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STRATEGIES FOR THE MITIGATION OF MUNICIPAL FINANCIAL PROBLEMS ASSOCIATED WITH ENERGY DEVELOPMENT: A SIMULATION EXPERIMENT*

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ABSTRACT

Alternative strategies are evaluated for financing municipal facilities in communities experiencing population influx due to an energy development such as power plant construction. The simulations, based on a system dynamics model of public service facilities, fall into two broad groups according to whether the needed revenues are sought from local or extralocal sources. Of all cases presented, only direct extralocal grants both eliminate public service shortages and keep the property tax rate down. The solution to the boomtown financing problem will likely involve some combination of strategies. The system dynamics analysis can help policymakers and planners conceptualize the nature of the situation and understand the range of options.

INTRODUCTION

Wide public and political recognition is now given to the fact that energy developments such as power plant construction or large-scale coal and uranium mining create strains for the nearby rural communities that host the labor forces required. Much effort has gone into modeling the population growth and subsequent facilities and service needs which these communities experience

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[1–4]. Another side of the coin is to evaluate the potential impacts of alternative strategies for financing the needed municipal facilities once they have been identified. In this context of generic policy evaluation, system dynamics simulation modeling can prove useful to planners and officials at the federal, state, and local levels. We report several simulations on alternative mitigation strategies and discuss some of the limitations on the use of this type of modeling in the policy and planning area.

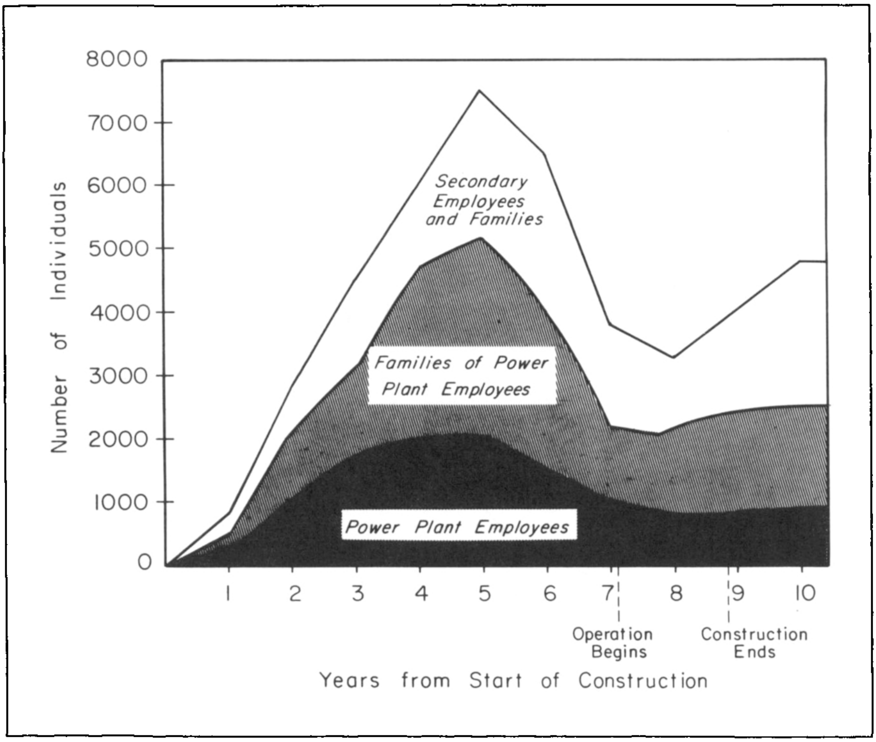
THE COMMUNITY IMPACT PHENOMENON

Construction of a power plant, installation of service bases for offshore drilling, mining of coal or uranium, construction of coal gasification or oil-shale plants, and various other energy-related activities are either presently ongoing or are planned for many parts of the country. Either because the resources are not located near major population centers or because of air, water, and land requirements and regulations, these activities tend to be focused in rural or semirural areas which can physically accommodate them but which generally lack the labor force base to supply an indigenous source of construction workers. This disjunction of labor availability and demand means that, depending on the proximity of metropolitan areas to furnish commuting labor, a significant amount of in-migration will occur.

The bulk of the in-migrants will be temporary; their stay will depend on the construction time for the particular project and can vary from less than two to more than ten years. The total population increase that a community can expect will depend on the size and proportion of families accompanying the workers and on secondary employment opportunities that develop to attract nonconstruction workers (see Figure 1). Various modeling efforts are underway, as we pointed out above, to project the population increase and to estimate the municipal needs this population will create. The community involved will have to provide water, waste-water, police, fire, medical, educational, and transportation services. Depending on the extent of existing underutilized capacity, municipal expenditures can increase significantly.

FINANCIAL STRATEGIES

The fiscal problems facing small communities undergoing rapid growth are several. First, there will probably be a lack of adequate revenue for expansion or construction of such facilities as sewage treatment plants, water supply systems, and schools. Second, lead time problems arise since prospective revenues from the new development will accrue to the community after the facility is operational – not in the preconstruction years when the community should be expanding its services to accommodate the pending population influx of workers and their families (see Figure 2). Third, the communities face fiscal

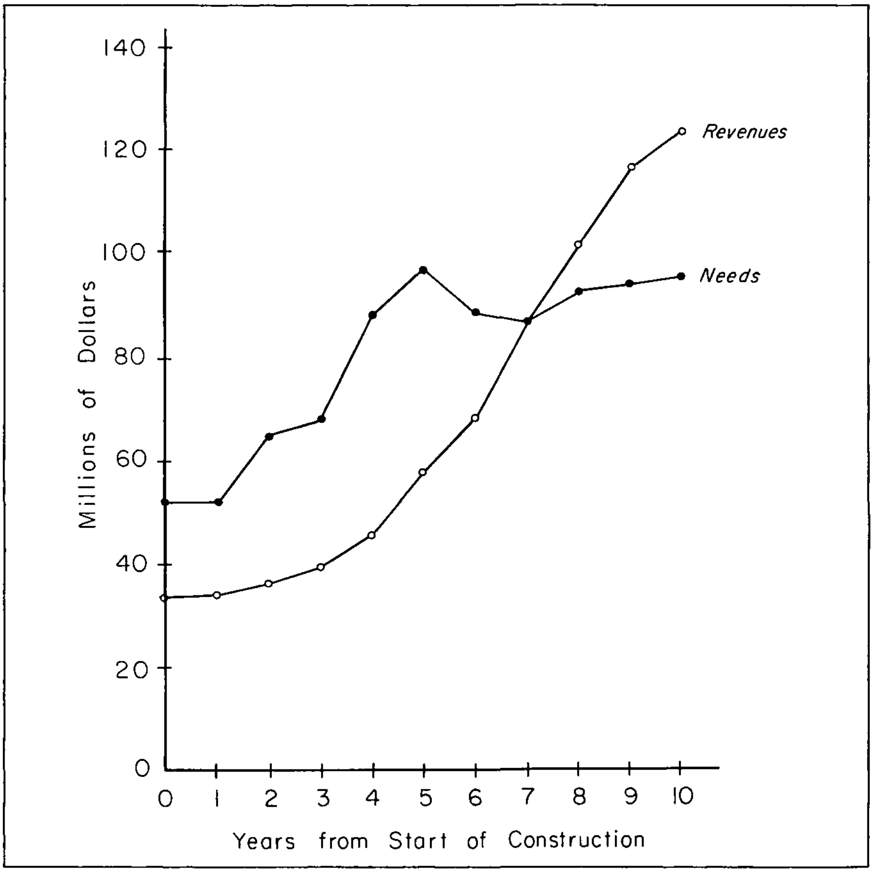


SOURCE: *Rapid Growth from Energy Projects: Ideas for State and Local Action,* U. S. Department of Housing and Urban Development, Washington, D.C., 1976.

Figure 1. Added population from construction and operation of a typical 2,250-megawatt coal-fired power plant.

uncertainty since there is no guarantee that contingencies will not occur that would force the industry to cancel or cut back on development plans. Fourth, "community development needs and socioeconomic problems associated with large-scale energy development are unlikely to conform to local jurisdictional boundaries." [3, p. 75] Such situations mean that tax benefits can accrue to one community while financial impacts fall to another. Fifth, shortages of private as well as public capital can occur, leading to an inadequate housing supply and a lack of expansion in retail and service businesses.

Strategies for mitigation of financial problems are associated with these major categories of funding: (a) traditional debt and security devices, (b) federal/state support programs; and (c) industry. Other relevant strategies such as tax-base sharing, creation of special districts, and public ownership are available, but these types of mitigation devices have proven thus far to be less feasible politically than the strategies discussed here.



SOURCE: Colorado Oil Shale Region, *Tax Lead Time Study,* Colorado Geological Survey, Denver, pp. 1-13, 1974.

Figure 2. Revenue-expenditure analysis.

