officials from Farmington, New Mexico. The input and output information for the BOOM1 and MAUM models is shown in Fig. 3 below.

The use of these specific simulation and evaluation models to aid in the analysis of the boom town decisions has been described in detail elsewhere.^{12,13}

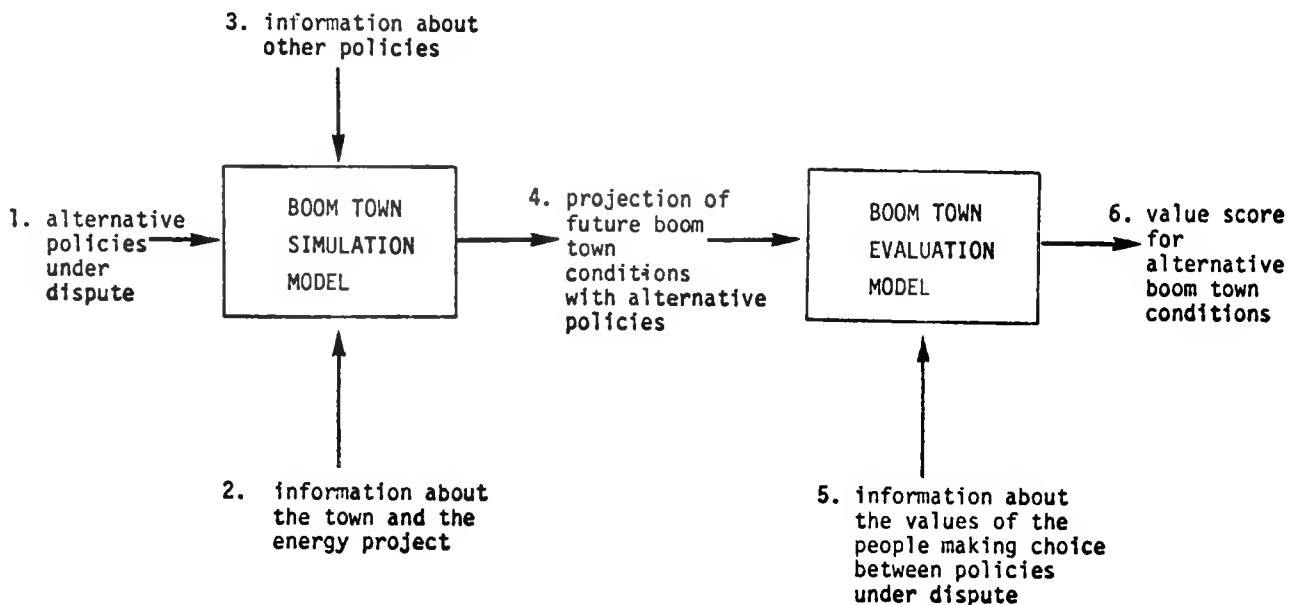


Fig. 2. A general, two-stage process for decision analysis of boom town policies.

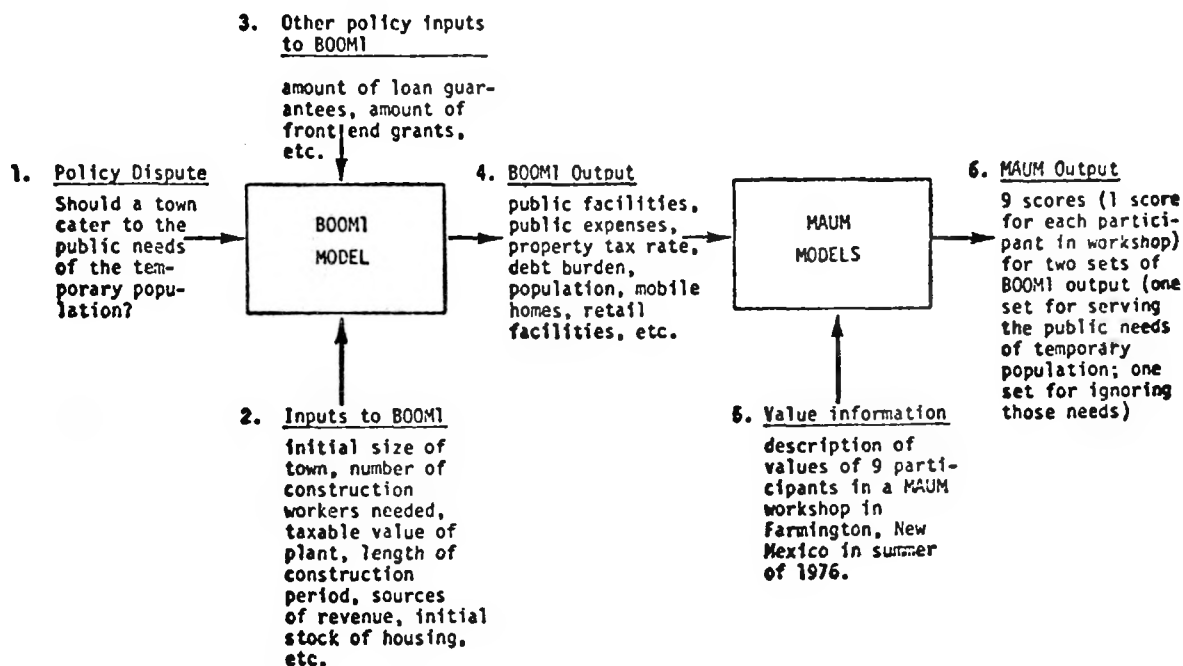


Fig. 3. A specific, two-stage process for decision analysis on one boom town policy.

Thus, the following description is limited to a brief account of how the information portrayed in Fig. 3 is organized and manipulated to help resolve the dispute over building public facilities for the construction-related population.

Starting from the left side of Fig. 3, three sets of information are required as input to the BOOM1 model.

1. BOOM1 requires information about the policy under dispute. In this case, BOOM1 simulates the effects of a town experiencing a boom under two strategies--either public officials attempt to provide the facilities for the peak population or they do not.
2. BOOM1 requires information about the town and the energy project in order to simulate the effects of following each of the two strategies. As Fig. 3 shows, this information includes the initial population of the town, the town's sources of revenue, the initial housing stock, the initial stock of retail facilities, the number of construction workers required, the length of the construction period, and many other variables.
3. The third input describes the policy assistance measures available to the town. Does the town qualify for grants of "front-end" money? Is the town to be provided with loan guarantees? The availability of such assistance measures will have a strong influence on the ability of the town to provide public facilities and services during the boom.

These three sets of information are manipulated by the model to produce simulated outcomes under many different conditions. Output variables of the model include changes in property tax rates, shortages and surpluses of public facilities, availability of housing and retail facilities, numbers of mobile homes, and numerous other variables.

The right side of Fig. 3 shows the way in which the simulated outcomes of the two strategies are evaluated in order to determine which strategy is "best." Two sets of simulated boom town conditions (one with extra public facilities; one without) are used as input information to nine MAUM value models, which represent in quantitative form the values and preferences of nine participants in a Farmington workshop. The output of the second stage of the decision analysis process is a set of nine pairs of scores—one pair of scores per participant. By comparing the pairs of scores for an individual participant, one can learn whether the individual prefers the simulated outcome without the extra public facilities. And finally, by comparing the overall preferences of the nine viewpoints, one can learn if a consensus exists concerning the disputed policy of providing public facilities for the construction-related population.

III. ANALYSIS

A. The BOOM1 Simulation Model

The BOOM1 simulation model is one of a series of computer models developed at LASL to help investigators test the effectiveness of alternative boom town policies. The model has been implemented on the computer systems of six groups outside of LASL. Although several of these groups are making impressive improvements in the model, the "second generation" models have not yet been sufficiently documented to allow the reader to examine their full range of assumptions. Thus, all simulations shown in this paper have been performed with the BOOM1 model, which is described in summary form¹⁴ and in full technical detail¹⁵ in reports available from LASL.*

B. Simulating the Effects of Building the Extra Public Facilities

We simulate the outcome of building the extra public facilities under the worst case assumptions listed previously. Specifically, we assume that a 1500-megawatt coal-fired power plant is to be located near a hypothetical agricultural town with a preboom population of about 8 000. The agricultural base of the town is assumed to remain constant, and no additional basic industry locates near the town during the course of the simulation. Since the parameter values in BOOM1 specify a nominal construction work force that is 10 times larger than the operating work force, we expect to see the characteristic population growth and decline pattern shown previously in Fig. 1. As Fig. 4 indicates, the characteristic population pattern is, indeed, generated by the BOOM1 model as it simulates the effects of the hypothetical boom.