Traditional Debt and Security Devices

The usual capital source for communities involves long-term municipal borrowing through tax-exempt bonds. However, many "state constitutions contain limitations on the amount of general obligation indebtedness which a municipality may incur and/or establish ceilings on local mill levy rates." [5, p. 556] Traditional devices also "lack the specialized features required to pledge future revenue sources [e,g,. property taxes] to create current funds to solve the front-end requirement that public facilities and services be in place when they are needed." [5, p. 557] Nevertheless, communities with debt capacity will continue to issue bonds for financing public facilities and services.

Federal/State Support Programs

Various forms of grants, loans, and revenue-sharing from either the federal or state level can be used to assist communities (see Figure 3). Direct grants to impacted communities can come from federal aid programs or from state general revenues. However, as Markhusen notes [6, p. 94], "since such programs generally represent a . . . giveaway, the producing sector and local government alike have an incentive to apply for free public goods, regardless of their separate estimates of future local need." Severance taxes or mineral leasing revenues can be earmarked for an impact assessment fund by the state and used for either grants or loans. Whatever the source, and whether the aid comes in the form of loans or grants, government assistance can help alleviate the front-end financing problem exemplified in Figure 2.

In addition to numerous categorical aid programs, the federal government has established two impact funds: the Coastal Energy Impact Program under the Coastal Zone Management Act Amendments of 1976, and the Energy Impacted Area Development Assistance Program under Sec. 601 of the Power Plant and Industrial Fuel Use Act of 1978. In addition, such states as North Dakota and Montana have established community impact funds using severance tax revenues, and states such as Texas have had similar legislation proposed. Loan guarantees rather than loans can be extremely important in allowing a community to initiate facility expansion before the industrial development begins. Such guarantees, whether they come from industry or government; protect communities from having to default should a planned development not occur.

As indicated in Figure 3, there are many sources of fiscal assistance for communities. Political and statutory problems make implementation of some mitigation strategies more difficult than others [5, pp. 556-571]. Some states would require enabling legislation to adopt, for instance, tax-exempt industrial revenue bonds for loans to communities. Statutory limits on local bond interest rates, on bonding limitations, or on property taxes are also under state control.

We have excluded from this analysis the situation in which taxes accrue in one jurisdiction while the municipal expenditures are required in another (e.g., a power plant is built in one school district but the workers and their families live in another district). Strategies available to help solve such disparities include financial cooperation through state-authorized "joint powers" acts, special multipurpose districts, reallocation of local government functions, locally shared taxes based on service needs, formula distribution of state-collected taxes, and tax base sharing [3, p. 75].

Industry

The industry responsible for the development (with qualification for public entity sponsors exempt from property tax payment) generally will return to the community more revenues than the municipal costs which the community must

Federal:

- Categorical aid programs and planning grants
- In-lieu-of-tax payments
- Excise taxes
- Mineral lease and royalty payments
- Deferred municipal bond payments
- Loan guarantees and forgiveness programs
- Local tax guarantees

State:

- Severance taxes
- General revenue funds
- Tax-exempt industrial revenue bonds
- Deferred municipal bond payments

Industry:

- Tax prepayments
- Local bond purchases
- Direct construction (lease-purchase)
- Impact payments
- Loan guarantees
- Bond or tax payment guarantees

Figure 3. Examples of financial sources for aid to impacted communities.

bear. One way of getting those revenues up front is through industry prepayment of taxes, which are then credited against property taxes when these become due after start-up of the facility. Other industry-involved strategies include purchase of local municipal bonds, direct impact payments, and so forth (see Figure 3).

> To the extent that such financial commitments can be incorporated into the recoverable price of the product, . . . they can be justified. Current S.E.C. regulations may present obstacles in employing various corporate financial guarantees by requiring time consuming and expensive registration of these mechanisms as "securities." [5, p. 552]

Our concern here is not to analyze in depth the various mitigation strategies per se, but to demonstrate through a system dynamics model the effects various strategies can have on the fiscal situation of an impacted community. Following a brief history of the model used, we present and discuss simulation runs that address:

1. whether the assistance is locally generated or extralocal;
2. what type of assistance is offered (loan or direct grant); and
3. when the assistance is available (timing).

BOOMP: A SYSTEM DYNAMICS MODEL

The BOOM1 model was developed at the Los Alamos Scientific Laboratory to assist policy analysis of the community socioeconomic problems associated with energy development [7]. BOOM1 simulates the socioeconomic impacts (public service shortages, retail service shortages, housing shortages) accompanying the construction of a large power plant near a hypothetical agricultural community. The basic causal structure of BOOM1 flows from construction jobs attracting in-migrants, who in turn create considerable additional demand for private and public facilities that local markets cannot accommodate, to the resulting shortages. Several feedback loops connect the resulting shortage to decreased productivity of power plant construction workers.

BOOMP is an extension of BOOM1 designed to model public sector impacts in a more detailed fashion [8]. The public sector is disaggregated into Elementary Education, Secondary Education, Police Protection, Fire Protection, Water, Sanitary Sewerage, and Residual Services subsectors. Each of these subsectors is disaggregated into a Capital Facilities subsector and an Operating Expenditures subsector. The BOOMP conceptualization then identifies the major components of each of these subsectors. For example, Sanitary Sewerage capital expenditures consist of Sewage Treatment Plant Capital Costs, Sewage Collection Pipeline Capital Costs, Sewage Manhole Capital Costs, and Sewage Pumping Station Capital Costs.

The final step in the BOOMP conceptualization is establishing the supply and demand interface with the other sectors of the BOOM model. For example, Permanent Houses and Mobile Homes, by generating specifiable quantities of sewage, create a demand for Sanitary Sewerage Capital Facilities. Housing, of course, is interconnected with Population, which in turn is interconnected with the Construction Jobs generated by power plant construction.

For a more detailed understanding of the public facilities sector of BOOMP, consider Figure 4, which represents a standard system dynamics flow diagram of the Sanitary Sewerage Capital subsector. Daily water demand (residential and school) is computed in the water facilities subsector by multiplying mobile homes, permanent houses, and students (elementary and secondary) by per-unit demand coefficients. Sewage generation is then computed by multiplying a sewage-to-water ratio. This computation establishes Sewage Treatment Facilities Required (STFR). STFR is then compared with existing Sewage Treatment Facilities to determine Sewage Treatment Facilities Construction Required (STFCR). STFCR is then multiplied by the Fraction of Public Construction Financed (FPCF) to determine how much additional capacity is actually financed. (FPCF is computed in the municipal finance sector and depends upon the ratio of available revenue to aggregate public facility construction financing required.) Annual Sewage Treatment Facilities Capital Costs is then computed by multiplying Sewage Treatment Facilities Constructed by Unit Costs of Sewage Treatment Facilities (unadjusted for inflation) and amortizing.

SIMULATION OF ALTERNATIVE FINANCING STRATEGIES

Eleven simulations of financial strategies are discussed. Two variables are displayed in each figure: Public Service Shortage (PSS) and Property Tax Rate (PTAXR). Each represents a composite index of several other variables computed separately by BOOMP. PSS is an average of the shortages (surpluses) in all the municipal facilities/services sectors (Water Distribution and Treatment Facilities, Sanitary Sewerage Collection and Treatment Facilities, Elementary School Facilities, etc.) in a given year. PSS is expressed as a negative or positive percentage. Negative implies no shortage (a surplus). For example, if the municipality requires 500,000 gallons per day wastewater treatment capacity to service the locally generated sewage and is only able to provide capacity for treating 250,000 gallons per day, a shortage exists of 100 per cent in wastewater treatment facilities ([500,000 - 250,000] ÷ 250,000 = 1.0 X 100 = 100%).

Property Tax Rate is expressed in the conventional millage rate and represents the sum of municipal school district, county, and special districts millage rates. The simulations fall into two broad groups according to whether the extra revenues are sought from local sources or extralocal sources. Local source revenue simulations can be further subdivided according to whether the local source is "traditional," "nontraditional," or "exotic."