*These reports have been reviewed by two federal agencies and the urban planning group at the Massachusetts Institute of Technology(MIT). The MIT review provides an excellent guide to boom town models for public officials who are somewhat unfamiliar with modeling procedures.¹⁶

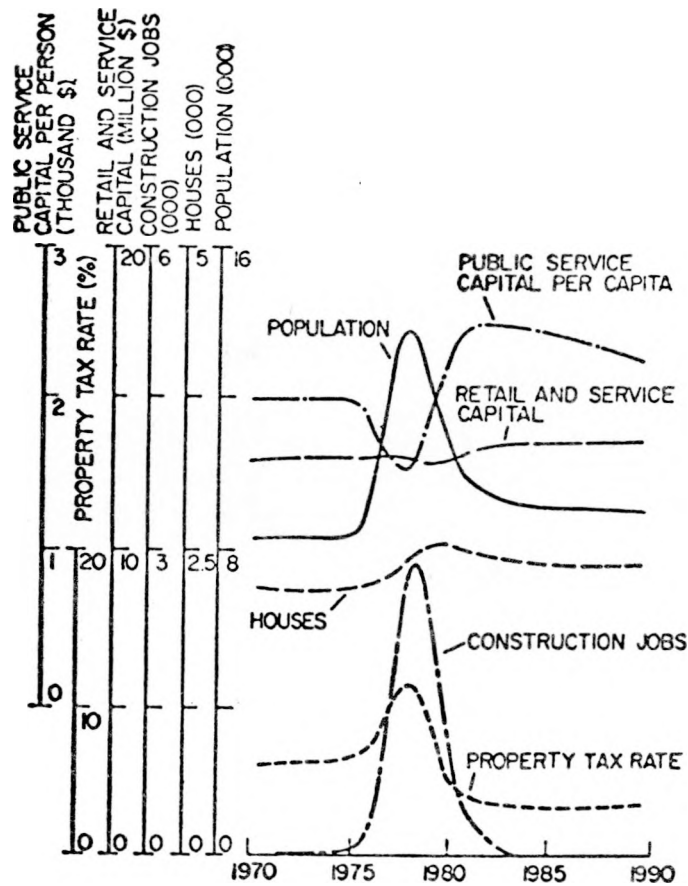


Fig. 4. Reference case behavior of the principal variables of the BOOM1 model.

In this simulation, construction of the plant is initiated in 1975 and is largely completed by 1981. The curves show no change during the preboom years 1970-1975. The amount of housing, public facilities, and retail and services facilities, for example, is just sufficient to meet the needs of the hypothetical town. The town may be said to be in equilibrium: no growth or shrinkage is needed in any sector to bring all of the town's sectors into balance with one another.

The equilibrium is upset, however, during the boom years 1975-1978. Construction workers immigrate in large numbers to work on the power plant. Company officials expected a peak work force of 1500 workers, but declines in productivity because of the general adverse conditions in the community cause contractors to hire many more workers to complete construction on schedule. In the third year of construction, for example, almost 3000 workers are on the payroll. Although the immigration of so many construction workers causes rapid increases in population, little permanent housing is developed and most construction workers live in mobile homes.

We assume in this simulation that the town is committed to providing the full complement of public facilities for the temporary as well as the permanent

population. Town officials make a considerable effort to serve the needs of the peak population by doubling the local property tax rate; however, the increase in both local property tax and state transfer payments is too little and too late to prevent a substantial decline in the adequacy of public facilities during the boom period. Retail and service facilities also fail to keep pace with the growth in population and income since private retail investors are reluctant to cater to the temporary business of the construction worker families.

The severity of the town's problems changes rapidly from year to year in this simulation. During the boom years 1975-1978, local officials face a sharply rising population, shortages of public facilities, limitations on their ability to issue new debt, and the need to raise local taxes. However, during the bust years of 1978 to 1982, the exodus of large numbers of construction workers causes a rapid decline in the number of mobile homes and people, and a growing surplus of public facilities. At the same time the construction workers are leaving, the units of the power plant are being brought into operation and contribute to the town's tax base. The enlarged tax base allows the town to lower the local property tax (without any sacrifice in public services) to a value well below the original tax rate of the early 1970's.

The curves in Fig. 4 show general behavioral tendencies of the model and should not be interpreted as predictions or forecasts of the precise impacts that a town would experience. Rather, these curves form a reference projection to be used as a point of comparison with other simulation results. In the next section, for example, we compare the reference case of Fig. 4 with simulation results obtained when town officials are assumed to NOT build the public facilities required for the construction-related population.

C. Simulating the Effects of NOT Building the Extra Public Facilities

By changing one equation in the public sector of BOOM1, the model can be re-programmed to simulate the boom town impacts under the assumption that town officials choose not to build the extra public facilities for the temporary population. Rerunning the model for the hypothetical town acting as host to the same power plant yields the curves shown in Fig. 5.

A comparison of the three curves of Fig. 5 with their behavior in the reference case projection of Fig. 4 shows that the following changes occur because of the town's decision NOT to build the extra public facilities:

1. Public facility shortages are more severe.

It is to be expected that the shortage of public facilities would be more severe in Fig. 5. Because the town does not invest in extra public facilities, the stock of public facilities grows only slightly during the boom years from 1975 to 1978. Consequently, the per capita stock of public facilities drops to a much lower level in Fig. 5.

2. Public facility surpluses do not occur.

Because the town does not build the extra public facilities for the construction-related population, it is not faced with a surplus of public facilities when the construction families leave town. Notice,

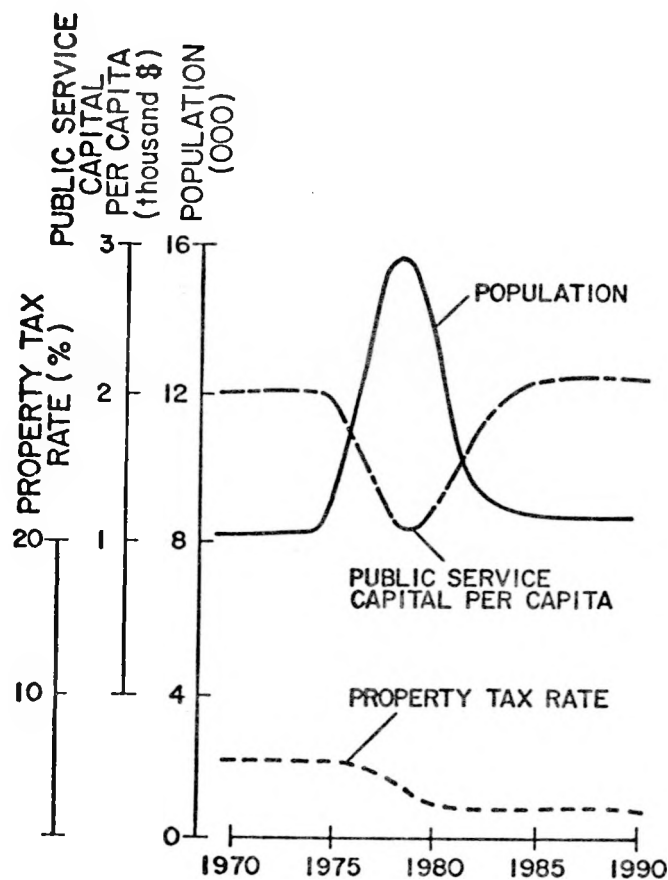


Fig. 5. Simulation result when public officials choose NOT to build the extra public facilities for the construction-related population.

for example, that the per capita stock of public facilities returns to the nominal level of 2000 \$/person by 1983 in Fig. 5. In Fig. 4, on the other hand, the per capita stock of public facilities climbs to the surplus value of around 2400 \$/person by 1983.

3. Property tax increases do not occur.

By choosing not to build the extra public facilities for the temporary population, the town is able to meet its remaining financial obligations without raising the property tax rate in Fig. 5. Specifically, the town is able to pay off debt as it comes due and is able to meet annual operating expenses even though the operating expenses increase sharply during the boom.

4. Population grows to a higher peak value.

A comparison of the population curves in Fig. 4 and Fig. 5 shows that the town's decision to NOT build the extra public facilities causes an increase in the population at the peak of the boom. This increase is generated by the simulated actions of the construction contractor

who must get the power plant constructed on schedule by employing workers whose turnover and productivity is adversely affected by the local quality of life. BOOM1 assumes that adequacy of public facilities is one of several factors influencing construction worker productivity. Simulations which show more severe shortages of public facilities (like Fig. 5) will consequently show sharper declines in construction worker productivity;* the contractor is forced to hire more workers; and the influx of the extra workers and their families leads to a larger peak population than shown in the reference case.

5. Housing and retail shortages are aggravated by the extra population growth.

Because of the increased number of construction workers required in Fig. 5, shortages of housing and retail facilities are more severe at the peak of the boom. Extra families that cannot obtain permanent housing are assumed to live in mobile homes.

6. Boom-induced cost overrun on the power plant is larger.

The wages paid to the extra construction workers hired in Fig. 5 lead to a larger cost of the completed power plant. The differences in cost overruns can be quite sizeable for large, capital intensive energy facilities. A 10% decline in productivity, for example, can add roughly \$50 million to the cost of a billion dollar facility.¹⁷

The comparison of the simulated outcomes of Fig. 4 and Fig. 5 completes the first step of the two-step analysis of the dispute over building the extra public facilities for the temporary population. The next step is to choose which of the simulated outcomes is "better." Obviously, the personal situation and preferences of each individual will influence his choice between the two outcomes. For example, a homeowner wishing to sell his home might well prefer the outcome shown in Fig. 5 because of the more severe shortage of housing. An immigrant family looking for permanent housing, on the other hand, would probably prefer the less severe housing shortage of Fig. 4. If the person making the selection were to ascribe considerable importance to the size of the property tax rate, he would probably prefer the outcome with lower taxes shown in Fig. 5. Another person may feel that adequacy of public facilities is much more important and prefer the outcome shown in Fig. 4.

To accomplish this second step in an organized and quantitative fashion, we make use of value models designed to allow investigators to choose among simulated outcomes like those shown in Fig. 4 and Fig. 5. The models were developed for public and private officials who participated in a boom town workshop conducted in Farmington, New Mexico in the summer of 1976. Workshop participants included the local mayor, a county commissioner, a county planner,

* BOOM1 also assumes that poor construction worker productivity leads to higher construction costs for public facilities. But since the town has decided NOT to build large numbers of public facilities in the simulation of Fig. 5, the extra inflation in public construction costs has little effect on the overall behavior of the model.

an environmental researcher, two energy company officials, and others. The procedures used to quantify the values and preferences of these participants is called Multi-Attribute Utility Measurement (MAUM).

D. MAUM Models of Boom Town Conditions

The potential of MAUM to deal with value-laden questions is apparent from the description of its use with the California Coastal Zone Commission.¹⁸ In the California application, MAUM was used to assist the commissioners in evaluating the applications for development in the coastal zone. The commissioners tended to have a very mixed set of values, and much of the commission's time was consumed arguing and re-arguing the relative importance of such factors as "distance from the mean high tide line," "density of the proposed development," and "number of on-site parking facilities." With the MAUM procedure, each commissioner specified his own values and importances in quantitative form. The application of the individual MAUM models to the backlog of applications before the commission led to a surprising result--the commissioners who had been arguing for so long were often in overall agreement on the applications. It appears from the California application, therefore, that MAUM has the potential to turn the normal adversary process of heated debate and confrontation into a more organized process that may lead to a surprising amount of agreement. This potential led us to organize the MAUM workshop in Farmington, New Mexico.

The first step in the MAUM procedure is to identify the persons or organizations whose personal, subjective values are to be used in the evaluation. In the Farmington workshop, nine community leaders participated, acting as representatives of the viewpoints of nine public and private groups. To preserve anonymity, the views of these participants are simply labeled as viewpoints one through nine.

The next step is to select the dimensions of importance. Nineteen dimensions were used in the Farmington workshop. Table I shows the list of dimensions along with the performance of the boom town simulation model from Fig. 4 and Fig. 5.

Notice that some of the dimensions in Table I convey snapshot-like information (e.g., the property tax rate at the peak of the boom). Other dimensions capture the "moving picture" features of the boom town development by providing information about the patterns of change over time (e.g., the duration of the shortage of public services).

Next, the viewpoint representatives rank and rate the different dimensions according to their own feelings about what is important in a boom town. The importance weights for one of the participants are shown in Table II, later in the paper.

In order to translate outputs of the simulation model, which are measured on a natural scale (like percent increase in property taxes), to common "value units," value curves are developed for each of the 19 dimensions. Figure 6 shows value curves for five of the viewpoints representatives for the fourth dimension (duration of surplus public facilities). Notice that viewpoints #6, #7, and #8 agree that a long period of surplus public facilities is bad (receives few value points along the vertical axis), whereas viewpoints #5 and #9 feel that a long period of surplus public facilities is a good thing and therefore has a high value. Such disagreements over value curves (and importance weights) have occurred frequently in this and other MAUM applications.

TABLE I
LIST OF IMPACT DIMENSIONS AND SIMULATED
OUTCOMES FROM FIG. 4 AND FIG. 5

IMPACT DIMENSION	BUILD EXTRA FACILITIES (FIG. 4)	DO NOT BUILD EXTRA FACILITIES (FIG. 5)
Public Facilities		
1. Size of shortage (peak)	20%	46%
2. Duration of shortage	5 yr.	8 yr.
3. Size of surplus (peak)	17%	0
4. Duration of surplus	15 yr.	0
Property Tax Rate		
5. Peak value	11%	5%
6. Duration of higher taxes	5 yr.	0
7. Eventual value	2.4%	2.4%
Retail and Service Facilities		
8. Size of shortage (peak)	55%	77%
9. Duration of shortage	8 yr.	8 yr.
10. Size of surplus (peak)	0	0
11. Duration of surplus	0	0
Permanent Housing		
12. Size of shortage (peak)	12%	21%
13. Duration of shortage	5 yr.	5 yr.
14. Size of surplus (peak)	2.2%	7.5%
15. Duration of surplus	4 yr.	4 yr.
Mobile Homes		
16. Fraction peak size	46%	57%
17. Duration of large numbers	6 yr.	6 yr.
Construction Families		
18. Size of the fraction	52%	55%
19. Duration of large numbers	6 yr.	6 yr.

At this point in the MAUM procedure, all the ingredients are available for an overall evaluation:

- objective performance of the simulation model along each dimension for the two alternatives to be compared,
- subjective importance weights for each of 19 dimensions, and
- subjective value curves to translate the performance of the simulation model into "value units."

These pieces of information are combined in a simple, weighted sum for each viewpoint to yield a total score for the outcomes tabulated in Table I.

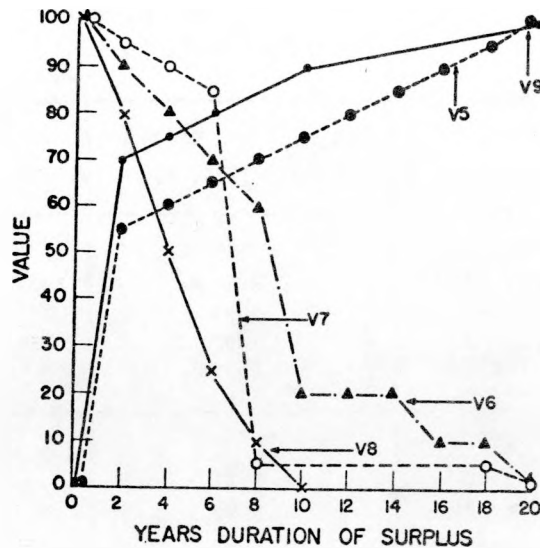


Fig. 6. Value assessments (0 \Rightarrow worst possible; 100 \Rightarrow best possible) of the desirability of the duration of a surplus of public facilities.

Table II shows the elements in the weighted sum for viewpoint #1's evaluation of the two outcomes. Notice that viewpoint #1 prefers the simulated outcome associated with building the extra public facilities by an overall score of 44.0 to 28.4.

A line-by-line comparison of the entries in Table II shows the particular features of Fig. 4 and Fig. 5 that lead this participant to prefer the outcome with the extra public facilities provided. First of all, this participant rated attribute #1 (severity of the shortage of public facilities at the peak of the boom) as the most important attribute. Thus, the change in performance along this dimension (20% shortage versus 46% shortage) contributed 13.4 value points to this participant's overall preference for Fig. 4. This participant was less concerned with possible surpluses of public facilities (see the low weights for attributes 3 and 4). Thus, the lack of surpluses in Fig. 5 contributed little to the final evaluation of the outcome with extra public facilities not provided. Indeed, the only comparative advantage that Fig. 5 seems to have in this participant's evaluation is the lower property tax rate (see attribute 5, 11% peak tax rate versus 5%); the lower tax rate is worth 2 value points to this participant.