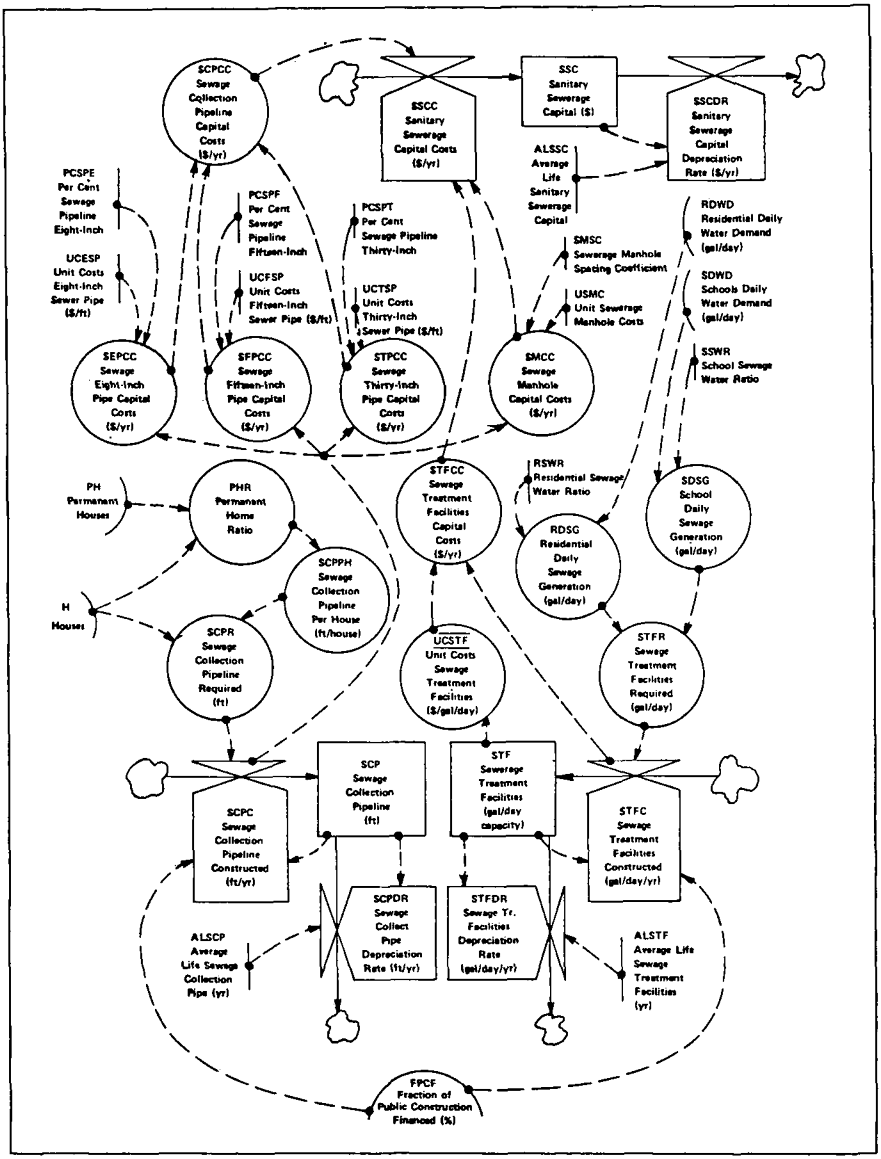


Figure 4. Sanitary sewerage capital.

Figure 5 exhibits the case of "no power plant." The hypothetical town is assumed to maintain its 1970 population until 1990. Since facilities/services and population were assumed to be in equilibrium in 1970, there are no shortages or surpluses throughout the era and no change in the property tax rate that began at 145 mills.

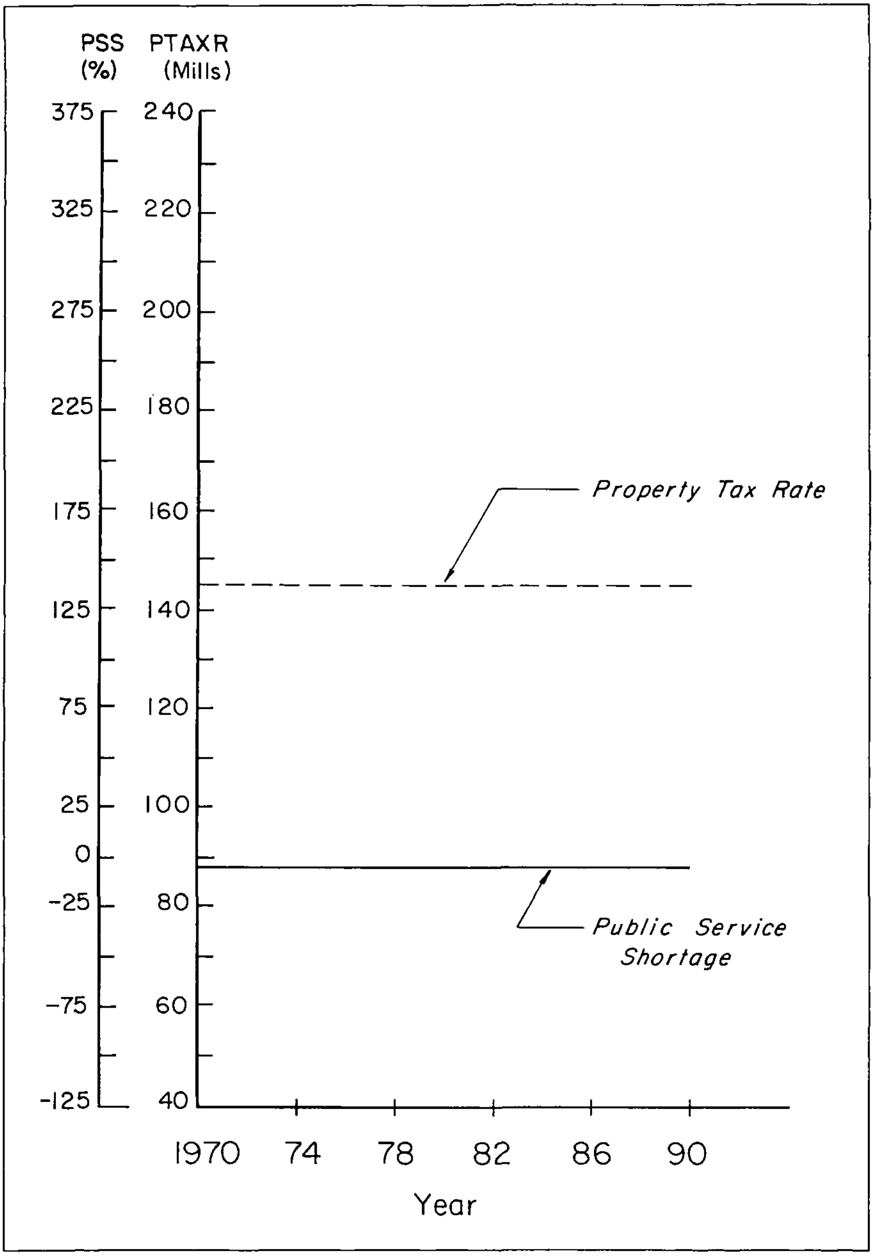


Figure 5. No power plant.

Figure 6 exhibits the first simulation, assuming power plant construction. The major relevant assumptions made in this simulation are as follows:

1. a statutory limitation restricts the cumulative municipal debt to 10 per cent of local assessed value;
2. a statutory ceiling prevents the local property tax rate from being incremented more than 6 per cent in a given year (in states where this ceiling exists, it often can be waived with a local election);
3. aside from a state-provided minimum foundation school program that finances 80 per cent of school operating costs (up to $1080 per high school student and $850 per elementary student), there are no extralocal sources of revenue; and
4. there are no local sources of revenue aside from property taxes and user fees.

As Figure 6 indicates, this is the "worst case" simulation in that the town experiences a whopping 350 per cent shortfall in the provision of public services during 1977 (two years after construction of the power plant begins). It is the "best" case to the extent that the property tax rate rises only to 173 mills in 1979 and drops thereafter.

The second simulation (Figure 7) reverses the above condition but is still a "worst" case. The only change of assumption was that no ceiling was imposed on the rate of change in the property tax rate, i.e., the town was limited only by its bonding capacity. As Figure 7 indicates, the peak construction year public service shortage was cut from 350 per cent to 45 per cent. However, the property tax rate skyrocketed to 249 mills and there was still a shortage of 45 per cent in public services provided.

The third simulation removes the property tax rate ceiling and permits the town to issue debt up to 20 per cent of its assessed value. As Figure 8 indicates, there is little change except PSS is slightly diminished.

The fourth simulation allows the town to finance new services by increasing user fees (water rates) by 300 per cent. As Figure 9 indicates, the effect is dramatic in that shortages are now only about 11 per cent in 1978 but property tax rates still zoom. This strategy has two major disadvantages:

1. user fees are considered highly regressive when levied against necessities (water and sewage disposal); and
2. when increased at anything approximating the rate necessary, the fees are likely to elicit widespread citizen disapproval, particularly as property tax increase.