The 15.6 value points (44.0 minus 28.4) with which participant #1 favors the outcome with the extra public facilities indicate a preference that is not shared by a majority of the participants in the Farmington workshop. We show the evaluations of all nine members of the workshop in Fig. 7. As Fig. 7 shows, only two participants agree with participant #1 that the public facilities should be provided for the temporary population, whereas six of the participants are opposed to providing the extra public facilities. An examination of the contributions to the total weighted sum for two of the opposing participants (#2 and #4) shows that the higher taxes associated with Fig. 4 are key factors in the

TABLE II
MAUM EVALUATION OF SIMULATED OUTCOMES FROM VIEWPOINT #1

Dimension	Weight	BUILD FACILITIES (Fig. 4)			DO NOT BUILD FACILITIES (Fig. 5)		
		Simulated Impact	Impact Value	Weighted Value	Simulated Impact	Impact Value	Weighted Value
1	14.8	20%	90	13.4	46%	0	0
2	12	5 yr.	35	4.2	8 yr.	20	2.4
3	1.8	17%	30	.5	0	100	1.8
4	.6	15 yr.	100	.6	0	100	.6
5	2.3	11%	18	.4	5%	100	2.4
6	1.8	5 yr.	100	1.8	0	100	1.8
7	1.8	2.4%	100	1.8	2.4%	100	1.8
8	6	55%	18	1.0	77%	1.5	.1
9	3.5	8 yr.	80	2.9	8 yr.	80	2.9
10	1.8	0	100	1.8	0	100	1.8
11	.6	0	100	.6	0	100	.6
12	14.8	12%	46	6.9	21%	29	4.3
13	12	5 yr.	0	0	5 yr.	0	0
14	2.3	2.2%	98	2.3	7.5%	93	2.2
15	2.3	4 yr.	95	2.3	4 yr.	95	2.3
16	9	46%	0	0	57%	0	0
17	6	6 yr.	50	3.0	6 yr.	50	3.0
18	6	52%	0	0	55%	0	0
19	.6	6 yr.	100	.6	6 yr.	100	.6
				Total = 44.0			
					Total = 28.4		

overall evaluation. Moreover, these two participants were disappointed in the 20% shortage of public facilities that occurred in Fig. 4 and did not ascribe much value to the difference between 20% shortage and the 46% shortage shown in row 1 of Table I.

The evaluations reported in Fig. 7 complete the second step of the two-stage analysis. The conclusion to be drawn from this initial analysis is that a STALEMATE exists among the viewpoints represented in the Farmington workshop over the question of providing extra public facilities for the temporary population. Of course, this conclusion may change if we were to repeat the analysis with changes in some of the parameter estimates in the BOOM1 simulation model. To see if the "STALEMATE" conclusion is dependent on the specific parameter values used in BOOM1, we repeat the two-step analysis with changes in several parameters that have been shown to have major effects on the behavior or particular output variables of the BOOM1 model.

E. Sensitivity Analysis of the STALEMATE Conclusion

Previous sensitivity analyses have shown that the BOOM1 output changes markedly when several vicious circles are removed from the model. An example of one of the key vicious circles is shown in Fig. 8. This diagram shows the

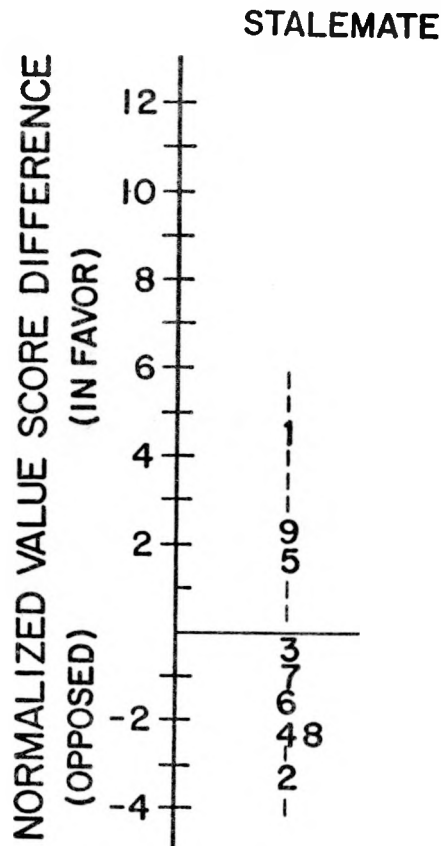


Fig. 7. STALEMATE result from nine evaluations of simulated boom town outcomes.*

interconnections among BOOM1 variables used to represent the "Problem Triangle" described in Case Studies prepared by the Denver Research Institute. The action of the "Problem Triangle" in Rock Springs, Wyoming, has been described by John Gilmore as follows:¹⁹

The Rock Springs case study describes how the boom degraded quality of life in the community. The effect a degraded quality of life may have on productivity and

* In this diagram, the value score difference for each participant is plotted on a normalized scale. A normalizing factor of 3.3 value points is used to provide the reader with a feeling for the scores. The figure of 3.3 points was calculated by finding the average value score difference that the nine participants would associate with two outcomes that were identical in every respect except that one outcome showed a doubling of the local property tax rate while the other showed no change in the tax rate. To plot participant #1's position in Fig. 7, for example, the 15.6 value point difference of Table I was divided by 3.3 points to yield a normalized value score difference of almost 5. In other words, the strength of participant #1's preference for the outcome with extra public facilities is almost 5 times the strength of the average participant's preference for avoiding a doubling of the local tax rate.

turnover was experienced by Bechtel Corporation in their construction of the Jim Bridger plant in Rock Springs. During the spring of 1974, productivity of construction workers at the plant dropped well below expectations. Since the contractor was on a tight schedule, the loss in productivity had to be made up by hiring more construction workers. The additional population created an even greater strain on provision of local services and caused further decline in the quality of life. Productivity then dropped even more.

Previous sensitivity analyses have revealed another area of sensitivity as well. This second area involves the way in which BOOM1 simulates the response of retail investors to the increased purchasing power in the town. Several factors contribute to the calculation of the amount of retail and service facilities that would be constructed. These include wage rates, the fraction of income spent on retail purchases, the fraction of retail purchases made locally, and the direct purchases of retail products by the energy company. The most important factor in the retail sector, however, is a constant called the "Fraction of Temporary Income Considered by Retail Investors." In the simulations of Fig. 4 and Fig. 5, this constant is set to zero to represent the case where retailers are reluctant to cater to the temporary purchasing power of the construction families. To see the effects of a bold retail assumption, we have re-run the model with the "Fraction of Temporary Income Considered by Retail

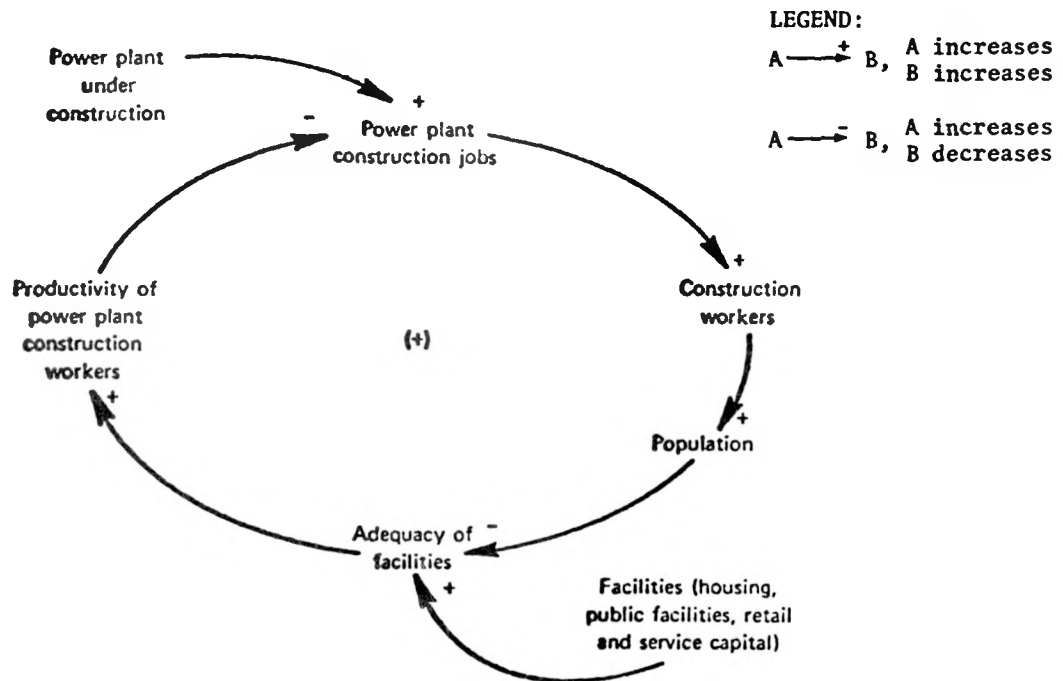


Fig. 8. Interconnection of BOOM1 variables to form a vicious circle (equivalent to the "Problem Triangle").

Investors" set to one. As one might expect, this change leads to an increased investment in retail facilities, the creation of more secondary jobs, an increase in assessed valuation, and an increase in the peak population. The larger population, in turn, aggravates the shortages of housing and public facilities at the peak of the boom. To see if these changes will affect the STALEMATE conclusion of Fig. 7, we have repeated the two-stage analysis portrayed in Fig. 3 with a bold retailer assumption.*

The results of repeating the simulation and evaluation calculations with these two sets of changes in BOOM1 parameters are summarized in Fig. 9. The first column of numbers in Fig. 9 is identical with the STALEMATE configuration of Fig. 7-- three participants favor the construction of the extra public facilities and six oppose their construction. The second and third columns of Fig. 9 show the results of repeating the entire analysis under the assumption that the vicious circles do not exist (column 2) and that retail investors will cater to the temporary purchasing power of the construction families (column 3). The striking result of this sensitivity analysis is that the STALEMATE configuration is unchanged.** The same three participants remain in favor of building the extra public facilities; the same six participants remain opposed. Indeed, the relative positions of each participant in the configurations of Fig. 9 remain largely unchanged.

F. Discussion of the STALEMATE Result

The outcome of the sensitivity tests shown in Fig. 9 indicates that the STALEMATE conclusion is probably not the result of particular parameter estimates of the BOOM1 model. After examining the evaluations of all nine MAUM models, we conclude that the STALEMATE results from the following five factors:

1. a difference in opinion among the MAUM workshop participants about what is important in the town. (If all participants held the same values as participant #1, for example, we would have obtained a consensus that the public facilities should be constructed for the temporary population.),
2. the large changes in BOOM1 output variables arising from the fact that the expected construction work force is several times larger than the operation work force,

* Although BOOM1 does not explicitly use a secondary employment multiplier, the "bold retailer" sensitivity test can be viewed in terms of large changes in such a multiplier. For the "timid retailer" assumption, BOOM1 behaves as if a secondary multiplier were almost zero (some secondary jobs are created in the public sector). For the "bold retailer" assumption, BOOM1 behaves as if a multiplier were near 1.6 in the beginning of the boom and dropped to a lower value by the peak year of construction. For a discussion of the various ways in which different local impact models calculate secondary employment, see the review prepared by the planning lab at MIT.²⁰

** The insensitivity of these results should be especially striking to planners familiar with models to forecast population changes in boom towns. Two key inputs to these models are the estimate of basic employment and the size of the secondary employment multiplier. The analysis summarized in Fig. 9 involves huge changes in these inputs and consequently large changes in the population projections of the BOOM1 model.

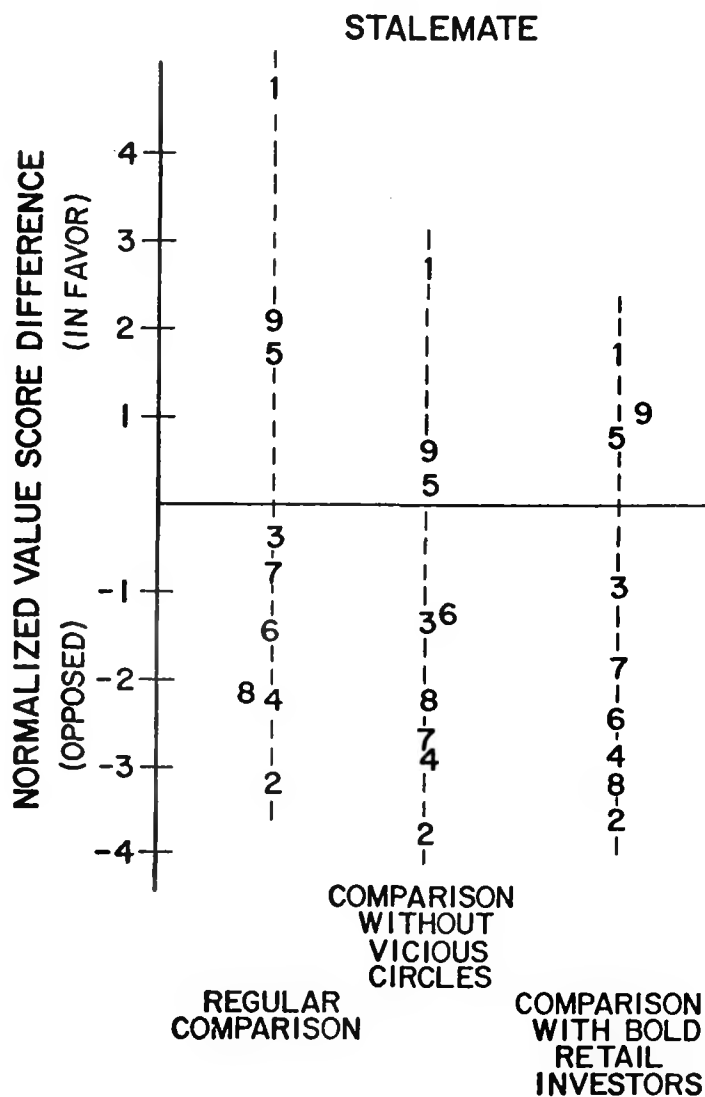


Fig. 9. Sensitivity test of the STALEMATE result.

3. the absence of follow-up development in the town that would help take up the surplus in the stock of public facilities that exists in the early 1980's,
4. the failure of the town to provide the nominal per capita stocks of public facilities in Fig. 4 even though the town was committed to doing so, and
5. the increase in local tax burden that accompanied the influx of thousands of new workers in Fig. 4.

We feel that these five factors are fundamental aspects of the boom town problem posed in this paper (factors 2 and 3, in particular, arise from the worst case assumptions used in this paper). Consequently, these factors are

not likely to disappear in any further sensitivity tests that might be performed to check the effects of particular parameter estimates in the BOOM1 model. On the other hand, some of these factors might be eliminated through the implementation of boom town prevention and mitigation strategies.

Generally speaking, the factors at the bottom of the list are more easily eliminated by policy action. Loan guarantees and front-end grants, for example, would help the town provide the full complement of public facilities without large increases in local taxes. Thus, these measures would tend to eliminate the 4th and 5th factors from the list. Promotional campaigns to attract "follow-up" industry to the town would tend to eliminate the third factor, and lengthening the construction interval so as to lower the size of the peak construction work force would impinge on the 2nd factor.* The difference in values cited as factor #1 is perhaps the least changeable factor underlying the STALEMATE results of Fig. 9.

In the next section, we examine the effectiveness of various prevention and mitigation strategies that impinge on the 4th and 5th factors in the list. The purpose of the policy analysis is to see if the STALEMATE result of Fig. 9 can be broken.

IV. BREAKING THE STALEMATE--AN ANALYSIS OF MITIGATION STRATEGIES

In this section, we simulate and evaluate the effect of implementing four different policies designed to help a town overcome the problems of providing a full complement of public facilities at the peak of the population boom.

- Policy 1 The town receives a dependable signal from the energy company about the date on which construction is to be initiated and completed and an accurate estimate on the size of the construction work force. This information is used by the town to construct extra public facilities before the construction families arrive in town.
- Policy 2 In addition to the dependable signal, the town receives a loan guarantee to allow it to issue debt even though its outstanding debt exceeds the bonding capacity.
- Policy 3 In addition to the signal and the loan guarantee, the town receives a direct grant of \$10 million to be used for public construction.
- Policy 4 In addition to the signal, the loan guarantee, and the grant, the town receives a 50% increase in per capita transfer payments during a four-year interval of abnormally high operating expenses.