The fifth simulation (Figure 10) represents the first "nontraditional" run, i.e., local revenue sources are sought other than the traditional property taxes and user fees. Specifically, the town is permitted to levy a no-exemptions 1 per cent sales tax (generating $35 per capita), a local income tax generating $25 per

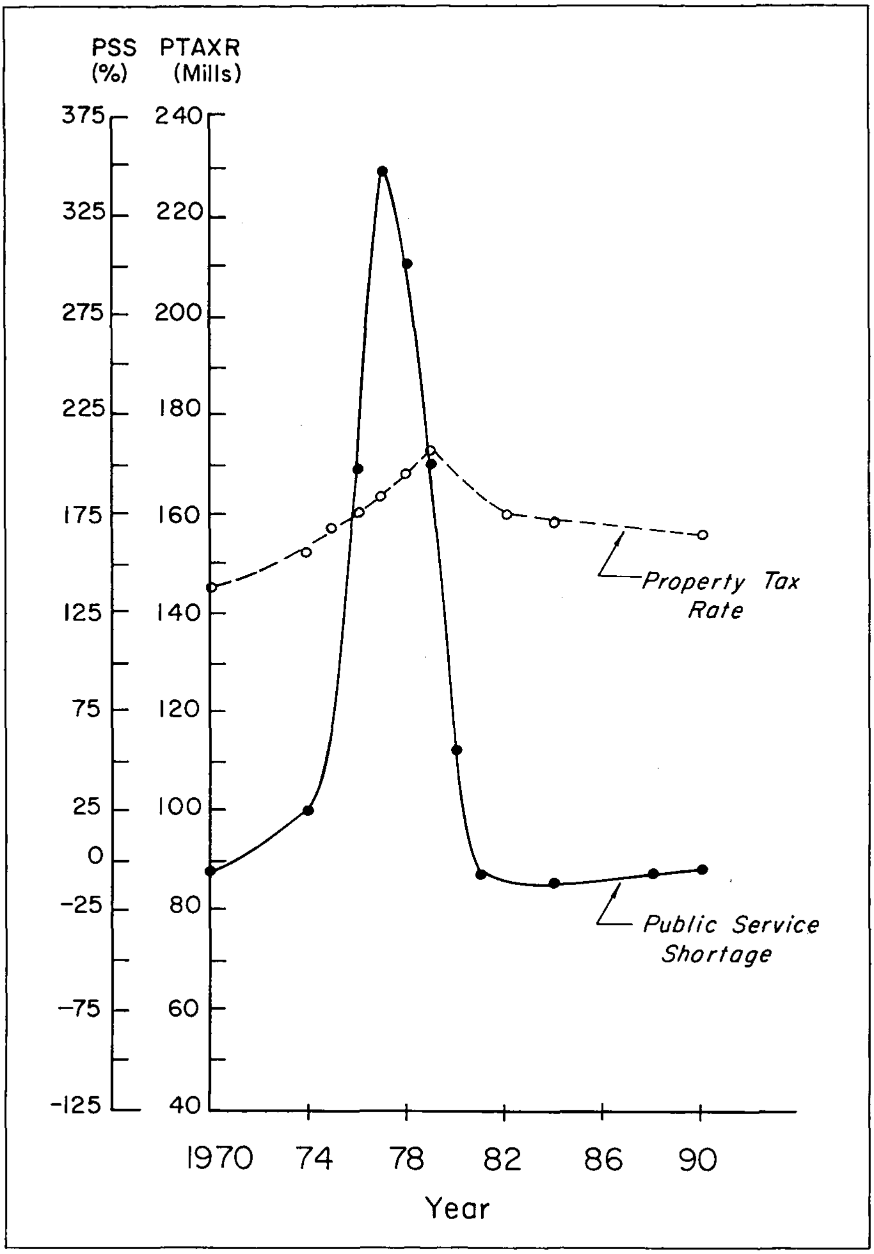


Figure 6. Property taxes and user fees (normal).

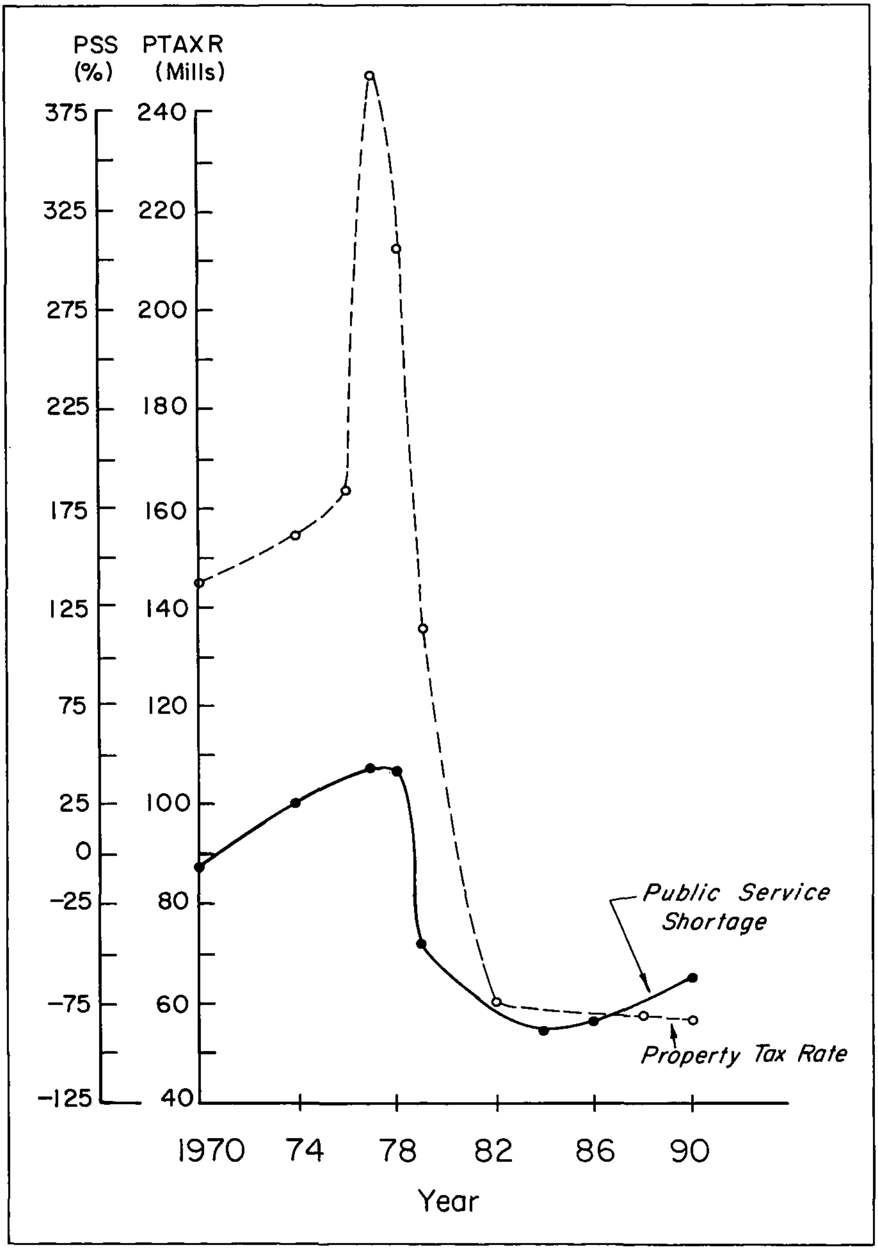


Figure 7. Property taxes and user fees (no PTAXR ceiling).

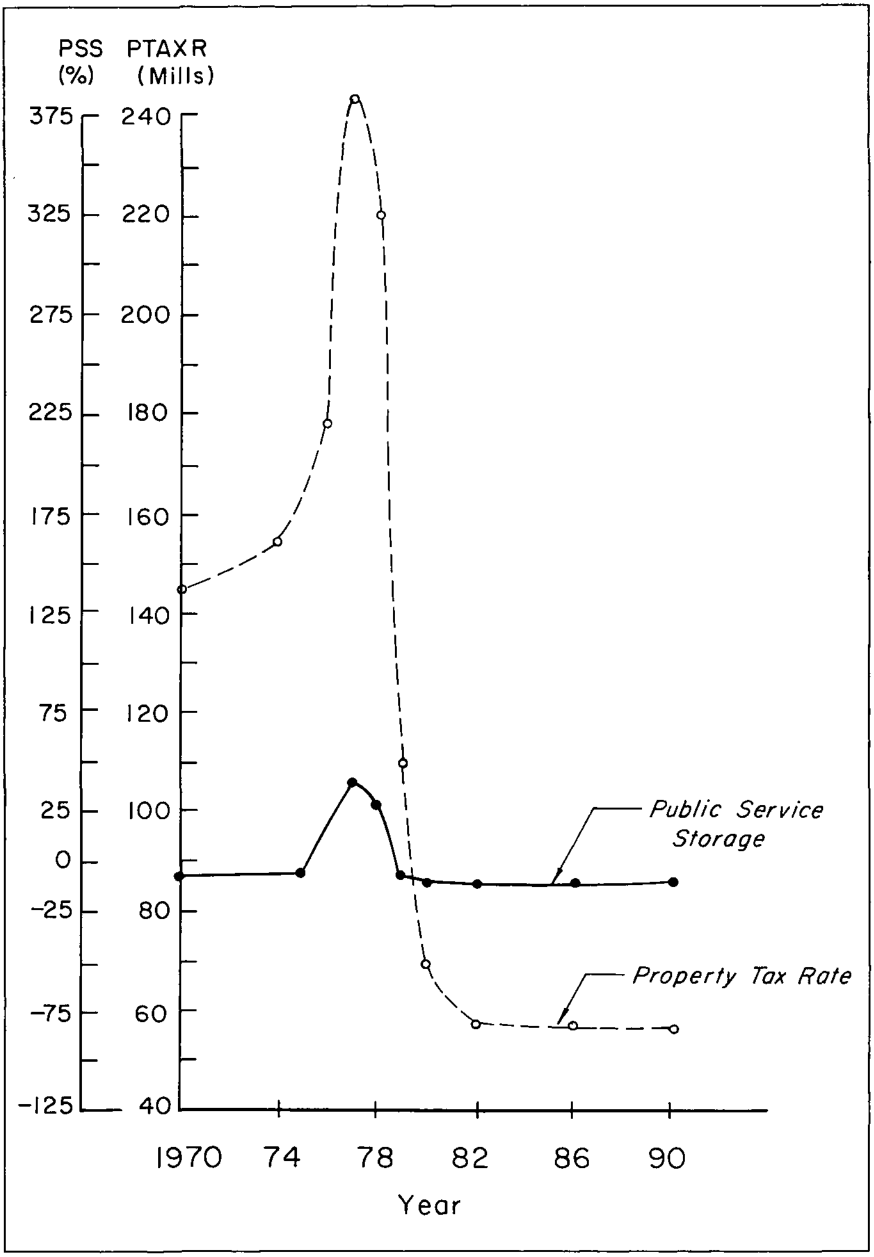


Figure 8. Property taxes and user fees (20 per cent bonding capacity).

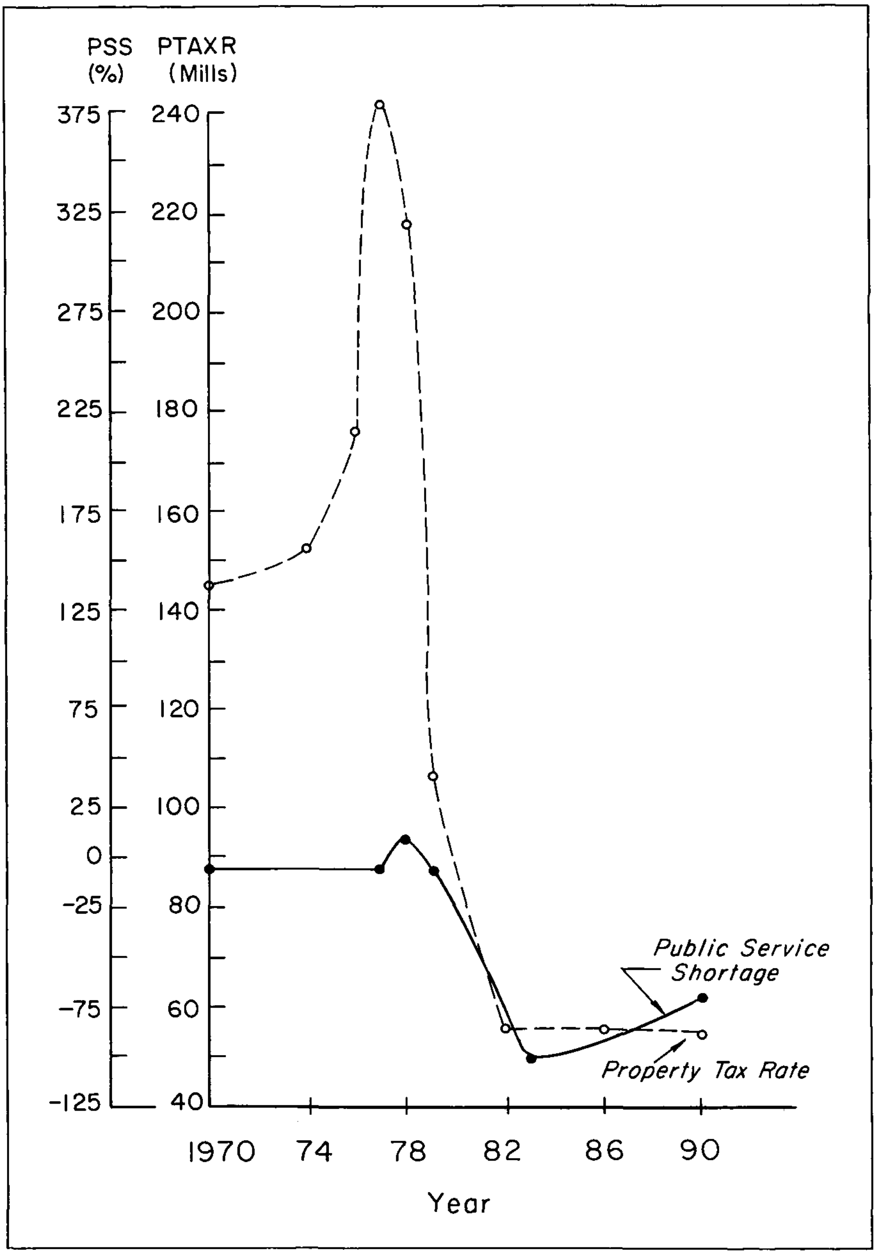


Figure 9. Property taxes and user fees
(300 per cent increase in user fees).

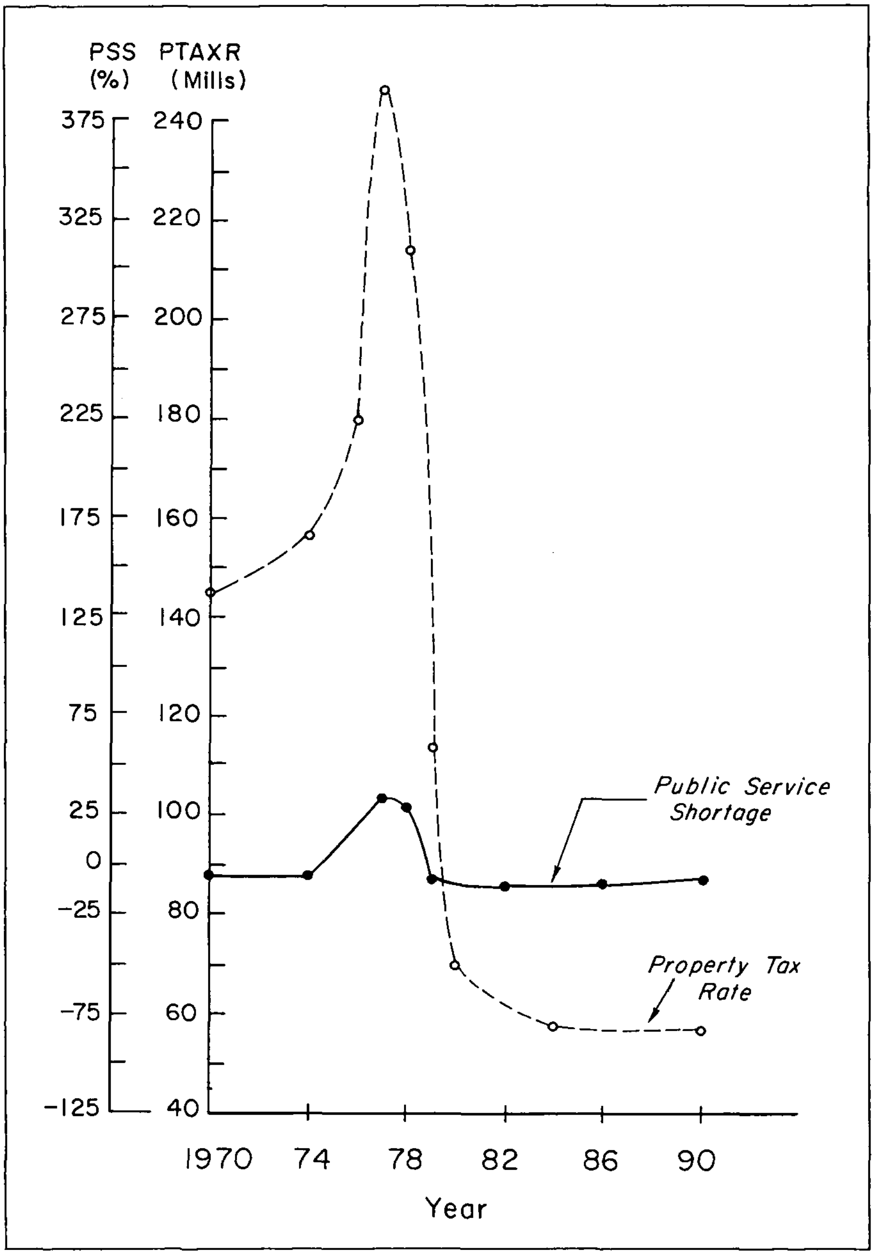


Figure 10. Property taxes, user fees, sales taxes, income taxes, and occupation taxes.

capita, and an occupation tax. (In regard to the latter, "for example, Denver levies a $2-per-month tax on both employers and employees for the privilege of working and employing workers inside Denver. In 1973, Denver raised approximately $10 million through this tax or $18 per capita." [9, pp. 3-36]

As Figure 10 indicates, the shortage is only slightly reduced, and the property tax rate remains high. Aside from this inefficacy, the strategy is not likely to be acceptable for other reasons as noted by the Western Governors' Regional Energy Policy Office [5, p. 185] in the case of New Mexico:

> Aside from the inflexible property tax, neither the counties nor the municipalities have access to major additional taxes. Local income taxes are not permitted by state law. A municipality may enact by ordinance a sales tax of one-fourth of a percent and an additional one-fourth percent by vote of the people. Forty-five cities have enacted the tax by ordinance. On six occasions, the voters in those cities were asked to enact the additional one-fourth tax. In only two cities did the measure receive approval.