* Lengthening the construction interval to reduce the stress on the host community has been discussed in a variety of reports. An analysis following the two-stage procedure used in this paper is presented in a report from the University of Southern California.²¹ The strategy is also mentioned in reports from Argonne,²² Battelle,²³ and the Stanford Research Institute.²⁴

A. Preinvestment in the Public Sector

One of the causes of the 20% shortage of public facilities shown in Fig. 4 is the assumption that public officials are reluctant to make major investment decisions on the announced intentions of energy companies and the accompanying collection of rumors about the energy facility. Specifically, BOOM1 assumes that the public officials wait until the population increase actually occurs before initiating action to finance and construct new public facilities. The "wait until the bodies are in town" aspect of the public sector of BOOM1 characterizes towns that have grown cautious from watching large-scale plans for industrial development be announced and then later postponed or abandoned.

If the energy company were to provide the town with a dependable signal about the date of initiation and completion of a project and a reliable estimate as to the size of the construction work force, however, towns could go ahead with the planning, financing, and construction of new public facilities before "the bodies are in town."* To simulate the case where a town receives such a signal from the energy company and decides to preinvest in public facilities, the public sector of BOOM1 has been reprogrammed to behave differently during a "planning interval" from 1974 to 1978. During the planning interval, the public sector behaves as if its goal were to provide the nominal amount of public facilities for an expected peak population of 14 000. During other years, the public sector makes investment decisions by following the rule to "wait until the bodies are in town." That is, investment decisions are based on the current (not the expected) population in the years outside the planning interval. Re-running the model with these changes in the public sector yields the behavior shown in Fig. 10.

Because of the preinvestment in public facilities, the behavior in Fig. 10 is quite different from the behavior shown earlier in Fig. 4. At the start of the planning interval, the town invests heavily in new public facilities, which drives up the public service capital per capita to values well in excess of the nominal figure of \$2000/person. To help pay for the construction of these new facilities, the town is forced to increase the local tax rate about three-fold. As the population approaches its peak value, the surplus of public facilities built up during the years from 1974 to 1976 is gradually erased. By the peak of the boom in 1978, the town experiences a small shortage of public facilities. This shortage is caused in part by the inability of the town to issue debt in excess of the local bonding capacity.

When the outcomes of Fig. 10 and Fig. 5 are evaluated using the nine MAUM models, the number of viewpoints in favor of building the extra public facilities increases from a minority of three to a majority of six. This shift is shown in Fig. 11. A comparison of the two columns in Fig. 11 shows the changes in individual evaluations brought about by the preinvestment in public facilities. The most dramatic shift in Fig. 11 is the normalized value score for viewpoint #3. This participant's evaluation shifts from a position of slight opposition to building the extra public facilities to a position as the most enthusiastic supporter in favor of building them.

*An example of such a signal from the energy company is the provision by Missouri Basin Electric Co-operative to the town of Wheatland, Wyoming, which limits the number of construction workers on the Laramie River power plant to within a certain margin of the announced employment forecasts.²⁵

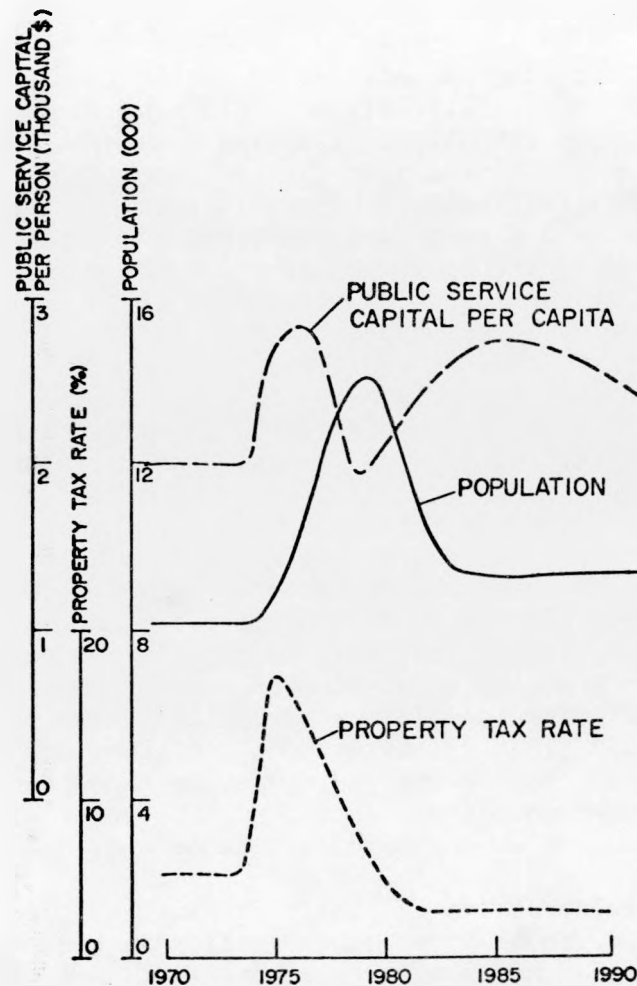


Fig. 10. Simulation result under policy no. 1--preinvestment in public facilities made possible by a dependable signal from the energy company.

Looking at the evaluations of all nine participants, we conclude that the implementation of policy no. 1 has created a substantial shift in majority opinion from opposition to building the extra public facilities to a majority feeling in favor of building them. Nevertheless, a stalemate persists since viewpoints #2, #7, and #8 still oppose the construction of the extra facilities.

B. Loan Guarantees for the Public Sector

One reason for the small shortage of public facilities that occurs in Fig. 10 is a constraint in the municipal financing sector of BOOM1 that limits the amount of new debt that may be issued when the town's outstanding debt draws close to or exceeds the bonding capacity. One way to eliminate this front-end financing problem is to provide the town with loan guarantees that would allow the town to continue issuing debt even though the total debt outstanding exceeds the bonding capacity. Such measures are easily simulated with the BOOM1 model.²⁶

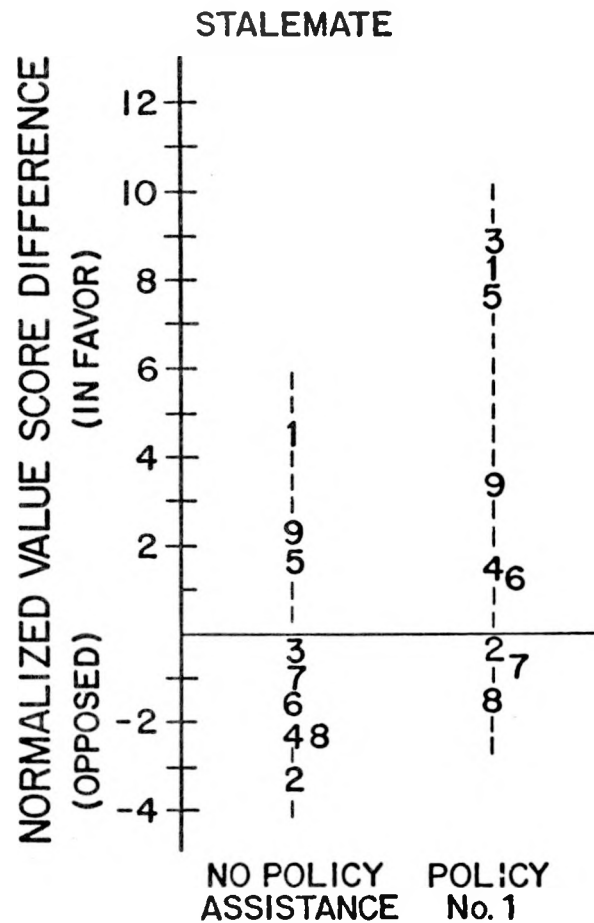


Fig. 11. STALEMATE result from evaluations of policy no. 1.

Rerunning the simulation model with the debt constraint removed leads to two changes over the behavior shown earlier in Fig. 10. First, the town is able to build the stock of public facilities to a sufficiently high level that no shortage exists at the peak of the boom in 1978. Secondly, the town is able to finance the construction of these new public facilities with more debt than was issued in Fig. 10. Because the town does not have to rely so heavily on "cash financing," the peak value of the local property tax rate in 1974 is slightly lower in the new simulation. These and other changes along the 19 dimensions have been evaluated with the MAUM models. The new evaluation results are reported in Fig. 12.