Thus, there are two problems with "nontraditional" local sources. They generate inadequate revenue levels to offset property tax rates significantly (a 1 per cent sales tax typically generates $35 per capita, and food exemptions lower this by 20 per cent), and they typically incur dramatic citizen disapproval (sales taxes are the most popular [9, pp. 3-17] and that is not very popular).

The simulation depicted by Figure 11 offers an alternative local source. Instead of "nontraditional" local taxes, an "exotic" tax is levied. No local sales, occupation, or income taxes are levied. In addition to property tax and user fees, however, a *use* tax is levied. As defined by the Colorado Oil Shale Region study [9, pp. 3-18, 3-19]:

> The great majority of use tax revenues in Colorado are derived from motor vehicles (taxed at point of registration based on owner's address), construction building materials (taxed on estimated basis when the building permit is issued), and machinery and equipment (licenses issued to local business and periodic returns required) . . . . In areas of rapid growth, with unusually high rates of construction, the tax may generate significantly more revenue.

In addition to property taxes and user fees in this simulation, the town levied a $150-per-new-house construction materials use tax. The major advantages of this type of "exotic" tax are:

1. by shifting the tax burden to new residents, it meets citizen approval more readily; and
2. "there are no significant time lags between the collection of use taxes and the occurrence of economic activity." [9, pp. 3-19]

As Figure 11 shows, the construction materials use tax, for all its timeliness,

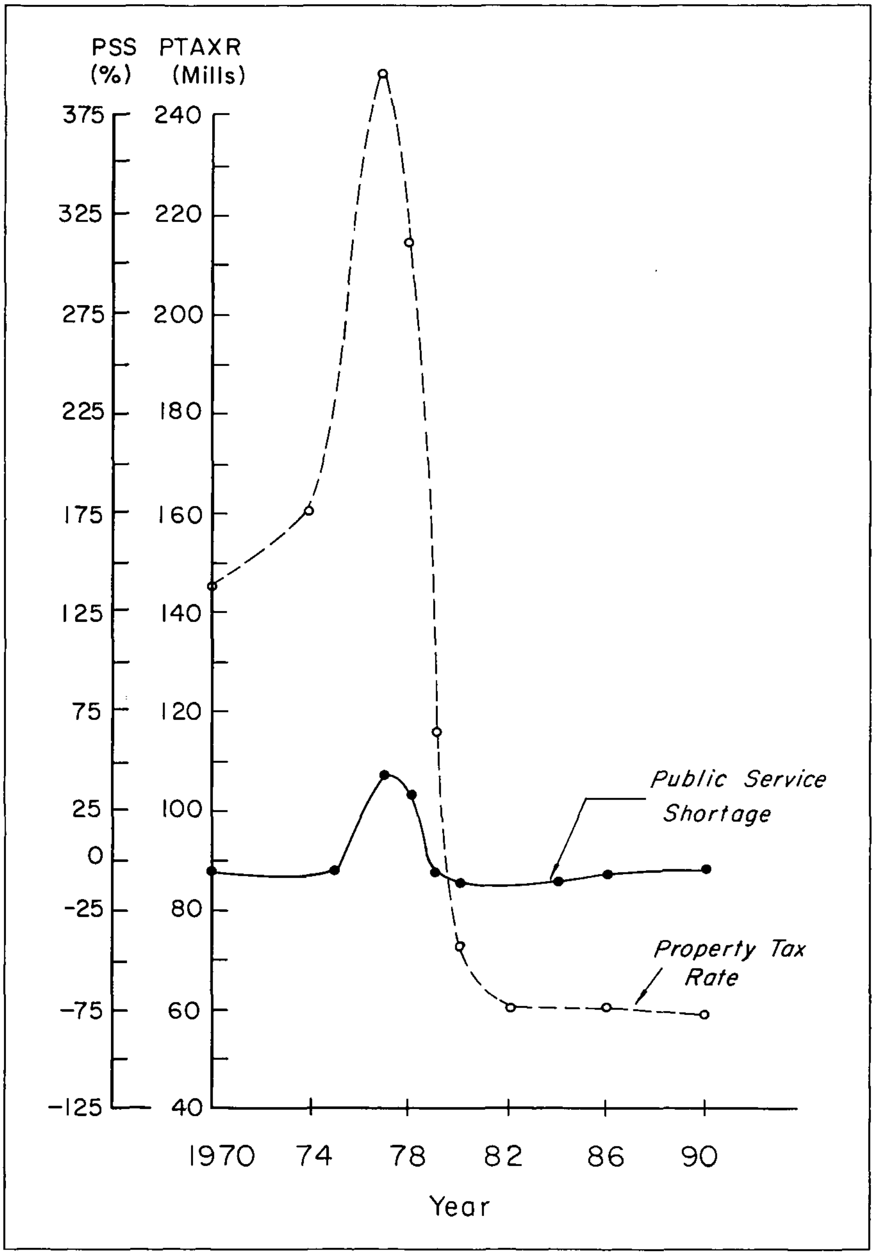


Figure 11. Property taxes, user fees, and a construction building use tax.

simply generates inadequate revenue for such a small community as the one depicted by BOOMP. The impacts on PSS and PTAXR are negligible.

The final "exotic" simulation tests a local revenue strategy that has proven efficacious in some settings. According to a study by Gilmore, Moore, Hammond, and Coddington [10], Meeker, Colorado, solved its problems in the following manner:

> Meeker is in effect requiring its new residents to pay for a substantial share of the capital costs their arrival necessitates, before they move in. In 1974, the town raised its water tap fees from $250 to $850 per unit. Total tap fees for water and sewer are now $1,350 per unit . . . . The town has also begun construction on new utilities systems which will increase its population-serving capacity from 2,000 to 7,800. Not counting interest, roughly 90 per cent of the costs of these facilities will be paid by tap fees . . . .

Figure 12 shows the results of adding a $1,350-per-unit utility connection fee to property taxes and standard user fees. The results show little effect. There is, however, a significant reason for this lack that applies also to the disappointing results shown in Figure 11. These revenues are tied directly to new housing construction. Meeker was assured of vigorous housing construction. The hypothetical town represented by BOOMP is experiencing a housing shortage and a slow market response at the same time it is experiencing a public service shortage. Thus, if the housing shortage could be solved, utility connect fees can provide dramatic, citizen-approved local revenue. The problem is that such a source adds more to the already inflated price of housing and thus may further exacerbate housing shortages.

In sum, no locally generated revenue strategy solves the public service financing problem of the town represented by BOOMP. Dramatic increases in user fees lower the shortage considerably but add a sizable burden to the already exorbitant local tax rate and would likely require sainthood from local residents to be acceptable. Removal of the ceiling on property tax rate increments dramatically lowers the service shortage at the expense of an intolerable property tax rate. Use taxes and utility connection fees shift the tax burden but generate inadequate revenue because of the depressed housing market.

The results of the first extralocal simulation are depicted in Figure 13. This simulation illustrates the effects of a special loan-guarantees program. A Colorado legislative proposal included the following [5, p. 21]:

> . . . a *bond underwriting fund,* in which monies from the state's share of future oil shale bonus payments would be deposited. In essence, the proposal would authorize the use of the fund to guarantee bonds of local government that were used for public facilities required by virtue of the location, construction, or operation of energy conversion and resource development operations . . . . The guarantee contract would become operative when a political subdivision [was] unable to make principal and

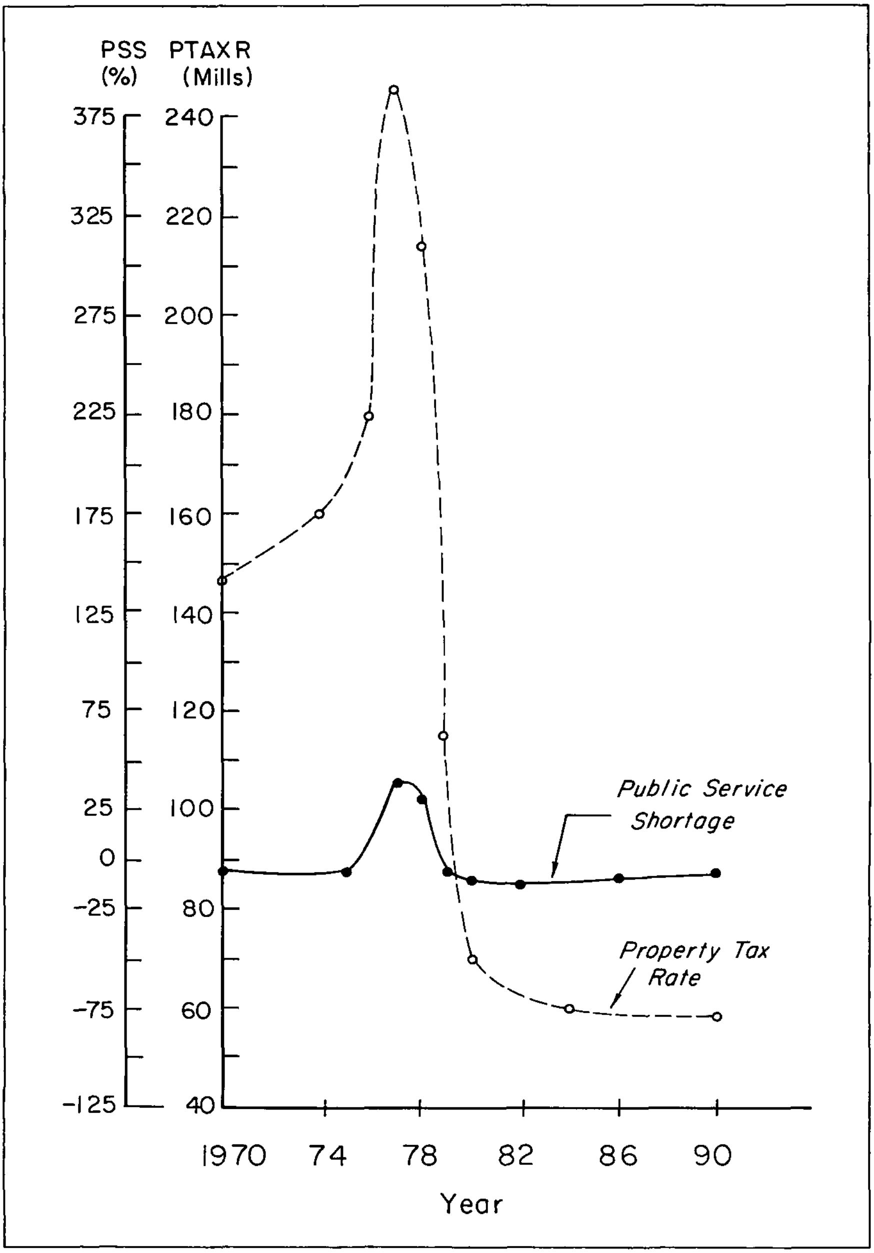


Figure 12. Property taxes, user fees, and a utility connection fee.

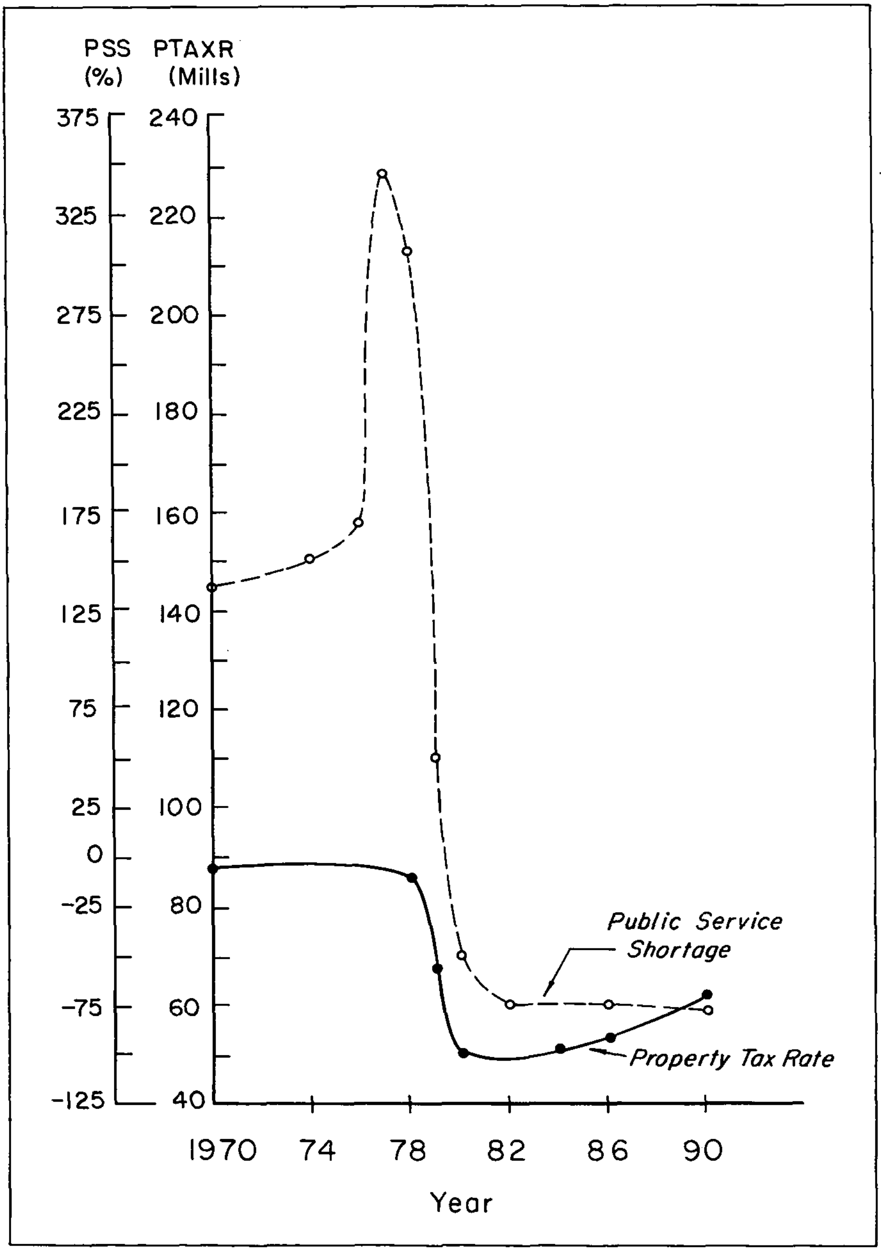


Figure 13. Property taxes, user fees, and bond underwriting.

and interest payments on its bond when such payments became due. If the subdivision could not make the payments, the state would have loaned monies from a bond underwriting revolving fund, which would be subject to eventual repayment by the local subdivision.

This strategy is implemented by BOOMP by:

1. computing the difference between the New Debt Required (NDR) to provide needed facilities and the actual New Debt Issued (NDI) (which is lower than NDR because of bonding limitations);
2. assuming the bond underwriting fund picks up the difference, thus allowing NDI to equal NDR; and
3. accumulating the annual differences between NDR and NDI and adding them to the cumulative Municipal Debt in 1980.

Figure 13 shows that this strategy eliminates the public service shortage. The problems with this strategy are twofold: the property tax rate remains exorbitant during the construction years and the town has large underutilized public facility capacity during subsequent years – an inefficient allocation of public resources.

The next simulation allows the prepayment of taxes by the power plant developer. This strategy was implemented with BOOMP by

1. summing all the plant taxes due to the municipality between 1975 and 1985;
2. adding 1/8 of the total to the annually computed Municipal Revenue (MREV) between 1973 and 1980; and
3. subtracting 15 per cent of the total (plus an incentive) from MREV between 1981 and 1985.

Figure 14 shows that this strategy also eliminates the public service shortage. Still, the additional revenues are not sufficient to reduce the property tax rate significantly during the construction interval, i.e., all the revenue is simply used to build new facilities.

The final simulation was the only one that both eliminated the shortages and kept the property tax rate down (see Figure 15). In this simulation extralocal grants were provided to finance additional facility construction. The grants were allocated when needed and in sufficient quantities to allow the property tax rate to remain at its preboom level during construction and decline thereafter.