A comparison of the new configuration for policy no. 2 (preinvestment plus loan guarantees) with the results from policy no. 1 (preinvestment without loan guarantees) shows that the majority opinion of 6 in favor of building the extra public facilities has grown to a majority of 7 because of the implementation of the loan guarantees. Furthermore, the position of viewpoint #7 is so close to the horizontal axis that it could easily be labeled as neutral. The implementation of the loan guarantees also strengthens the support of several of the participants for building the extra public facilities. Notice, for example,

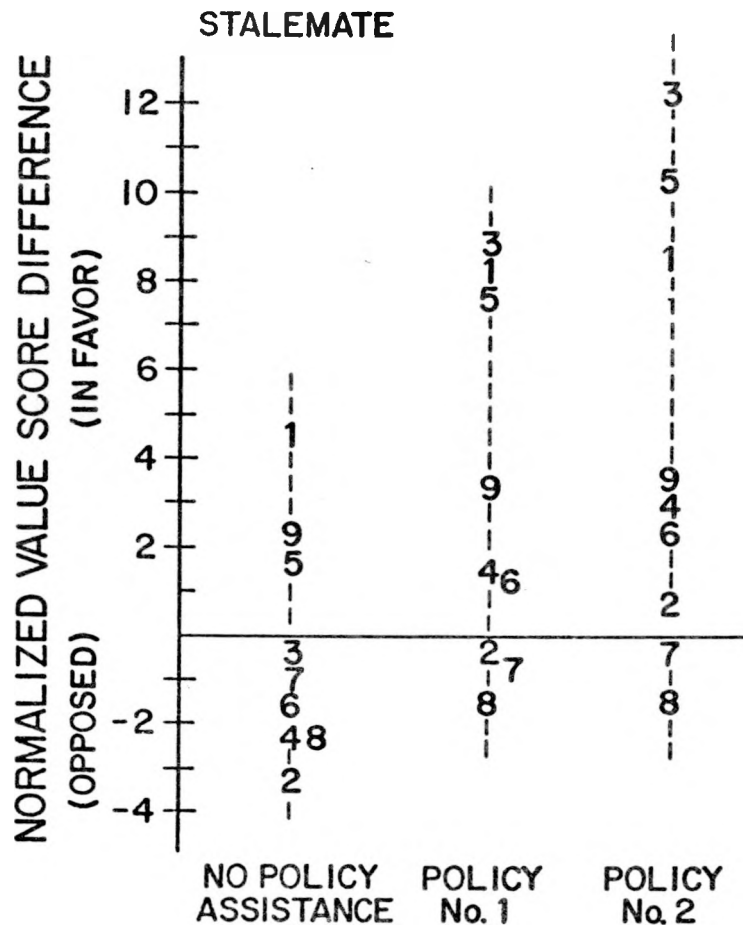


Fig. 12. Nine evaluations under policies no. 1 and 2.

that viewpoints #3, #4, and #5 are more solidly in favor of building the extra public facilities under policy no. 2 conditions. Nevertheless, the evaluations of policy no. 2 do not show a consensus since viewpoint #8 still opposes the construction of the extra public facilities. We have examined the line-by-line contributions to viewpoint #8's evaluations (in a table similar to Table I, but not shown here) to learn the source of this participant's opposition to building the extra public facilities. We learned that the main reason for his position is a strong preference for the lower property taxes shown in Fig. 5.

In the remaining portion of this section, we examine the extent to which programs to relieve the town of the higher tax burden of Fig. 10 are successful in achieving a consensus among the nine viewpoints portrayed in Fig. 12.

C. Direct Grants to the Public Sector

One way to reduce the tax burden on the town is to provide a direct grant to help finance the construction of the extra public facilities needed for the temporary population. Under policy no. 3 conditions, we examine a combination of policies--a direct grant of \$10 million to be used for public construction, the loan guarantee, and the dependable signal from the energy company. To simulate

the effect of the direct grant, we add an additional construction rate to the public sector of the BOOM1 model. This rate adds \$10 million worth of public facilities to the town's stock of public facilities without requiring the town to come up with any "cash" or debt financing. Once the facilities are in place, however, the town must meet the extra expenses of operating them. The evaluation of the simulated outcome under policy no. 3 conditions is shown in Fig. 13.

The evaluation results for policy no. 3 (preinvestment, loan guarantees, and the \$10 million grant) are only slightly different from the results for policy no. 2 (without the grant).^{*} Indeed, the positions of many of the viewpoints are largely unchanged by the reduction in the tax increase afforded by the provision of the grant. Viewpoints #3, #5, and #1 are unchanged; viewpoints #9, #4, #6, and #2

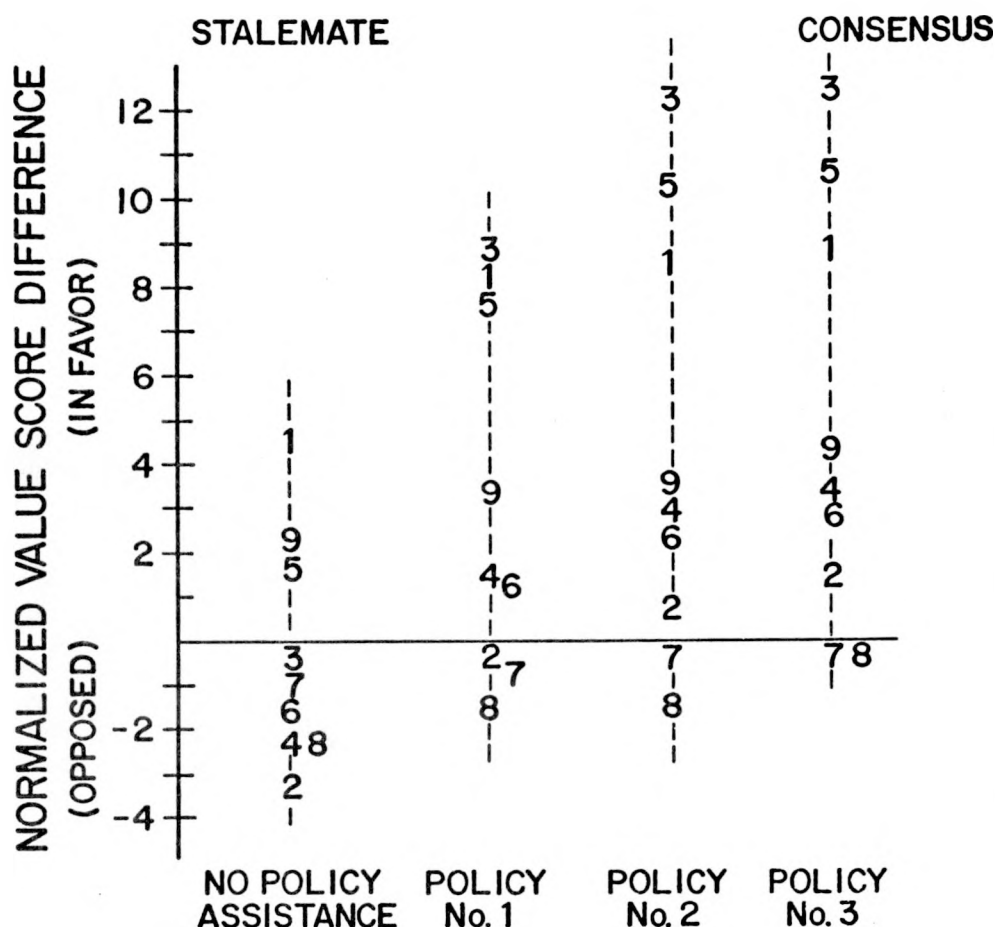


Fig. 13. MAUM evaluations under policies no. 1, 2, and 3.

^{*}The minimal response of the nine viewpoints to the \$10 million grant is especially interesting since much of the debate over assistance to boom towns involves the issue of providing direct grants for public construction.

increase only slightly; viewpoint #7 remains neutral; and viewpoint #8 increases by about one unit to a position of neutrality. We label the configuration under policy no. 3 conditions a "consensus" since the only two viewpoints in opposition to building the extra public facilities are so close to the horizontal axis that they could be regarded as neutral. In the next section, we seek an absolute consensus by adding a final policy measure to the package of three policies examined up to now.