These simulations should by no means be regarded as definitive. The likely solution to the boomtown financing problem will involve some combination of prepayments, loan guarantees, grants, locally generated revenue aimed at existing residents (they do enjoy the benefits of many new facilities), and locally generated revenue aimed at newcomers. The goal is, of course, an equitable and efficient solution. These simulations simply illustrate some of the

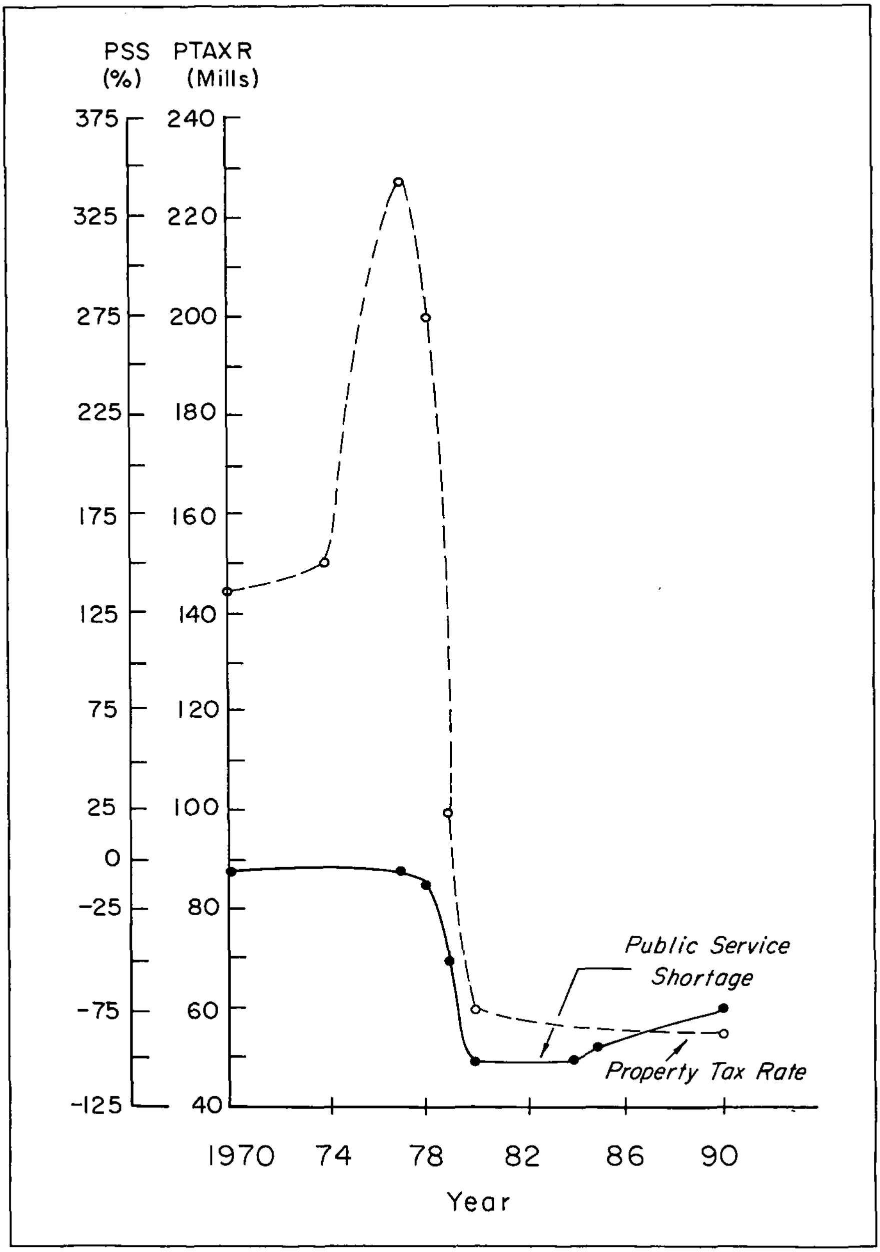


Figure 14. Property taxes, user fees, and industry prepayment of taxes.

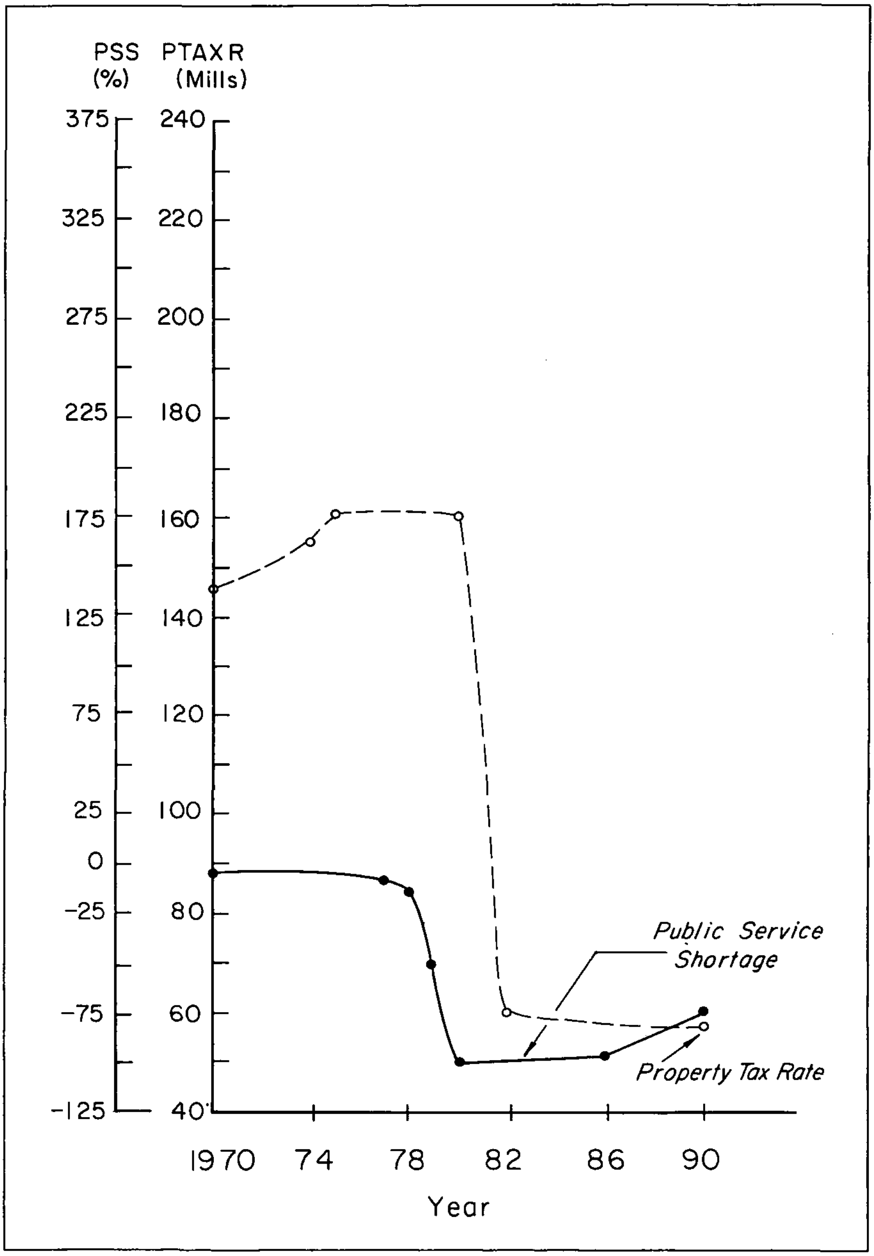


Figure 15. Property taxes, user fees, and grants.

potential problems associated with the various strategies under a special set of conditions.

CONCLUSION

Simulations using the BOOMP model point up the fact that there is no simple, "one-shot" solution to management of community fiscal problems that arise because of a temporary population influx. The major use of this type of modeling is to help policymakers and planners conceptualize and understand the nature of the situation and the range of options. It is both a learning tool and a policy tool at a generic level. This type of modeling, however, is not appropriate for planning a concrete strategy for any particular community. As we noted, the specific circumstances in each community (e.g., the housing situation in Meeker, Colorado) will influence the appropriate strategy.

We would like to reiterate that the mitigation strategies examined here by no means exhaust the list of options. The simulations show that in some cases none of the financing schemes are very effective. States might consider, as an alternative or as part of a package, establishment of mobile units to provide some types of services such as classrooms or health facilities [4]. In areas where several communities will be experiencing noncoincident construction peaks, these units could be rotated. It is clear in any case that the state level must be the focal point for development of mitigation strategies. Some states are presently serving only as conduits for federal funds to communities. Others, such as Wyoming, have implemented multifaceted programs backed by appropriate legislation.

The community itself must actively plan for the growth period and for the postgrowth era. The BOOMP simulations can help put this point across forcefully. The simulation depicted in Figure 14, for instance, shows large, underutilized public facility capital following the construction years. A community can either avoid overinvestment at the cost of some shortages during the peak construction years or aggressively pursue other industries to locate there, using the public service availability as an attractiveness factor. It is in pointing to such situations that the BOOMP model is a particularly useful tool.

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