D. Increased Transfer Payments

One reason for the continued, if slight, opposition of viewpoints #7 and #8 to the construction of the public facilities for the temporary population is the doubling of the local tax rate that occurs in spite of the \$10 million grant. This increase is due to the increased operating expenses that the town incurs in maintaining and operating the new facilities and serving the large population.

One way to remove the increased tax burden from the town is to increase the formula for calculating transfer payments. In the previous simulations, transfer payments are calculated on the basis of \$200 per person in the town. Under policy no. 4 conditions, we assume that the town receives transfer payments at the rate of \$300 per person during the four-year interval from 1974 to 1978, when expenses are abnormally high. During all other years, payments are calculated by the normal formula. The behavior of the model with the municipal financing sector receiving the increased transfer payments (in combination with the three other policies) differs from the policy no. 3 simulation result in only one respect--the local property tax rate increases by only 50% (as compared to the 100% increase under policy #3). Running this new outcome through the nine MAUM models yields the configuration shown under "policy no. 4" in Fig. 14.

The final configuration in Fig. 14 shows an absolute consensus. The reduction in the peak value of the local property tax rate afforded by the increase in transfer payments was sufficient to cause viewpoints #7 and #8 to shift from positions of slight opposition to join the majority opinion in favor of building the public facilities for the construction-related population.

An examination of the relative changes that occur from column to column in Fig. 14 shows the effectiveness of various policies in achieving this consensus opinion. Clearly, the most effective policy is the first one--preinvestment in public facilities made possible by a dependable signal from the energy company about the timing and size of the construction work force. The addition of the loan guarantee (policy no. 2) creates a very strong majority in favor of building the extra public facilities. Indeed, under policy no. 2 conditions, only viewpoints #7 and #8 oppose the construction of the extra public facilities. The addition of the \$10 million grant (policy no. 3) and the increase in state transfer payments (policy no. 4) are sufficient to convince these last two viewpoints that building the extra public facilities is preferable to ignoring the need for extra public facilities during the construction period.

E. Discussion of "Worst Case" Assumptions

The consensus of opinion shown in Fig. 14 exists in spite of the three worst case assumptions mentioned in the introduction to the paper. To the extent that these assumptions may be relaxed, one should expect an even stronger consensus in favor of building the extra public facilities for the temporary population. If, for example, the town has access to lower cost, modular public

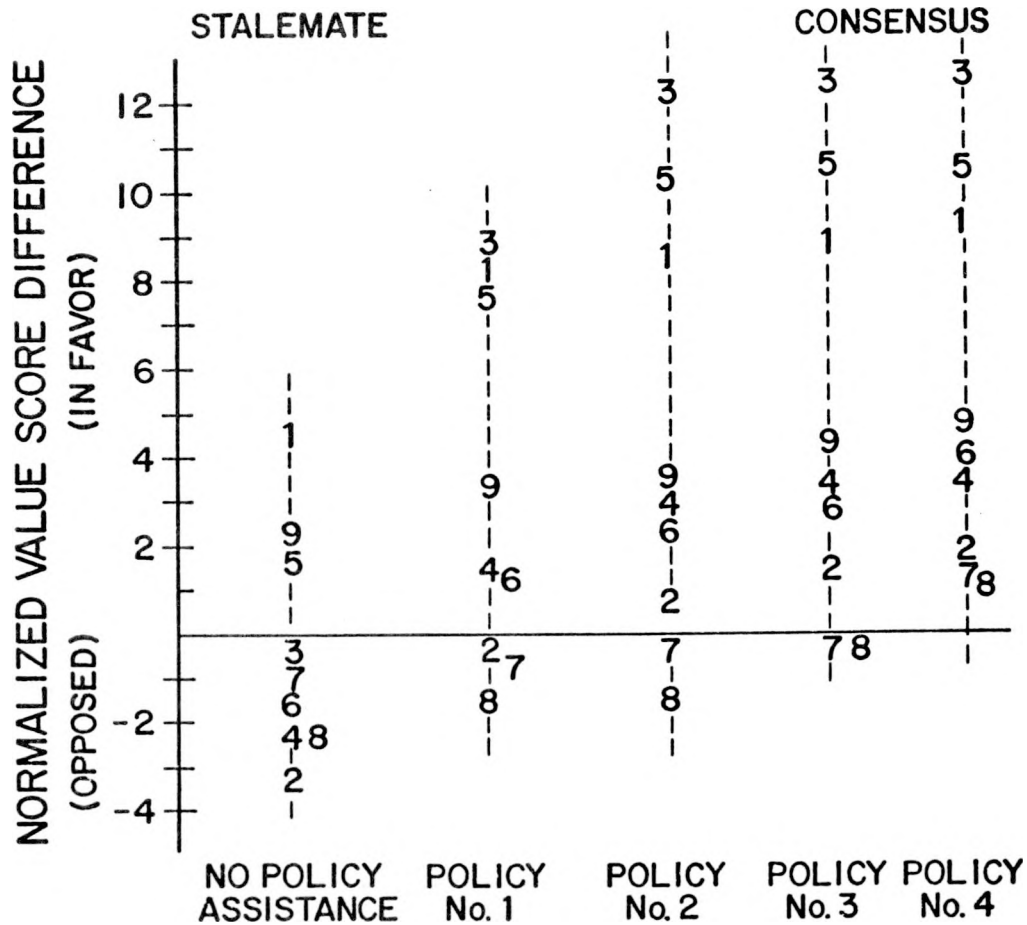


Fig. 14. MAUM evaluations of all policies tested.

facilities that could be easily removed after the construction families leave town, one would expect stronger support for investing in such facilities. To the extent that towns may wish to attract additional basic industry, new simulations could be performed to reexamine the question of providing extra public facilities. Of course, these new simulations would not show the severe population decline that occurs in the late 1970s in the simulation runs of this paper. Under these milder conditions, one would expect an even stronger showing in support of building the extra public facilities for the temporary population.

V. SUMMARY AND POLICY CONCLUSIONS

This report poses the question:

Should a town provide the public facilities required to serve the needs of the peak population if such facilities would not be fully used after the construction-related families leave town?

To answer this question, we make use of existing simulation and evaluation models. The simulation model is used to show the effects of a hypothetical town's decision to attempt or not to attempt to build the extra public facilities. The evaluation models employ statements of the values of nine public and private leaders to evaluate the simulated outcomes. The application of this two-stage process leads to a STALEMATE of opinion among the nine leaders--three viewpoints favor the construction of the extra public facilities; six viewpoints oppose their construction.

A sensitivity analysis of the STALEMATE result shows that the conflict over the question is not affected by changes in particular parameter estimates of the simulation model. Indeed, we attribute the STALEMATE result to several immutable factors that are likely to characterize a wide variety of boom towns. These fundamental factors include the genuine differences in values and preferences among local residents, the large size of the construction work force, and the "front-end" financing problems that impede a town's ability to provide the full complement of public facilities needed at the peak of the boom.

An analysis of several mitigation strategies shows that the implementation of specific boom town policies converts the STALEMATE view into a CONSENSUS in favor of building the extra public facilities. We find that requiring the energy company to provide a dependable signal about the size and timing of the construction work force is the most effective policy in creating the CONSENSUS view. This signal allows the town to build up the stock of public facilities before the construction-related population moves into town. Adding loan guarantees to the requirement for a dependable signal from the energy company is sufficient to create a strong majority opinion in favor of building the extra public facilities. And finally, providing additional financial assistance in the form of direct grants for public construction or increased transfer payments creates an absolute CONSENSUS in favor of building the extra public facilities.

The policy conclusion to be drawn from this analysis is that local viewpoints could arrive at a consensus to provide the full complement of public facilities needed at the peak of the boom as long as specific boom town policies are implemented. Most importantly, they require a dependable signal from the energy company about the size and timing of the construction work force. Further assistance in the form of a loan guarantee or a direct grant for public construction is needed to deal with the front-end financing problem. If such policies are not implemented,* local viewpoints could be locked in a stalemate over the preferability of even attempting to provide the public facilities required for the peak population.

* We add a word of caution to those readers participating in the current debate over the best source of funds for boom town assistance programs: the preceding analysis does not focus explicitly on the source of the boom town assistance measures. Except for the signal from the energy company, all policy assistance measures tested in this paper could come from either the energy company, the state government, the federal government, or some combination of the three. The analysis does not show which participant should take the lead in providing the assistance; it does show the effectiveness of specific measures in improving local conditions, should the assistance become available.

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